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(continued on back cover)
THE GENUS CYBIANTHUS (MYRSINACEAE) IN ECUADOR AND PERU

JOHN J. PIPOLY III

Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060, U.S.A.
jpipoly@brit.org; clusia@latinmail.com

ABSTRACT

The genus Cybianthus was revised to provide taxonomic treatments of the Myrsinaceae for Flora of Peru, Catalogue of the Vascular Plants of Ecuador, and Flora of Ecuador. Eight of Cybianthus’ ten subgenera are represented, and an updated description of the genus, keys to its subgenera and emended descriptions for each are provided. Detailed descriptions of the morphology, anatomy and ecology of the genus are presented. Cybianthus subgenus Itenos is relegated to synonymy under subgenus Microconomorpha. Within each subgenus, keys, full descriptions, synonymy, distribution, ecology and conservation statuses, local names and uses are given for each species. In addition, specimens are cited for each species, including extralimital ones to show extremes in morphological variation. Thirteen species are relegated to synonymy, nine names are lectotypified, and one, Cononmorpha rigida, is neotypified. One new combination, Cybianthus guyanensis subsp. pseudolongifolius, is made, and Cybianthus poepigii is transferred from subgenus Cybianthus to subgenus Weigeltia. The following 15 new species are described, illustrated and their phylogenetic relationships are discussed: Cybianthus anthuriophyllus, C. cenepensis, C. comperuvianus, C. croatti, C. flavovirens, C. fosteri, C. grandezii, C. granulosus, C. huampamiensis, C. incognitus, C. jensonii, C. nestorii, C. pseudolongifolius, C. timanae, C. vasquezii.

RESUMEN

Al preparar tratamientos taxonómicos sobre la familia Myrsinaceae para los proyectos Flora del Perú, Catálogo de las Plantas Vasculares del Ecuador, y Flora del Ecuador, se llevó a cabo una revisión del género Cybianthus. Se encuentra en la región ocho de los diez subgéneros, y se provéen tanto una descripción actualizada para el género como para cada subgénero también. Se presenta descripciones detalladas tratando la morfología, anatomía y ecología del género. Se relega Cybianthus subgénero Itenos a la sinonimia bajo subgénero Microconomorpha, y se transfiere Cybianthus poepigii del subgénero Cybianthus al subgénero Weigeltia. Para cada subgénero, se provéen claves, descripciones completas, sinonimia, distribución geográfica y estado actual de su conservación, nombres locales y usos. También se cita colecciones revisadas para cada especie, incluyendo ellas fuera de la región delimitada cuando se muestran variación morfológica significativa. Se relean 13 especies a la sinonimia, se lectotipifcica 9 binomiales y uno, Cononmorpha rigida, se neotipifica. Se publica la nueva combinación, Cybianthus guyanensis subsp. pseudolongifolius. Se describen, se ilustran y se discuten el parentesco para 15 especies nuevas, listadas a continuación: Cybianthus anthuriophyllus, C. cenepensis, C. comperuvianus, C. croatti, C. flavovirens, C. fosteri, C. grandezii, C. granulosus, C. huampamiensis, C. incognitus, C. jensonii, C. nestorii, C. pseudolongifolius, C. timanae, C. vasquezii.

INTRODUCTION

The genus *Cybianthus* Martius was cladistically defined by the presence of unique glandular granules at the junction of the corolla tube and lobes by Pipoly (1987). In addition, the unique combination of lateral (axillary) inflorescences, gamosepalous and gamopetalous flowers, and stamens connate by their filaments at least one-fourth their length, and adnate to the corolla tube at least one-third its length (Pipoly 1987, 1992a) allows for practical recognition from herbarium specimens. With this contribution, *Cybianthus* now contains 167 species in ten subgenera. The genus includes species formerly included in the genera *Comomysine* Hook. f., *Conomorpha* A. DC., *Correlliana* D'Arcy, *Cybianthopsis* Lundell, *Grammadenia* Benth., *Microcomomorpha* Lundell, and *Werneltia* A. DC. (Pipoly 1987, 1992a). In Ecuador and Peru, 43 species in 8 subgenera are known. Among the species, none are endemic to Ecuador, while 11 are endemic to Peru.

The broad generic concept for *Cybianthus* was first proposed by Agostini (1970) as a precursor to his dissertation (1972); that was followed by the formal transfers and a key to the subgenera (Agostini 1980). Subsequently, while revising subgenus *Grammadenia*, Pipoly (1987) determined that the paleotropical genus *Embleia* Burman f. was the sister group to the entire genus and that it was most parsimonious to include *Grammadenia* within *Cybianthus*. Preparation of taxonomic treatments for the Myrsinaceae in *Flora of Peru*, *Catalogue of the Vascular Plants of Ecuador* and *Flora of Ecuador* revealed that many taxa were new, and much confusion had arisen among the concepts prevalent for taxa already described. Among adjacent countries with significant Amazonian regions, Ecuador and Peru share more species of *Cybianthus* in common than do any other pair of countries. While it would have been desirable to include Colombia to provide a treatment for the entire northwestern South America, the number of additional species endemic to Colombia, or known only from Colombia and Venezuela, would have increased the size of the treatment by fifty percent. Given that it will be some time until a revision of the entire genus for *Flora Neotropica* is complete, the present treatment is intended to serve as a precursor to that monograph and to make the names available for the other aforementioned projects. A revised description of the genus *Cybianthus* follows, including keys and emended descriptions for the eight subgenera occurring in Ecuador and Peru, along with keys to the taxa and full descriptions for each. For each of the fifteen new species described, illustrations are provided, while for all species, full descriptions and synonymy, discussions of distribution, ecology and conservation status, etymology, and when known, local names and uses are elucidated.

MORPHOLOGY

Morphological terms in this treatment follow Lindley (1848) and Pipoly...

**Habit and Architecture**

The majority of *Cybianthus* species in Ecuador and Peru are large shrubs or small trees to 18 meters tall. Four species are small shrubs or subshrubs (*Cybianthus croatii, C. humilis, C. lineatus, C. nanayensis*) usually under one meter tall. With the exception of two species in subgenus *Grannmadenia*, all species are terrestrial. *Cybianthus marginatus* is an obligate epiphyte, while *C. magnus* is a facultative epiphyte, frequently found on large tree trunks, but also known from large rock outcrops.

Most members of *Cybianthus* exhibit Rauh’s Model of architecture (Hallé et al. 1978), characterized by a polyaxial, monopodial, rhythmically growing, readily distinguishable trunk, that develops tiers of branches morphogenetically identical to itself. All branches are orthotropic and monopodial, with lateral (axillary) inflorescences that do not affect shoot development. However, two subgenera (*Comonymysine* and *Triadophora*) exhibit Corner’s Model (Hallé et al. 1978), characterized by a single aerial meristem that produces a monoaxial (unbranched) axis on which inflorescences are lateral (axillary). The resulting monocaulous tree is pleionanthic (not hapaxanthic, or mono-carpic) and growth is indeterminate. The trunk may grow rhythmically or continuously. Sporadic occurrences of this architectural model occur in members of subgenus *Weigeltia*, from the Guianas and eastern Amazonia, however, none of those species are known from Ecuador and Peru.

While conducting fieldwork in Peru, a collection of *Cybianthus kayapii* (Lundell) Pipoly was observed reiterating. In the population observed at Explorama Lodge near Yanamono, (Loreto, Peru) one individual (Pipoly et al. 12383), exhibited bayonet reiteration, caused by destruction of the apical meristem of the trunk. The individual bore a reduced staminate inflorescence with flowers slightly larger and more maroon in color than normal, and smaller leaves with shorter petioles. As I have noted elsewhere (Pipoly 1987, 1992a), leaves on the reiterative shoots resemble those of saplings. Variation in inflorescence and floral morphology seen in this Peruvian population is consistent with variation reported in Pipoly (1992a). Therefore, it appears that changes in sex expression are consequent to a reiteration phenomenon, rather than circumstantially associated with it. I postulate that reiterative branches may be hormonally juvenile and as such, are morphogenetically incapable of producing bisexual or pistillate flowers, and produce only sapling leaves until flowering occurs. This process may account for the great variation in leaf morphology and apparent sexual lability often associated with many species of *Cybianthus*. Unfortunately, for individuals of normally dioecious species with monoaxial
models, it is not possible to determine if sex change has occurred because no inflorescences are usually observed before the original apical meristem is destroyed, and no inflorescences on other branches are available for comparison. However, precociously flowering individuals of Cybianthus incognitus (P. Barbour 2405) support the hypothesis. Clearly, pruning experiments in situ will be necessary to test this hypothesis.

Branchlets

A branchlet is here defined as the distal 10 cm of any branch. Branchlets may be flexuous, or straight; terete or angular; smooth, verruculose, or verrucose-papillate (Fig. 1A, 1B), glabrous, glandular-papillate (Figs. 1D, 3F, 4F), ferrugineous stipitate-lepidote (Fig. 2A–F), ferrugineous or rufous dendroidal and/or stellate-tomentose (Fig. 3A), rufous sessile furfuraceous lepidote, with a tomentum of malpighiaceous trichomes (Fig. 3D), glandular-granulose, with hydroptotes (Fig. 3C), epunctate or rubiginous punctate-lineate, bearing lenticels or not.

Leaves

Species of Cybianthus, like all Myrsinaceae, are exstipulate and have simple leaves. The leaves are usually alternate, but may be subopposite or pseudoverticillate, especially in subgenera Micromonomorpha, Comomysine, Weigelia and Cybianthus. In the majority of species, the leaves are petiolate, but in subgenus Grammadenia they are sessile. The ptyxis (the form in which one single leaf is folded on itself in bud) is most often supervolute (Cullen 1978), but it has not been adequately studied thus far for each subgenus. The leaf vernation sensu Cullen (1978), is at least analogous with floral aestivation, or the relationship of one leaf to another; in Cybianthus, it is in fact, unknown. The leaf blade texture may be membranaceous, chartaceous or coriaceous. The shape is most often elliptic, but may be oblanceolate, lanceolate, obovate, rarely ovate or oblong (Cybianthus marginatus). The apex may be acute, acuminate, long-attenuate, rounded, obtuse, or emarginate, without mucro or rarely (subgenera Grammadenia, Comomysine, Triadophora) mucronate (Fig. 21). The base is rarely auriculate (subgenus Grammadenia) or obtuse approaching auriculate (Cybianthus grandezi, C. kayapii, C. anthuriophyllus) and is usually cuneate, long-attenuate, acute or obtuse, decurrent on the petiole or not. The adaxial surface may be nitid, pallid, or sordid, rarely scrobiculate, pusticulate or pustulate when mature. The blade margin may be regular or irregular, flat inrolled or revolute, entire, or rarely undulate, lobate, crenate or dentate (Cybianthus pastensis), densely and minutely serrulate (C. anthuriophyllus), or coarsely dentate (C. schlimii, some populations of C. pastensis, C. poepigii), or with a very subtle but vascularized vein ending (C. verticilloides) opaque, or rarely scarios (all species in
Fig. 1. SEM photos of morphological features in subgenus Grammadenia. A. Cybianthus marginatus (Pipoly 6546), showing verrucose papillae. B. Same, close-up. C. D. C. lineatus (Pipoly et al. 7729), showing stem surface. D. Glandular papillae. E. C. costaric anus subsp. morii (Pipoly 7017), pollen, equatorial and polar views. (Bars in figs. equal: A. 50 μm, B. 22.2 μm, C, D. 48 μm, E. 12.3 μm) Figure reproduced from Pipoly, 1987.
Cybianthus subgenus Grammadena; Cybianthus humilis, and C. crassii of Cybianthus subgenus Conomysmyine).

Leaf punctuation and punctate-lineation may be pellucid (translucent), black, orange red, or rubiginous (light red) in color. Punctations as defined by Pipoly (1987) are defined as rounded, lyso-schizogenously formed cavities and are distinguished from punctate-lineations, which are homologous, linear cavities in the leaves. Among taxa bearing non-pellucid punctations or punctate-lineations, all young, undepanded leaves have orange glands, even if mature leaves have red or black glands. Experiments to determine integrity of punctuation color have revealed that it is not a reliable taxonomic character...
Fig. 3. SEM photos of representative vestiture in subgenera *Laxiflorus*, *Macroconvexa*, *Triadophora* and *Comomysine*. A. *Cybianthus fulvopulverulentus* subsp. *magnudiffolius* (Cowan & Söderstrom 2146), branchlet, showing stellate trichomes. B. *C. spicatus* (Maguire & Politi 28064), showing hydropote in abaxial leaf pit. C. *C. pastensis* (Killip & García 33886), branchlet, showing developing hydropotes. D. *C. schlimii* (Fosberg 20148), branchlet, showing malpighiaceous trichome. E. *C. kuyapii* (holotype) Staminiate flower, showing vestigial pistillode, structure of androecium. F. *C. humilis* (Lehmann s.n.), showing glandular papillae of abaxial leaf surface. (Bars in Figs. equal: A–C, 50 μm, D & F, 25 μm, E, 0.4 mm).

(Pipoly 1987). The other punctation character states include “conspicuous” versus “inconspicuous,” reflecting the ease of viewing the punctation (a reflection of its relative diameter in transverse section), and “prominent” versus “not prominent,” which refer to whether the punctation is blister-like or planar, respectively.

The abaxial and/or adaxial surface of the blade may be glabrous, or with
a vestiture composed of stipitate ferrugineous lepidote scales (subgenus Comonomorpha, Fig. 2A–2F), sessile furfuraceous lepidote scales (subgenus Wieseltiera), dendroid and/or stellate trichomes, translucent glandular-lepidote scales, or with scattered glandular papillae (subgenus Conomysline, Figs. 3F, 4F), malpighiaceous trichomes (subgenus Triadophora, Fig. 3D), or hydropotes (subgenera Laxiflora, Microcomonomorpha, Grammadenia, Conomysline, Figs. 3A, 3C, 4A–E). The adaxial surface is usually glabrescent.

Hydropotes ("water drinkers") were previously thought to be unique to subgenus Grammadenia (Pipoly 1987), but have now been found in all species of subgenus Conomysline. Described by Mayr (1915) and Grüss (1927a, 1927b), hydropotes have been reported for numerous submerged aquatic angiosperms (Fahn 1979; Gessner & Volz 1951). Elegant ultrastructural and autoradiographic studies undertaken by Lüttge (1964) and Lüttge and Krapf (1972) demonstrated the mineral absorptive function of hydropotes. While both subgenera bear these structures, their morphology is strikingly different. The hydropotes of subgenus Grammadenia (Fig. 5) consist of five to seven subsidiary cells, a central foot cell, a basal cell, a stalk cell, and up to 12 cells forming a scale-like cap, while those of subgenus Conomysline consist of five to seven subsidiary cells, a central foot cell, a stalk cell, and up to 12 cells forming a lenticular cap or globose body. In subgenus Conomysline, the cap cell is formed before elongation of the stalk cell. In Cybianthus verticilloides (Fig. 4B), C. sprucei (Fig. 4D), and C. kayapii (Fig. 4E) the cap consists of a spherical body of cells, while in C. croatti (Fig. 4A) and C. simplex (Fig. 4C), the cap is lenticular. It is interesting to note that within subgenus Grammadenia, the shape of the cap is the same among all species, while in Conomysline, there are 4 types. The occurrence of hydropotes in subgenus Laxiflora, in pits over the abaxial leaf surface, and in subgenus Microcomonomorpha, under the papillate tomentum of the branchlets, was unknown before the present study. Despite these differences, the structures are homologous, based on position, function and ontogeny. In early ontogeny, a mucilaginous substance accumulates around the base cell (Fig. 7E). Later, the cap breaks off (Fig. 7F), leaving a mucilaginous ring around the broken basal cell (Pipoly 1987, unpubl. data).

Subepidermal fibers, visible as numerous, thin, parallel lineate structures on both surfaces of leaf blades in subgenus Triadophora are unique to it. They have recently been shown to be homologous with those of Claviija in the Theophrastaceae (Pipoly, unpubl.).

Petioles are present in most taxa, with the notable exception of subgenus Grammadenia, where the leaves are sessile. The petioles may be canaliculate, marginate, or canaliculate with margins, trigonal, or rarely subterete, and may be pulvinate (abruptly swollen basally) or gradually tapering basipetally.
Fig. 4. Representative SEM photos of morphological features in subgenus *Comomyrsine*. A–E, Hydropores of abaxial leaf surface. A. *Cybianthus croatti* (holotype), showing lenticular cap. B. *C. verticilloides* (holotype), showing globose cap. C. *C. simplex* (Zak 1350), showing lenticular cap. D. *C. sprucei* (Cuatrecasas 15743), showing globose cap. E. *C. kayapii* (holotype), showing depressed-globose cap (somewhat collapsed). F. *C. kayapii* (holotype), branchlet, showing glandular papilla. (Bars in Figs. equal: A. 25 μm. B. 20 μm. C. 10 μm. D–F, 25 μm).

Cataphylls and Pseudocataphylls

Cataphylls (Fig. 9B) and pseudocataphylls are synapomorphic to subgenera *Comomyrsine* and *Triadophora*, respectively. Earlier (Pipoly 1987), I had mistakenly interpreted them as inflorescence bracts. They may be alternate or pseudoverticillate, alternating with pseudoverticels of leaves, or apparently axillary to them, rigid, chartaceous, or membranaceous, linear-subulate to
Fig. 5. Ontogeny of hydropotes in subgenus Grammadema. A, B, & D. Cybianthus costaricanus subsp. costaricanus (Pipoly 7608), SEM photos. A. Mature hydropote, cap with at least 8 cells, and with 5 subsidiary cells. B. Younger hydropote, cap with 4 cells, and with 6 subsidiary cells. C. C. costaricanus subsp. morii (Pipoly 7017), longitudinal section of young hydropote, showing subsidiary cells (sc), foot cell (fc), stalk cell (st), cap cell (ca), basal cell not discernible. D. Young hydropote, with 2-celled cap, showing mucilaginous substance (ms). E, F. C. costaricanus subsp. panamensis (Pipoly 7056), paradermal sections. E. Showing mature hydropote, with 12-celled-cap. F. Showing hydropote after cap has broken off. (Bars in Figs. A–F equal: A & C. 28 μm, B. 20 μm, D. 10 μm, E. 36 μm, F. 53 μm. Figure reproduced from Pipoly, 1987.)
acicular, rigid to membranous, keeled or flat, apically mucronate or not, prominently punctate or punctate-lineate, glabrous, rufous puberulent, glandular-papillate, bearing hydropotes, or orange lepidote scales, sessile or on a pedicole to 2 mm long. Pending further developmental studies, I am distinguishing cataphylls from pseudocataphylls based on the absence of a pediole in the former and its presence in the latter. Within Cybianthus, pseudocataphylls are unique to subgenus Triadophora, while cataphylls are unique to subgenus Comomyr sine. Both pseudocataphylls and cataphylls may be distinguished from an inflorescence bract by the fact that neither of these structures are axillant to an inflorescence, neither are ephemeral, but both occur in pseudowhorls.

Inflorescence and Flowers

The inflorescence in Cybianthus is always lateral (axillary), and it may consist of a simple raceme (erect or lax), a subpyramidal or pyramidal panicle (sometimes thyrsoid), a spike, or rarely, a pleiochasium. At times, species with essentially racemose inflorescences may produce a panicle consisting of a pseudover ticel of racemes on a reduced peduncle. In this treatment, an inflorescence is considered spicate if the pedicels are obsolete or less than 0.3 mm long and subspicate if the pedicels are from 0.4–0.8 mm long. In most species, the staminate inflorescence tends to be longer, slightly more lax, and bears greater numbers of flowers. In those species bearing panicles, the staminate ones bear secondary branches of the inflorescence that are longer, more floriferous, and at times, more branched than the pistillate and bisexual panicles.

The inflorescence bracts are early caducous and are rarely seen in the field or on specimens. The secondary branch bracts of panicles are also rarely collected, with the exceptions of subgenera Comomyr sine and Triadophora. The floral bracts may be membraneous or chartaceous and are usually persistent in staminate inflorescences, but are at times caducous in pistillate ones. The floral bracts may be glabrous or bear a tomentum either adaxially, abaxially, or on both surfaces. The floral bract apices are acute, attenuate, or acicular, the margins entire or undulate.

The pedicels are cylindrical, clavate, or obconic, and at times accrescent or crassate in fruit. In most species, the pedicels are subtended by an axillant floral bract, but in Cybianthus kayapii, it is inserted at about the middle of the pedicel.

Figure 6 illustrates the tremendous variation in floral morphology among members of the genus, along with representative staminate and pistillate flowers from Embelia, the paleotropical sister genus of Cybianthus. The flowers may be functionally staminate, pistillate or bisexual. Consequently, the plants are normally functionally dioecious, but may also be bisexual or polygamous. Flowers are normally perfect, but in some species of subgenera Weigeltia, Comomyr sine and Cybianthus, the pistillode is often obsolete in the stami-
Fig. 6. Representative flowers of *Cybianthus* subgenera and sister genus, *Embelia*, open flowers in anthesis above, calyx lobes below. A–B, Subgenus *Microanomorpha*, (*Cybianthus pastensis*), note monomorphic flowers. A. Staminate flower (*Killip & García 33686*). B. Pistillate flower
nate flowers. The staminate flowers are usually larger than the pistillate ones. The flowers are usually 4 or 5 (−6)–merous, but they are 3–merous in subgenus *Triadophora* (Fig. 6K, 6L). The majority of species are homomeres, but *Cybianthus kayapii* has heteromeres flowers, (the calyx 4– and the corolla 5–merous), and in *C. anthuriophyllus*, the calyx 6– and the corolla 5–merous. Either or both whorls of the perianth may be membranaceous, chartaceous, coriaceous or carnose, epuncate, punctate or punctate-lineate. The punctations may be inconspicuous or conspicuous, prominent (raised) or not, pellucid, brown, orange or red. The calyx may be valvate or imbricate, and may be coryliform, cupuliform or urceolate. The corolla is valvate or imbricate, and may be campanulate, cupuliform, tubiform, infundibuliform, salverform, rotate or subrotate. The stamens and staminodes are similar in morphology, but the staminodes are smaller. The filaments of the stamens and staminodes are partially united at the base to form a conspicuous or inconspicuous, membranaceous, chartaceous or carnose tube, except in subgenus *Cybianthus*, which has a terete or rarely, angulate staminal tube developmentally fused with the corolla tube, the stamens thus appearing epipetalous. In some species, the tube bears lobes (sterile projections of tissue) which alternate with the apically free portion of the filaments. The apically free portions of the filaments may be terete, flat, or absent. The anthers may be dorsifixed, basifixed or versatile. Anthers may be lanceolate, ovate, cuadrate, or deltate, apiculate, acute, truncate or emarginate, the apiculate ones may have the apiculum erect, distally or proximally recurved, glabrous or glandular-papillate. Antherodes of the pistillate flowers are similar to the anthers but reduced in size, and normally devoid of pollen, but occasionally, they may produce copious amounts of abortive pollen (Pipoly 1983a). The connective may be epuncate or prominently punctate, or rarely glandular-papillate. The pollen is tricolporate and psilate (Fig. 1E). The pistillode may be lageniform, conic or obturinate. The pistil may be obnapiform, 

conic, ellipsoid, or obturblinate, with a punctiform, or capitlate stigma. The stigma is large and capitlate, with erose-fimbriate lobes and is caducous in subgenus *Comomyrsine*. The ovary in species from Ecuador and Peru are tetrate. The placenta may be cotyliform, cupuliform or globose, with 2–4 uniseriate ovules naked or partially immersed. The fruit is a globose or depressed-globose drupe and is one-seeded, with a thick or thin exocarp.

**ANATOMY**

This treatment is not intended to serve as a monograph of the genus, but a few salient anatomical features may prove useful in identifying sterile material or wood samples. Druses (Pipoly 1987-Fig. 8B–C) are ubiquitous in Myrsinaceae, as are pericyclic fibers (Pipoly 1987, Fig. 8A). All Myrsinaceae have resin ducts (canals) at least in the cortex, and in the field, copious amounts of resin are visible in the canals of the pith and secondary phloem, in freshly cut branchlets, in species of subgenera *Grammadenia* and *Laxiflorus*. Aerenchyma in the cortex of the primary stem is unique to subgenus *Grammadenia* and is found in all species (Fig. 7F), except in *Cybianthus lineatus* (Fig. 7E). The pith in primary stems of subgenus *Weigeltia* is parenchymatous with large, rounded starch grains, while that of *Cybianthus magnus* has angular collenchyma (Pipoly 1987). It is interesting to note that the collenchyma of the outer cortex in *Cybianthus magnus* subsp. *asymmetricus* is tangential rather than angular, while that of *C. magnus* subsp. *magnus* is angular (Fig. 8 D–F). All species of *Cybianthus* have cortical vascular bundles, that may be amphicribal (Fig. 7C) or hemiamphicribal (Fig. 7D), with (Fig. 7C) or without (Fig. 7D) accompanying perivascular fibers. Wood of subgenus *Comomyrsine* is notable for its thin-walled vessels (Fig. 9D), while the fiber-tracheids of subgenus *Grammadenia* have walls so thick as to significantly occlude the lumina (Pipoly 1987- Fig. 7C). Also, starch is present in the phloem fibers of subgenus *Comomyrsine* (Fig. 9E, 9F) but not in *Grammadenia*. In leaf anatomy, it is notable that subgenus *Grammadenia* has functionally acrodromous veination. This is due to its unique leaf-node continuum, and consequent primary vascular system (Pipoly 1987-Figs. 7–9; 11–12) where the cathodic and anodic leaf traces are autonomous from each other and from the relevant midrib trace, a system thus far unique among angiosperms. Leaves of subgenus *Triadophora* may be easily recognized by their subepidermal fibers, while those of *Cybianthus lineatus* are unique for their bifacial palisade layer (Pipoly 1987- Fig. 14b).

**ECOLOGY**

In Ecuador and Peru, species of *Cybianthus* occur in wet or moist, tall terra firme forest on laterite, limestone or white sand, seasonally inundated igapó or várzea, premontane humid, wet or pluvial forest on laterite or sandstone,
Fig. 7. Primary stem histological features in subgenus Grammadenia. A–B. Cybianthus ptariensis, (Pipoly et al. 7133), periderm formation, showing epidermal cork development. C. C. marginatus (Pipoly 6546), amphicribal cortical bundle without perivascular fibers. D. C. ptariensis (Pipoly et al. 7133), hemampicribal bundle with perivascular fibers (pf). E. C. lineatus (Pipoly 7229), section showing parenchymatous pith, inner and outer cortex. F. C. marginatus (Pipoly 6546), section showing aerenchymatous inner cortex; parenchymatous pith and outer cortex. (Bars in Figs. A–F equal to: A. 30 μm, B. 120 μm, C. 48 μm, D. 60 μm, E. 465 μm, F. 120 μm. Figure reproduced from Pipoly, 1987.

cloud forest, elfin forest, montane or subpáramo thickets, or sandstone scrub at high elevation.

The *terra firme* and premontane forest life zones are the richest in endemics, with six and five species, respectively. *Terra firme* is here divided into two

edaphic categories, lateritic and white sand (often referred to as “varillal” by Peruvians) and is defined as lowland tall moist or wet forest which is not inundated. The canopy normally reaches 35 meters, with very few emergent individuals. In the lateritic *terra firme*, *Cybianthus kayapii*, *C. schlimii*, *C. pseudolongifolius*, *C. vasquezii*, *C. cenepensis*, *C. grandezii*, *C. fuscus*, *C. jonsonii*,
Fig. 9. Morphological and anatomical features of subgenus Conomyrsine (Cybianthus kayapii, Pipoly et al. 12490). A. Habit, showing bayonet reiteration. B. Habit, showing pyramidal, bipinnate panicle and leaf tapering to obtuse base. C. Stem apex, showing cataphylls. D. Transverse wood section, showing thin-walled vessels. E. Tangential wood section, showing rays and phloem fibers-tracheids. F. Phloem fiber-tracheids, showing starch grains. (Bars in Figs. A–F, A. 12.6 cm, B. 2 cm, C. 1 cm, D. 400 μm, E. 100 μm,
and *C. venezuelanus* are found. *Cybianthus kayapí, C. schlimii*, and *C. grandezii* are found on steep banks of small creekbeds, *C. cenepensis* and *C. venezuelanus* are ridgetop species, and *C. cenepensis, C. jenomii, C. vasquezii* and *C. pseudolongifolius* grow along terraces above larger rivers. Vásquez (1997) has described “Irapayal,” “Yarinal” and “Supay Chacras” associations within the lateritic terra firme, but with so few comparative, quantitative forest inventories completed for both countries, I am not able to precisely list the *Cybianthus* species known from each. The terra firme forests on white sand (varillal) are shorter in stature than those on lateritic soils, and generally support lower numbers of lianas. Among the varillal forest types described for Peru, Vásquez (1997) lists “varillal seco,” “varillal húmedo” and “chamizal” or “ojo de varillal” associations, only some of which have been noted on label data. However, *Cybianthus peruvianus, C. spichigeri,* and *C. gigantophyllus* occur on rolling hills in the varillal forest type. Among those species which occur on steep hillsides near light gaps, *Cybianthus gigantophyllus* is most notable, as it occurs in the ecotonal area between forest gaps and mature forest. *Cybianthus nanayensis,* a subshrub, is frequently found in gaps left by large treefalls in overmature forests, and along trailsides, where it occurs in the rather dense herbaceous stratum. *Cybianthus resinosis,* another inhabitant of the terra firme forest on white sand, occurs on terraces above black water rivers in the forest, while *C. nestorii* is found in the more open shrubby “varillal seco” transitional area near the riverbank. *Cybianthus fulvopulverulentus* subsp. *magnoliiifolius* typically occurs in campina, or campinarana formations in Brazil, but in Peru it has been collected once in the “varillal seco” an open shrubby area on white sand several hundred meters from a black water riverbank. Unfortunately, no literature directly addressing this forest type is known for Ecuador.

The two forest types subject to inundation have been divided into várzea, flooded by white water, and igapó, flooded by black or black and white water. The other significant difference between these two forest type is that in várzea, the forest is inundated for a much shorter time than that of the igapó. To date, I know of no documentation for occurrences of forests inundated by clear water in Ecuador or Peru, as they are found elsewhere in Amazonia (Brazil, Colombia, Venezuela), but are best developed in Colombia. Three species are known from igapó, with no endemics. *Cybianthus guyanensis* subsp. *pseudoicacores* is found in the igapó at its limit with terra firme, while *C. penduliflorus* is found well within the igapó and is frequently found in standing water. *Cybianthus spicatus* is found both in igapó and várzea, and exhibits both staminate and pistillate ecotypes, with some exhibiting apparent random variation. It is a broadly ranging polymorphic ochlospecies (sensu Pipoly 1983a) with great morphological variation. The known Peruvian populations, from Huánuco and San Martín, are identical to those found in central Guyana (Pipoly 1983a). The other várzea species, *Cybianthus cyclopetalus,*
is known only from Madre de Dios in Peru, and from the Juruá area in Brazil. It grows in the margin of várzea near its junction with the terra firme forest. Forest associations within the várzea have been described by Vásquez (1997), but I have been unable to match the corresponding complement of *Cybianthus* species, owing to inadequate label data. The three forest associations present in várzea for Peru include, “barrillal,” “restinga” and “bajial.” Clearly, more fieldwork is needed to discern foristic differences among these association types.

Premontane forest habitats are found from scarcely above 200 m to nearly 1,000 m. The forest is lower in stature than the terra firme, have a greater epiphyte load, and a larger number of lianas. Those on sandstone are distinguished here from those on other soils. On sandstone, three species are found of which one, *Cybianthus timanac*, is endemic. The other species, *Cybianthus compervianus*, a new taxon described herein, is known from these forests in Peru, Bolivia and adjacent Brazil. The other premontane forest formation on lateritic soils hosts 9 species, *Cybianthus minutiflorus*, *C. buamamianensis*, C. granulosus, C. poeppigii, C. schlimii, C. peruvianus, C. fosteri, and C. venezuelanus and C. flavovirens. Among these, only *Cybianthus venezuelanus*, C. poeppigii, C. schlimii and C. peruvianus are not endemic. A surprising new distribution record for *Cybianthus lepidotus*, from Bagua Province, Imaza District, of Amazonas Department, Peru, is recorded here. *Cybianthus lepidotus* was once thought to be a Guayana Higland endemic, but was found in Bolivia in the Maipiri region on the sandstone “laja” formations there (Pipoly 1992a). This kind of disjunction, concomitant with those for species such as *Cybianthus spicatus*, and *Cybianthus lineatus* (see below), support recent thematic map data at NASA, showing that the Ecuadorean/Peruvian area north, slightly east, and immediately south of the Cordillera del Cóndor, contains significant sandstone formations that may constitute “tepui satellites” (sensu Maguire 1979). Clearly, much more exploration in southeastern Ecuador and northern Peru, should be a high research priority.

There are six species of *Cybianthus* known from cloud forests. *Cybianthus pastensis* and *C. incognitus* are found in areas of high shade and moisture within these forests. Along the margins to the leeward side, in that portion of the Chocó Floristic Province that extends into Ecuador, *Cybianthus cuatrecasasii* may be found, while on the eastern Andean slopes of Peru, *C. laetus* grows in exposed, wind-swept margins of the forest. The lack of records for *Cybianthus laetus* in Ecuador is more likely a collection artifact than a reflection of its rarity, given its occurrence in the Department of Boyacá, Colombia. It is notable that *Cybianthus patensis* and *C. incognitus*, when growing at elevations below 1,000 m, are ridgetop species. *Cybianthus magnus* subsp. *magnus* is an obligate epiphyte in closed cloud forests, growing in the forks of trees or on deep detritus, and shielded from winds.
Elfin forests and montane thickets are transitional formations below the jalca (a formation like a páramo but without species of the Asteraceae subtribe Espletiniae). Elfin forests host considerable numbers of trees and usually have trees up to 5 m tall. The montane thicket (subpáramo) grows in more exposed areas at higher elevations and is dominated by low shrubs and small trees to 2 m, with broad crowns. *Cybianthus marginatus* is found in both of these habitats, but the leaves and stature of the plants are much smaller in the thicket formation. Also, the verrucose papillae of the stem are much more pronounced in the thicket habitats than in plants growing in the elfin forest. *Cybianthus magnus* subsp. *asymmetricus* grows in open montane forests or subpáramo thickets, and elfin forests, where it is subject to exposure to the high winds and rain. Its leaf variation is significant, but it is easily recognized from subspecies *magnus* by the hydropotes of the adaxial leaf surface and orange punctations of leaf, inflorescence and perianth parts and the unique white, then lavender fruits.

Finally, sandstone scrub, called "pajonal," is known thus far only from Peru. It is the formation growing at the highest elevations where Myrsinaceae occur, mostly well over 3,000 m. In these habitats, there are few, small shrubs which rarely exceed 1.5 m tall. *Cybianthus lineatus* is found in this habitat, the first locality for this species outside the contiguous Guayana Highland. No similar habitat has been described in Ecuador, but it may be present in the Cordillera del Cóndor.

**TAXONOMIC CONCEPTS, NOTES ON KEYS AND SPECIMEN CITATIONS**

My species concept follows that of Wiley (1978, 1981), who defined a species as follows: "An evolutionary species is a single lineage of ancestor-descendant populations which maintains its identity from other such lineages and which has its own evolutionary tendencies and historical fate." My subspecies concept (Pipoly 1987), defines a subspecies as follows: "groups of populations within a single lineage of ancestor-descendant populations that show variation by unique combinations of plesiomorphies, or homoplastic apomorphies, correlated with biogeography and/or ecology. This rank is primarily used to convey information regarding variation in the life histories of these populations and character state differences hypothesized to be the result of this variation. The subspecific rank in no way attempts to predict speciation events."

The keys are artificial and designed to expedite identification of herbarium specimens. An attempt has been made to emphasize vegetative characters to increase the keys' usefulness with sterile material. The numbers appearing before the taxa refer to their respective position in the key; any correlations with phylogenetic relationships are coincidental. Quantitative and qualitative data presented in keys and descriptions for floral parts and bracts were taken from organs rehydrated from herbarium specimens by boiling in water.
Measurements from these range from 10% to 15% greater than those measurements taken directly from dried material. Data regarding stem diameters, inflorescence rachises, pedicels, leaf, and fruit shape were taken from dried herbarium specimens. Extra-Ecuadorean and -Peruvian specimens are cited for all new species and for recent collections of other species used to significantly amplify previously published morphological descriptions (Pipoly 1981, 1983a, 1983b, 1987, 1988, 1991, 1992a, 1993, 1994, 1995, 1996).

A description of the genus Cybianthus and a key to its subgenera in Ecuador and Peru are provided below. This description, along with that of the subgenera and species that follow include features found in each taxon as a whole, including those populations and species occurring outside Ecuador and Peru. Phylogenetic studies applicable to species in this treatment may be found in Pipoly (1987) and in the forthcoming Flora Neotropica treatment.

**TAXONOMIC TREATMENT**


Terrestrial or epiphytic, monoaxial or polyaxial, dioecious, monoeious or polygamous *shrubs or trees* to 15 m tall. *Roots* positively geotropic or diageotropic. *Branchlets* glabrous, glandular-granulose, dendroid- and stellate-tomentose, furfuraceous- or ferrugineous-stipitate-lepidote. *Leaves* sessile or petiolate, alternate, subopposite, or pseudoverticillate, the venation camptodromous or rarely acrodromous; *petioles* obsolete or when present, canaliculate or marginate, tapering gradually to the base, or abruptly swollen toward the base, here termed “pulvinate.” *Inflorescence:* staminate, pistillate, bisexual or polygamous, lateral (axillary), a simple raceme, panicle of racemose or spicate (rarely corymbose) branches, a pleiochasium, or an indeterminate umbel appearing racemose. *Flowers* functionally unisexual or bisexual, 3–6(–7)-merous; *calyx* cotyliform to cupuliform, the lobes imbricate, valvate or aberrantly contorted, basally connate 1/5–2/3 their length, abaxially glabrous, glandular-granulose, ferrugineous-stipitate-lepidote, or translucent-lepidote, adaxially glabrous, epunctate or prominently orange, red or black punctate, the lobes entire to erose-fimbriate, glabrous or glandular-ciliate; *corolla* rotate, subrotate, cupuliform or campanulate, rarely infundibuliform or salverform, the lobes imbricate or valvate, basally connate 1/5–3/4 their length, abaxially glabrous, glandular-granulose, or ferrugineous-stipitate-lepidote, adaxially glandular-granulose at least at the junction of the tube and lobe, the margin entire to erose-denticulate, glabrous, glandular-granulose or rufous glandular-papillate; *stamens* and staminodes adnate to corolla tube at least 2/3 their length, the filaments variously connate to form a tube, the staminal tube adnate to the corolla tube or at times
developmentally fused with it (thus the stamens appearing epipetalous), bearing fleshy lobes alternate with the apically free portions of the filaments or not, the anthers erect or distally curved, ovate, widely ovate, or triangular, basifixed or dorsifixed, apically acute, rounded, truncate, emarginate or minutely apiculate, the apiculum erect, proximally or distally curved, basally truncate, cordate, or rarely hastate, deshiscent by apicaly pores, confluent apical pores (birimose), or by wide or narrow longitudinal slits; pollen tricolporate, psilate; staminodes morphologically similar to the stamens but greatly reduced in size, the antherodes at times producing abortive pollen; pistil obnapiform, ellipsoid, umbonate or obtrumpate, the ovary sparsely to densely translucent glandular-lepidote, the style glabrous, the stigma capitate, capitately lobate, or punctiform, persistent or early caducous, the placenta free-central, carnose, umbonate or globose, the ovules campylotropous (1–)2–5(–7), uni- or biseriate; pistillode conic, lageniform, obtrumpate or irregularly shaped vestigial pistillode, the pistillode hollow or bearing a sterile placenta, rarely absent. *Fruit* drupaceous, 1(–2)-seeded, the endosperm translucent, non-starchy, the embryo small, linear, flexuous, erect or curved, longitudinal or transverse, the cotyledons not well-developed.

*Distribution.*—One hundred sixty-seven species; Nicaragua, Costa Rica south through Panama to the Andes southward to Bolivia, from Colombia eastward across Venezuela and Brazil and the Guianas, then southeastward to the Atlantic coastal forests of SE Brazil.

*Ecology.*—Members of *Cybianthus* are principally riparian, occurring only in primary forests or rarely in somewhat disturbed ones, and thus, may serve as indicators of environmental quality. Throughout the range of the genus, its members are known from wet tepuí savannas, moist scrub, cloud and elfin forests (including “ceja de selva”), subpáramo thickets, montane, premontane, pluvial, wet and moist forests, páramo, jalca, igapó, várzea, varillal, campinas, campo rupestre, restinga, cerrado, and caatinga vegetation types. In Ecuador and Peru, the majority of the species occur in lowland and premontane forests at the junction of *Hylaea* and the eastern slopes of the Andean Cordillera (see ECOLOGY section).

*Cybianthus* is most closely related to the paleotropical lianous genus *Embelia* (Pipoly 1987), and cladistically defined by the unique glandular-granules at the corolla lobe and tube junction. For practical purposes of identification, the combination of lateral racemes or spikes, or racemose or spicate panicles, and filaments which are shorter than the corolla, connate at least 1/4 their length, and adnate to the corolla at least 1/3 its length, allows for easy recognition.

**KEY TO SUBGENERA OF CYBIANTHUS IN ECUADOR AND PERU**

1. Corolla corylitorm, cupuliform, campanulate, or rarely salverform; anthers longer than wide, distally recurved, apically acute or minutely apiculate.
2. Branchlets glabrous or glandular-granulose; anthers dehiscent by narrow longitudinal slits ........................................... I. Microonomorpha

2. Branchlets ferrugineous tomentose or stipitate-lepidote; anthers dehiscent by wide longitudinal slits.

3. Branchlets and calyx ferrugineous stipitate-lepidote; abaxial corolla surface glabrous near margin ..................................... II. Conomorpha

3. Branchlets ferrugineous tomentose, calyx glandular-granulose or glabrous, rarely ferrugineous tomentose; abaxial corolla surface glandular-granulose near margin .................................. III. Laxiflorus

1. Corolla rotate to subrotlate; anthers wider than long, erect, apically rounded to truncate or emarginate.

4. Petioles abruptly swollen basally; anthers dorsifixed, longitudinally dehiscent.

5. Plants monoaxial; anthers erect, not versatile.

6. Stem glandular papillate, at times with hydropotes, bearing cataphylls apically and at times, alternating with the leaves; leaves without subepidermal fibers; flowers 4- or 5-merous; corolla lobes epunctate or inconspicuously pellucid or orange punctate, glandular-granulose within; stigma large, capitate-lobate, early caducous, the lobe margins fimbriate ............................................ IV. Comomyrsine

6. Stem with malpighiaceous hairs, without cataphylls, but at times with aborted leaves (pseudocataphylls); leaves with numerous parallel subepidermal fibers (most easily seen adaxially); flowers 3-merous; corolla lobes prominently black punctate, maculate, glabrous within except at lobe and tube junction; stigma small, capitate-lobate, persistent, the lobe margins entire .................................... V. Triadophora

5. Plants polyaxial; anthers versatile ........................................ VI. Weigeltia

4. Petioles obsolete or not abruptly swollen basally; anthers basifixed, poricidally dehiscent.

7. Leaves sessile, apically mucronate, basally auriculate, the margins scarious; staminal tube merely adnate to corolla tube .......... VII. Grammadenia

7. Leaves petiolate, apically acute, acuminate or caudate, basally acute, attenuate or cuneate, the margins opaque; staminal tube developmentally fused to corolla tube, the stamens thus appearing epipetalous ........................................ VIII. Cybianthus


Terrestrial monoecious, dioecous or polygamous shrubs or small trees. Bark smooth to slightly fissured, light brown, thin. Root positively geotropic. Trunk distinguishable, leptocaulous, the growth dynamics following Rauh’s
Architectural Model (Hallé et al. 1978). Branchlets thin, terete, densely ferruginous glandular-granulose, the granules often stipitate. Cataphylls and pseudocataphylls absent. Leaves pseudoverticillate; blades petiolate, often with translucent glandular lepidote scales. Inflorescence a simple raceme or bipinnate panicle, staminate, pistillate, or polygamous, the peduncle 1–4 cm long, densely glandular-granulose; inflorescence and floral bracts, perianth and pistil bearing prominently raised red or black punctations; inflorescence bracts large, often foliaceous and persistent; floral bracts linear-lanceolate, the margins glandular-ciliate, caducous, the pedicels erect, accrescent in fruit. Staminate, pistillate and bisexual flowers monomorphic (similar in shape), the staminate the largest, the pistillate the smallest in size, white to yellowish-green, (4–) 5(–6)-merous; calyx coryliform, the lobes valvate, the margins densely glandular-ciliate; corolla coryliform to campanulate, the lobes imbricate, glabrous without except glandular-granulose near the margin, glandular-granulose over the entire surface within; stamens and staminodes with a conspicuous staminal tube, the apically free portions one to three times longer than the anthers, the anthers elongate-triangular to ovate, prominently curved distally, apically obtuse to apiculate, basally cordate to hastate, dorsifixed 1/3 to more than 1/2 length from base, dehiscent by narrow longitudinal slits, the staminodes producing abortive pollen grains; pistil in pistillate and bisexual flowers obturinate, the ovary densely translucent-lepidote, the style thick, truncate, the style punctiform, the placenta umbonate, bearing 3–4 uniseriate ovules immersed in placential tissue, but exposed apically by placential pores; pistillode similar to pistil but reduced in size, hollow or bearing 2 abortive ovules. Fruit drupaceous, 1-seeded, the exocarp thin, prominently black punctate.

Subgenus Microconomorpha contains 5 species, of which one, Cybianthus pastensis (Mez) G. Agostini, is known from Ecuador and Peru. I earlier indicated that there was no evidence to support subgenus Iteoides as a separate entity (Pipoly 1987), so it is treated here in synonymy under subgenus Microconomorpha.


Small or tree to 6 m tall. Branchlets and inflorescence densely ferrugineous glandular-papilllose, the branchlets angulate to prominently ridged, (1.5–) 2–3 mm diam. Leaves pseudoverticillate; blades membranaceous to coriaceous, narrowly oblanceolate to oblong or obovate, (3.0–) 6.5–14.5 (–21.0) cm long, (1.2–) 2–4.5 (–6.8) cm wide, apically attenuate, acute or acuminate, basally cuneate, not decurrent on the petiole, prominently punctate and minutely ferrugineous stipitate-papilllose above and below, the midrib impressed above, raised below, the secondary veins 7–15 pairs, prominently raised below, the margin undulate, lobate, crenate or dentate, rarely subentire; petioles marginate, (0.2–) 0.5–2 (–2.7) cm long, densely glandular-papilllose. Staminate, pistillate or polygamous inflorescence: monomorphic, erect or lax, a simple raceme, 1.8–5.5 cm long, the rachis thin to thick, densely glandular-papilllose; inflorescence bracts chartaceous, obovate to elliptic, (4.3–) 6–11 mm long, 3–7 mm wide, apically acute to acuminate, basally cuneate, densely and prominently red punctate; floral bracts chartaceous, linear-lanceolate, (0.8–) 1.4–2.2 (–7) mm long, 0.6–0.8 mm wide, apically attenuate, caducous; pedicels cylindrical, (1.3–) 2–7 (–7.5) mm long, densely glandular-papilllose. Flowers (4–) 5-merous, white to yellowish-green; calyx chartaceous, shallowly coryliform, (0.6–) 0.8–1.1 (–1.5) mm long, unequally divided, the tube 0.2–0.5 mm long, the lobes suborbicular to very widely ovate, (0.4–) 0.6–1 mm long and wide, rounded to acute apically, globose, densely and very prominently orange or black punctate, the margin subentire to erose-dentate, densely glandular-ciliate; corolla chartaceous, coryliform, 2–2.6 (–3.6) mm long, the tube 0.2–0.3 mm long, the lobes ovate to narrowly ovate, 1.7–2.3 (–2.8) mm long, 0.8–1.3 (–1.5) mm wide, highly reflexed at anthesis, apically rounded to obtuse, prominently orange or black punctate; stamens
and staminodes 1–1.6 (–2.5) mm long, the staminal and staminodial tube 0.7–1.8 mm long, the apically free portions of the filaments 0.3–0.7 mm long, the anthers elongate-triangular, 0.6–1.2 mm long, apically obtuse, basally hastate, the connective red punctate ventrally and dorsally, dorsifixed ca. 1/3 to slightly less than 1/2 from base; pistil and pistillode 1.2–1.8 mm long, the ovary (0.6–)0.8–1 mm long, 1–1.3 mm diam., densely translucent glandular-lepidote, the style thick, 0.5–0.8 mm long, the stigmas punctiform, the pistillode hollow or containing one abortive ovule. Fruit globose, green, then red, then black at maturity, 3–4 mm diam. when dried exocarp thin, prominently pellucid punctate.

**Distribution.**—Costa Rica to Colombia, southward to Peru, from 1,500–3,200 m elevation.

**Ecology and conservation status.**—*Cybianthus pastensis* is known from premontane and montane pluvial and cloud forests, and at elfin forest margins. Populations in areas exposed to winds have more coriaceous leaves and shorter stature, frequently as small as one meter in height. The wetter the habitat, the more membranaceous the leaves become, and the longer the inflorescences. Fieldwork in Colombia has shown that populations may contain six individuals per hectare, and that the population rapidly dwindles in areas of disturbance. Owing to population dynamics thus far observed, *Cybianthus pastensis* should be considered threatened.

**Etymology.**—The specific epithet refers to the area from which the type specimen was collected, near the city of Pasto, Department of Nariño, Colombia.

Representative specimens examined. **COLOMBIA.** Antioquia: Mpio. Urrao, Parque Nacional Natural “Las Orquídeas,” Vereda Calles, Permanent Premontane Rainforest Inventory Plot, right bank of Río Calles, 06° 32′ N, 76° 19′ W, 1,450–1,500 m, 29 Nov 1993 (fr), J. Pipoly, A. Cogollo et al. 17322 (BRIT, COL, JAUM, MO), limits of Parque Las Orquídeas, left bank of Río Calles, 1,450–1,500 m, 30 Nov 1993 (ster.), J. Pipoly, A. Cogollo et al. 17376 (BRIT, JAUM, MO); near limit of Parque Las Orquídeas, Alto de Palmitas, ca. 1 km from INDERENA Cañada Calles, 1,300–1,400 m, 1 Dec 1993 (ster.), J. Pipoly, A. Cogollo et al. 17505, 17523 (BRIT, JAUM, MO), 2 Dec 1993 (fl bud), J. Pipoly, A. Cogollo et al. 17534 (BRIT, COL, JAUM, MO); Right bank of Río Calles, 1,350–1,450 m, 7 Dec 1993 (stam. fl), J. Pipoly et al. 17881 (BRIT, COL, JAUM, MO); Along trail to Finca La Quince, above Urrao, 06° 30′ N, 76° 10′ W, 2,500–2,800 m, 21 Nov 1988 (stam. fl), G. McPherson et al. 13212 (BRIT, HUA, MO); Mpio. Frontrino, Región de Murrí, ca. 13 km from Núchibar, 06° 40′ N, 76° 20′ W, 2,000 m, 9 Dec 1988 (pist. fl, fr), G. McPherson et al. 13397 (BRIT, HUA, MO). Norte de Santander: San Antonio, W of Cali, near summit of Cordillera Occidental, 1,9800–2,350 m, 26 Feb–2 Mar 1959 (stam. fl), E. Killip & A. Garcia 33886 (A, S, US). ECUADOR. Azuay: Chiguindu, on E slopes of cordillera E of Sigsig, 03° 12′ S, 78° 36′ W, 1,600–1,800 m, 1889 (stam. fl), E. Lehmann 5143 (K–2 sheets). Carchi: Páramo de Achupallas, 01° 46′ S, 78° 33′ W, 2,000–3,000 m, 1899 (stam. fl), E. Lehmann 6262 (K–2 sheets); From Prima Vera about 6 hrs. hike up Río Gualchan Drainage to Nilo Ortiz' shelter, 00° 50′ S, 77° 72′ W, 1,930–2,200 m, 7–8 Jun 1993 (fl bud), J. Bradford et al. 55 (BRIT, MO, QCNE). Loja: Cerro Bangala, ca. 10 km E of Yangana, 2,500–2,700 m, 18 Oct 1988 (pist. fl, fr), G. Harling 25313 (GB), (stam. fl), G. Harling 25334 (GB); Cantón
Cybianthus pastens may be easily recognized by its pseudoverticillate leaves.
with variously serrate or incised margins, the very fine inflorescence rachis and minute flowers, and the stipitate papillae of the branchlets, leaves, petioles and inflorescence rachises. The prominent ridges of older branchlets and the swollen pseudoverticels of leaf scars are also distinct.


Terrestrial dioecious, bisexual, polygamous, or rarely, monoecious shrubs or trees. Roots positively geotropic. Bark smooth or fissured, brown, or beige, rarely with significant amounts of cork. Trunk distinguishable, leptocaulous, the growth dynamics following Rauh’s or rarely, Aubréville’s Architectural Model (Hällé et al. 1978). Branchlets thin to moderately thick, terete or ridged, densely to moderately covered with ferrugineous stipitate-lepidote scales, the scales at times appressed, rarely glabrescent. Cataphylls and pseudocataphylls absent. Leaves alternate, rarely approaching pseudoverticillate (C. peruvianus), petiolate, covered with ferrugineous stipitate lepidote scales, often glabrescent above; petioles canaliculate, marginate, or rarely winged. Inflorescence race-mose, spicate or paniculate, the panicles with racemose branches, rarely a solitary flower; inflorescence bract small, lanceolate, early caducous; rachis erect or lax, straight or rarely tortuous, ferrugineous stipitate-lepidote; floral bracts deltate, lanceolate or ovate, ferrugineous stipitate-lepidote, inserted at the base of the pedicel; pedicels cylindrical, at times clavate in fruit or absent, erect, apically recurved, pendent, or nodding, at times accrescent in fruit. Flowers unisexual, rarely bisexual, dimorphic, (3–)4–5–(6)–merous; calyx coryliform, cupuliform, crateriform, urceolate or patelliform, the lobes valvate, epunctate or with prominent (raised and blisterlike), conspicuous (readily visible buy flat), or inconspicuous brown, red or black punctations, the margin entire, rarely crenulate or crose; corolla campanulate to cupuliform, rarely salverform or tubiform, the lobes erect or reflexed, rarely cuculate, valvate or imbricate, ferrugineous stipitate-lepidote or glabrous and epunctate or prominently, conspicuously or inconspicuously pellucid, brown, or black punctate without, at times with a narrow line of glandular-granules along the margin, glandular-granulose within, the margins entire or rarely crenulate, glabrous or rarely glandular-granulose; staminodes resembling stamens but reduced in size, the tube conspicuous or inconspicuous, adnate to the co-
rolla, lobate or elobate, the anthers ovate or triangular-ovate, rarely linear-lanceolate, rarely deltate, usually recurved distally, rarely erect, apically acute, or apiculate, rarely rounded, the apiculum dorsally, rarely proximally recurved or erect, the base cordate, dorsifixed from near base to subversatile, the connective punctate or not; pistillode conic to lageniform, rarely absent, translucent-lepidote or glabrous, hollow; pistil obnapiform, rarely conic, the ovary globose, lobed or with an apical apophysis, the style short, the stigma capitate-lobate, 2–3-lobed or punctiform; placenta cupuliform or cotyliform, the ovules 2–4. Fruit subglobose, one(-two)-seeded.

_Cybianthus_ subgenus _Conomorpha_ contains 44 species, 10 of which have been recorded from Ecuador and Peru.

**KEY TO SPECIES OF CYBIANTHUS SUBGENUS CONOMORPHA**

1. Branchlets with erect stipitate ferrugineous lepidote scales, their margins not appressed; leaf blades subbullate to bullate, the secondary veins somewhat to deeply impressed above, prominently raised below; corolla infundibuliform or tubiform, or appearing so in bud.

2. Branchlets flexuous, 4–5 mm diam.; leaf blades perpuncticulose above, sparsely lepidote below, the secondary veins 22–26 pairs, the margin irregular; inflorescence tortuous, pinnately to bipinnately paniculate; corolla lobes prominently keeled, rugose without; anthers ventrally recurved. ......................................................... 2. _C. gigantophyllus_

2. Branchlets straight, 2–3 mm diam.; leaf blades not perpuncticulose above, densely lepidote below, the secondary veins 8–19 pairs, the margin regular; inflorescence erect, a simple raceme or poorly formed panicle consisting of basally clustered racemes; corolla lobes flat, smooth or verruculose without; anthers dorsally recurved.

3. Secondary veins 12–16; staminal tube epunctate; pedicels cylindric; calyx cotyliform; corolla membranaceous, infundibuliform, verruculose without; fruit smooth, 3.5–4.5 mm diam.; plants of premontane pluvial forests, subpáramo thickets and upper pluvial cloud forests, 1,000–1,960 m elevation ................................................................. 3. _C. occigranatensis_

3. Secondary veins 8–12; staminal tube punctate; pedicels obconic; calyx urceolate; corolla carnose, tubiform, smooth without; fruit cosparse, 7–15 mm diam.; plants of white sands or on sandstone, 150–180 (–1,500) m elevation ............................................................................ 4. _C. spichigeri_

1. Branchlets with appressed ferrugineous lepidote scales, the margins appressed; leaf blades not subbullate or bullate, the secondary veins planar or slightly raised above, barely discernible or slightly raised below; corolla campanulate to cupuliform.

4. Leaf blades coriaceous, rarely chartaceous, the margins subrevolute to revolute.

5. Leaf blades densely and prominently pustulate at maturity above, the secondary veins 24–28 pairs, inconspicuous below; inflorescence spicate (2–6–16 cm long; flowers subsessile, the pedicels 0.2–0.6 mm long; calyx deeply cupuliform. ................................................................. 5. _C. lepidotus_

5. Leaf blades essentially smooth or sparsely pustulate at maturity above,
the secondary veins 14–25 pairs, prominently raised below; inflorescence a raceme or panicle with 2–4 racemes branching from base, (2–)3–7 (–8) cm long; flowers pedicellate, the pedicels (0.5–)0.9–1.5 mm long; calyx cotyliform.

6. Branchlets suberete, 2–3 mm diam; leaf blades 1.2–2(–2.5) cm wide, smooth above; petioles 5–7(–10) mm long; staminate calyx carnose, 1.2–1.8 mm long; staminate corolla carnose, densely lepidote without, the scales overlapping, 3.2–3.4 mm long, the tube equal to the staminal tube, the lobes symmetric; anthers ovate; fruit with fleshy exocarp; plants of montane and cloud forests on sandstone.

6. Branchlets terete, 3–4 mm diam.; leaf blades (2.6–)3.5–5 cm wide, pusticulate above; petioles 10–15 mm long; staminate calyx chartaceous, 0.8–1.2 mm long; staminate corolla chartaceous, glabrous or sparingly lepidote without, the scales not overlapping, 2.0–2.6 mm long, the tube shorter than the staminal tube, the lobes asymmetric; anthers linear-lanceolate; fruit with thin exocarp; plants of lowland and lower montane forests on white sands.

4. Leaf blades chartaceous to membranaceous, the margins flat.

7. Leaf blades membranaceous to subchartaceous; petioles 5–10(–12) mm long; inflorescence a simple raceme or rarely 2-branched at base, 1–3 cm long; corolla salverform or campanulate; fruit globose.

8. Branchlets angulate; 1.5–2 mm diam.; corolla salverform, the staminate 2.2–2.6 mm; plants of premontane forests on sandstone and limestone, (244-)400–1,200 m elevation.

8. Branchlets terete, 2–3 mm diam.; corolla campanulate, the staminate, 2.8–3.2 mm; plants of lowland igapo forests, 90–240(--700) m elevation.

7. Leaf blades chartaceous; petioles (10–)13–17(–22) mm long; inflorescence a panicle with 2–8 racemes branched from base, 4–8 cm long; corolla chartaceous, infundibuliform or cotyliform; fruit depressed-globose.

9. Branchlets, petioles, abaxial leaf blades, inflorescence and calyx lobes moderately to densely lepidote, but the not scales overlapping; leaf blades smooth above at maturity; corolla cotyliform, the lobes oblong to oblanceolate, flat, smooth without, conspicuously black punctate, apically acuminate; staminal and staminodial tube chartaceous, conspicuous; anthers and antherodes obcordate, the apiculum distally recurved; pistilode conic; pistil lageniform.

9. Branchlets, petioles, abaxial leaf blades, inflorescence and calyx lobes moderately to densely lepidote, the scales overlapping; leaf blades pustulate above at maturity; corolla infundibuliform, the lobes ovate, verruculose without, inconspicuously brown punctate, apically rounded; staminal and staminodial tube membranaceous, inconspicuous; anthers ovate, antherodes subdeltate, the apiculum proximally inflexed; pistilode lageniform; pistil obnapiform.

11. C. cuatrecasasii

2. Cybianthus gigantophyllus Pipoly, (Fig. 2A, 10). Candollea 46:41. 1991.

Type: PERU. San Martin: Pumayacu, between Balsapuerto and Moyobamba, 600–1,200
**Fig. 10. Cybianthus gigantophyllus** Pipoly. A. Habit, showing flexuous branchlet, paniculate inflorescences. B. Pistillate flower, showing urceolate calyx and crenulate corolla lobe margins. C. Pistillate flower with one corolla lobe removed, showing cucullate corolla lobe apices, proximally recurved antherodes, and capitate, lobed stigma. A–D, drawn from holotype, by Peggy Duke. Figure reproduced from Pipoly, 1991.

Tree to 4 m tall. Branchlets flexuous, prominently ribbed, 4–5 mm diam., moderately lepidote. Leaves alternate; blades chartaceous, elliptic, (15.5)17–27 cm long, (5.9–)7–9.1 cm wide, apically long-acuminate, the acumen 1.2–3.5(–4) cm long, pustulare, perpuncticulose and glabrous above, sparsely lepidote below, midrib slightly depressed above, prominently raised below, the secondary veins 22–26 pairs, slightly depressed above, prominently raised below, the margin irregular, flat, entire; petioles canalicate, thick, (1.6–)2.7–4 cm long, ca. 3 mm diam., sparsely lepidote, prominently ridged below. Stamine inflorescence: unknown. Pistillate inflorescence: a pinnate to bipinnate panicle, 1.5–2.5 cm long, tortuous, the branches spicate, moderately lepidote; peduncle 0.3–0.5 cm long, floral bracts carnose, delatate, 0.8–0.9 mm long and wide, apically acute, margin crenulate basally, densely lepidote above and below; pedicels obsolete. Pistillate flowers 4-merous; calyx carnose, urceolate, 1.6–1.8 mm long, the tube 0.9–1 mm long, the lobes widely triangular, 0.5–0.7 mm long, 1–1.2 mm wide, apically acuminate-apiculate, the margin regular, entire, lepidote; corolla carnose, campanulate, 2.7–3.1 mm long, the tube 0.2–0.3 mm long, the lobes erect, 2.5–3 mm long, apically rounded to obtuse, prominently cuculate, abaxially ciliate, apically rugose and glandular-granulose along the margins without, inconspicuously black punctate, the margin glandular-granulose, erose-crenulate; staminodes 2.3–2.5 mm long, the staminodial tube membranous, inconspicuous, 0.2–0.3 mm long, elobate, glabrous, the apical free portions of the filaments 1.2–1.3 mm long, flat, the anthers ovate, 0.8–1 mm long, 0.6–0.8 mm wide, apiculate, the aciculum ventrally recurved, basally cordate, the connective epunculate; pistil obturiniate, 1.8–2 mm long, 1–1.3 mm diam., the ovary 1.4–1.6 mm long, the stigma capitate, 3–5-lobed, the placenta cupuliform, ovules 3, erect, the upper portions exposed. Fruit globose, 4–5 mm long and in diam., exocarp thin, black, inconspicuously pellucid punctate.

Distribution.—Cybianthus gigantophyllus is known from the headwaters of the ríos Marañón and Huallaga in San Martín, and the Iquitos area, along the Ríos Napo, Nanay and Amazonas in Loreto, at 130–500 m elevation.

Ecology and conservation status.—Cybianthus gigantophyllus occurs in primary terra firme forests, and on white sands (varillal) of lowland Peruvian Amazonia. Given increasing pressure from deforestation, it should be considered threatened.

Etymology.—The specific epithet refers to the leaf size, one of the largest known for the subgenus.

Local names.—Peru: “ukushnum,” “wewé,” “yakúsnum,” “yakúshnum” (Aguaruna).

*Cybianthus gigantophyllus* is most closely related to *C. occigranatensis* (Cuatrec.) G. Agostini and *C. spicibigeri* Pipoly. However, the large, flat leaves, long petioles, and tortuous panicles allow for easy recognition. In the original description (Pipoly 1991), I described the pistillate corolla as tubular, when it is, in fact, campanulate. When the flower is in bud, the corolla appears tubular as it longitudinally extends above the calyx, then it gradually opens, with cucullate apices. Within the tall terra firme forests on lateritic soils, it may be found above the flood line along small creekbeds.


**Shrub or small tree** to 4 m tall. **Branchlets** straight, suberete, 2–3 mm diam., densely lepidote. **Leaves** alternate; blades membranaceous, elliptic to obovate, (4–)7.5–14(–21) cm long, (2.5–)4–5(–7) cm wide, apically acuminate, the acumen 1.2–1.5(–3.0) cm long, basally acute, decurrent on the petiole, the midrib impressed above, prominently raised below, the secondary veins 8–12 pairs, deeply impressed above, prominently raised below, the leaf strongly bullate, adaxial surface smooth, densely lepidote when young, becoming pusticulate and sparsely lepidote or glabrous with age, abaxial surface densely lepidote, but the scales not overlapping; petioles canaliculate, 1.0–1.5(–1.8) cm long, densely lepidote, persistent. **Staminate inflorescence** a raceme or a panicle with 1–3 branches from the base, 4–8 cm long; peduncle, rachis,
branches and pedicels densely lepidote; peduncle 0.1–0.4 mm long; floral bracts membranous, ovate, shorter than the pedicels, 0.7–1.1 mm long; 0.4–0.5 mm wide, apically acute, densely lepidote abaxially, the margin entire; pedicels cylindric, thin, 1.5–6 mm long. *Stamine flowers* 4-merous; calyx carnose, cotyliform, 0.8–1.0 mm long, the tube 0.2–0.3 mm long, the lobes triangular to deltate, 0.5–0.9 mm long, 0.4–0.8 mm wide, apically attenuate to an acute or round tip, sparsely lepidote without, glabrous within, conspicuously brown punctate, the margin lepidote; corolla membranaceous, campanulate, 2.4–2.7 mm long, the tube 0.7–0.8 mm long, the lobes ovate, 1.6–1.8 mm long, 1.0–1.3 mm wide; apically attenuate to a round tip, verruculose without, smooth within, sparsely lepidote without toward apex, apically glandular-granulose within and along margins, conspicuously brown punctate, the margins entire; stamens 1.8–1.9 mm long, the filaments 2.6–2.8 mm long, the tube membranaceous, inconspicuous, adnate to the corolla tube, elobate, the apically free portions 0.2–0.3 mm long, the anthers triangular, 0.8–1.0 mm long, 0.5–0.6 mm wide, apically attenuate to an acute, dorsally reflexed tip, basally cordate, dorsifixed just above base, the connective dark, prominently brown punctate; pistillode lageniform, 1.3–1.5 mm long, densely translucent glandular-lepidote near the base. *Bisexual and pistillate inflorescence*; as in stamine but only rarely branched from base, 4–6 cm long; peduncle 0.1–0.3 cm long; floral bracts 0.5–0.8 mm long; pedicels 1.5–3.5 mm long. *Bisexual and pistillate flowers* as in stamine but calyx 0.8–1.1 mm long, the tube 0.3–0.6 mm long, the lobes deltate to oblate, 0.4–0.6 mm long, 0.8–1 mm wide; the margin irregular, entire; corolla as in stamine but 2.4–2.6 mm long, the tube 1.0–1.1 mm long, the lobes ovate, 1.4–1.6 mm long, 0.8–1.1 mm wide. *Bisexual flowers* with stamens 1.6–1.8 mm long, the tube 1.0–1.2 mm long, the apically free portions of filaments 0.2–0.3 mm long; the anthers 0.5–0.8 mm long, pistillode 1.5–1.8 mm long. *Pistillate flowers* with staminodes 1.6–1.8 mm long, the tube 1.0–1.2 mm long, the apically free portion of filaments 0.1–0.2 mm long, the antherodes 0.5–0.7 mm long; pistil obnapiform, 2.4–2.6 mm long, the ovary 1.1–1.2 mm long, 1.1–1.2 mm diam., the style 1.0 mm long, the stigma capitate, 2-lobed, to 0.2 mm long, the ovules 2–4, buried in the placenta below apical pores. *Fruit* globose, 2.5–4 mm long, 3.5–4.5 mm diam., the endocarp smooth, the aril scanty and adnate to both seed and endocarp, the embryo straight, ca. 3 mm long.

**Distribution.**—Panama (Darién), Colombia (Cordillera Occidental) and Ecuador (Esmeralda, Napo, Santiago-Zamora, Sucumbios), at 1,000–1,960 m elevation.

**Ecology and conservation status.**—Cybianthus occigenatensis occurs in premontane pluvial forests, subpáramo thickets and in upper pluvial cloud forest. Based on my observations of populations in subpáramo thickets at the Antioquia/
Chocó interface in the Cordillera Occidental of Colombia, this species tolerates disturbance well as long as the soil is not compacted. It is restricted to areas where rainfall exceeds 5,000 mm annually. At this time, the species does not seem to be threatened.

Etymology.—The specific epithet refers to its principal range of distribution, the Cordillera Occidental of Colombia and adjacent Ecuador.

Specimens examined. PANAMA. Darién: S slope of westernmost summit of Cerro Tacaracuna, massif between Pucro base camp and Tacaracuna summit camp, 1,400–1,600 m, 21 Jul 1976 (stam. fl), A. Gentry et al. 16867 (COL, LL-TEX, MO, PMA). COLOMBIA. Antioquia: Mpio Frontino, km 13 Nutibara-La Blanquita Rd., Región de Murrrí, Alto de Cuevas, 06° 44' N, 76° 23' W, 1,990 m, 6 Nov 1988 (fl bud), J. Zarucchi et al. 7201 (BRIT, HUA, MO); Mpio. Frontino, Vereda Venados, Parque Nacional Las Orquídeas, sector Dos Bocas, confluence of Río Venados and Río Calles, 06° 34' N, 76° 30' W, 29 Oct 1986 (stam. fl), R. Callejas et al. 2737 (HUA, MO); Mpio. San Luís, Autopista Medellín-Santa Fé de Bogotá, sector Río Samaná, Rd. toward Vereda La Josefina, 18 Dec 1982 (stam. fl), A. Cogollo & C. Estrada 296 (COL, JAUM, MO); Mpio. Urrao, Parque Nacional Las Orquídeas, Vereda Calles, Permanent Premontane Rainforest Inventory Plot, right bank of Río Calles, 06° 32' N, 76° 19' W, 1,450 m, 26 Nov 1993 (ster.), J. Pipoly, A. Cogollo et al. 17159 (BRIT, JAUM, MO), 27 Nov 1993 (ster.), J. Pipoly, A. Cogollo et al. 17182 (BRIT, JAUM, MO), Range NW of Cabaña de Calles, 1,450 m, 28 Nov 1993 (ster.), A. Cogollo et al. 7529 (BRIT, JAUM, MO), 1,450–1,500 m, 28 Nov 1993 (ster.), J. Pipoly et al. 17253 (BRIT, JAUM, MO), (ster.), J. Pipoly et al. 17281 (BRIT, JAUM, MO), 7 Dec 1993 (ster.), J. Pipoly et al. 17871 (BRIT, JAUM, MO), 9 Dec 1993 (fl. bud), J. Pipoly et al. 17979 (BRIT, JAUM, MO), Vereda Calles, Alto de Palmitas, ca. 1 km from Cabaña de Calles, 1,700–1,750 m, 2 Dec 1993 (ster.), J. Pipoly et al. 17542 (BRIT, JAUM, MO). Chocó: Mpio. Itsmina, Quebrada Raspadura, between Raspadura and Quibdó, split of Río Atrato and Río San Juan drainage basins, ca. 05° 15' N, 76° 38' W, 18 Apr 1979 (fr), E. Forero & R. Jaramillo 5307 (COL, MO); Serranía del Darién, along Colombian/Panamanian border, 1,400 m, 20 Jul 1976 (stam. fl, bisex. fl), A. Gentry, H. León & L. Forero 16842 (COL, MO); without locality, 1866 (fr), J. Triana 25889 (GH). Huila: Río Suaza, SW of Alejandría, 1,670 m, 23 Aug 1944 (stam. fl), E. Little 8532 (COL, US). Quindío: Mariquita, 1866 (stam. fl), J. Triana 2562 (P). Valle Del Cauca: Cordillerera Central, 5 km N of Darién along Rd. toward La Guajira, Upper Río Calima, 03° 58' N, 76° 28' W, 1,550–1,700 m, 24 Jan 1986 (fl bud), B. Stein & L. McDade 3284 (BRIT, HUA, MO); Finca Zungara, Corregimiento La División, crest of Cordillera Occidental, W of Cali, 6 km N of Cali-Buenaventura Hwy, 03° 32' N, 76° 35' W, 1,960 m, 12 Dec 1985 (ster.), A. Gentry et al. 53167 (COL, MO, US); without locality, 20 Oct 1943 (pist. fl, fr), J. Cuatrecasas 14918 (COL-2 sheets, F); Río Sanquini, La Laguna, 1,250–1,400 m, 10 Dec 1943 (stam. fl), J. Cuatrecasas 15658 (COL, F, US); Montre La Guardia, Carbonera Range, between Las Brisas and Albán, 1,950–2,000 m, 16 Oct 1946 (stam. fl), J. Cuatrecasas 22131 (COL, F, US, VEN); San Antonio, W of Cali, 1,900–2,350 m, 26 Feb 1939 (stam. fl), E. Killip & A. Garcia 33898 (A, BM, COL, F, NY, US); La Cumbre, 7 May 1922 (stam. fl), F. Pennell 5147 (GH, K, NY, US). ECUADOR. Esmeraldas: San Lorenzo Cantón, Reserva Órítica Awá, Parroquia Alto Tambo, Centro de la Unión, Cañón del Río Mira, 00° 52' N, 78° 26' W, 250 m, 22 Mar 1993 (fr), C. & M. Anestis 1313 (BRIT, MO, QCNE). Napo: Carretera Nueva, Cotundo-Coca, 1,130 m, 5 Aug 1984 (pist. fl, fr), C. Dodson et al. 15115 (MO); Cantón Archidona, 150 m NE of Caserío de Huanamó, right side of Carretera Hollín-Loreto, 00° 43' S, 77° 36' W, 1,200 m, 9 Sep 1988 (fr), F. Hurtado & D. Neil 235 (MO, QCNE), Cordillera de Guacamayos, Rd. to Archidona, Río...
Cybianthus occigranatensis is most closely related to C. timanae Pipoly, but is easily distinguished by the fewer secondary veins of the coriaceous leaf blades, the campanulate corolla with verrucose, prominently black punctate lobes and attenuate apices, and obnapiform pistil. The population from Alto de Cuevas in Antioquia, Colombia, has by far the largest leaves of any population of this species known thus far. Further study of the population biologies of Cybianthus montanus (Lundell) G. Agostini from Panama, C. occigranatensis, and C. timanae will be necessary to fully resolve the precise relationships and microecological roles each plays in montane wet and pluvial forests.

4. Cybianthus spichigeri Pipoly, Candollea 46:43. 1991. (Fig. 2B, 11).


Tree to 15 m tall. Branchlets thin, straight, terete, 2–5 mm diam., densely lepidote. Leaves alternate; blades chartaceous, elliptic to narrowly oblanceolate, (10–)15–20 cm long, (3–)5.2–6.5 (7.2) cm wide, apically caudate-acuminate, the acumen 1.9–2.3 cm long, basally acutish to obtuse, not decurrent on the petiole, bullate, the midrib and secondary veins strongly impressed above, prominently raised below, smooth and inconspicuously to prominently pellucid punctate above, moderately lepidote below, the margin essentially flat, but very slightly rolled at the very margin; petioles canaliculate, (1–)1.2–2 cm long, densely lepidote. Staminate inflorescence: a pyramidal pinnate pannicle, 1–4.5 cm long, 1–3 cm wide, peduncle 0.3–1 cm long; branch bracts chartaceous, linear-subulate, 0.6–1 mm long, 0.1–0.2 mm wide, apically attenuate, densely lepidote; pedicels cylindrical, (0.8–)1–1.5 mm long. Staminate flowers 4–5-merous, carnose; calyx suburseolate, 1.3–1.5 mm long, the tube 0.3–0.5 mm long, the lobes deltate, ca. 1 mm long and wide, apically acute.
Fig. 11. *Cybianthus spichigeri* Pipoly. A. Habit, showing minute inflorescences and large, costate fruits. B. Staminate flower in bud, showing subulate calyx and tubiform corolla. C. Staminate flower, showing long, prominently lobate staminal tube, cuculate corolla lobes, proximally recurved anthers. A–C, drawn from holotype, by Peggy Duke. Figure reproduced from Pipoly, 1991.
sparsely lepidote, prominently rugose, with one prominent brown punctation per lobe, the margins irregular, entire, sparsely lepidote; corolla tubiform, 2.4–2.8 mm long, the tube ca. 0.5 mm long, the lobes oblong, 1.9–2.9 mm long, 0.9–1.1 mm wide, apically acute, prominently cucullate, with only a few, scattered scales without, glandular-granulose within, the margin entire, glandular-granulose; stamens 2.2–2.4 mm long, the tube carnose, conspicuous, 1–1.4 mm long, lobate, the lobes 0.1–0.2 mm long alternating with the filaments, the apex of the tube and lobes punctate, the apically free filaments, 0.9–1.3 mm long, the anthers deltate, 0.5–0.7 mm long and wide, apically apiculate, the apiculum slightly proximally recurved, basally cordate, the connective dorsally punctate with small brown dots forming a triangle along connective margin; pistillode conic, 0.5–0.7 mm long, 0.2–0.3 mm wide, hollow, glabrous, the style conspicuously brown punctate, the stigma punctiform. **Pistillate and polygamous inflorescence:** a raceme, occasionally a poorly formed panicle of 1–3 racemes branched from base, 0.4–1.5 cm long, densely lepidote, tardily glabrescent; peduncle 0.1–0.4 mm long; floral bracts chartaceous, ovate, 0.8–1 mm long, 0.3–0.5 mm wide, apically attenuate, densely lepidote; pedicels obconic, (0.8–)1.5–2.5(–3) mm long, to 1.2 mm diam. apically in fruit, densely lepidote. **Pistillate flowers** as in staminate but calyx 1.0–1.2 mm long, the tube 0.4–0.5 mm long, the lobes 0.6–0.7 mm long and wide, staminodes and pistil unknown. **Fruit** depressed-globose, 0.7–0.8 cm long, 0.7–1.5 cm wide, prominently costate longitudinally, the exocarp costate, inconspicuously pellucid punctate.

**Distribution.**—Principally known from forests along the ríos Ucayali, Marañón and Napo Drainage Basin complex, Loreto, Peru, with one disjunct population in nearby Morona-Santiago, Ecuador, 150–180 (–1,500) m elevation.

**Ecology and conservation status.**—**Cybianthus spichigeri** is known from only a handful of specimens, but is locally quite common. Not enough is known of the population biology to categorize its conservation status, but its frequency in forest study plots of the Jenaro Herrera Reserve in Peru suggest it is reproducing and may not be in imminent danger. **Cybianthus spichigeri** is a varillal or premontane sandstone species in Peru, and in Ecuador it is known only from premontane sandstones. Occurrence of this species in the Cerros del Sirá, Peru, reinforces the concept that those mountains contain many unusual populations of otherwise lowland Amazonian plants.

**Etymology.**—The epithet commemorates Rudolphe Spichiger, Director of the Conservatoire et Jardin Botaniques, Chambéry, Geneve, Switzerland. Dr. Spichiger has devoted much of his career to study of global change, conservation of biodiversity, and systematics of the genus *Ilex*. Under his leadership, the Jardin has maintained active research programs in Paraguay, Peru, Madagascar, and throughout Europe.

*Cybianthus spichigeri* is unique within subgenus *Conomorpha* because of its costate fruits. In addition, the subulate leaf blades, punctate staminal tube, obconic pedicels, and polygamous inflorescences are also exceedingly rare characters that allow for easy recognition. Since its description (Pipoly 1991), an entirely staminate specimen (*R. Marmillod 9-R-137*) has been located. While the staminate inflorescence structure is quite different from that of the polygamous one, flowers of both are identical. The occurrence of this taxon three times in one inventory conducted at the Jenaro Herrera Reserve indicate that the relative frequency of reproductive individuals would permit a study of the breeding system and population biology for this most unusual taxon.


Shrub or small tree to 6 m tall. Branchlets straight, terete, 2-2.5 mm diam., densely lepidote. Leaves alternate; blades elliptic to narrowly elliptic, chartaceous to coriaceous, (3.1-)5-15 cm long, 1.6–6 cm wide, apically acuminate, the
acumen 0.3–2.0 cm long, basally acute to obtuse, midrib depressed above, prominently raised below, the secondary veins 24–28, inconspicuous above and below, punctulate and densely lepidote above at first, glabrous, densely lepidote below, the scales not overlapping, inconspicuously pellucid punctate, the margin entire, subrevolute to revolute; petioles thin, marginate, 1.0–2.5 cm long, densely lepidote. *Staminate inflorescence* a spike, rarely two subsessile spikes, (2–)6–16 cm long, 8–15-flowered, peduncle, pedicels, and axis densely lepidote, the scales not overlapping; peduncle (0.2–)0.5–0.8 mm long; floral bracts ovate to widely ovate, chartaceous, 0.5–0.6 mm long, 0.3–0.4 mm wide, apically acute, densely lepidote adaxially, the margin entire, glabrous. *Staminate flowers* (4–)5-merous; calyx cupuliform, carnose, 0.9–1.2 mm long, the tube 0.2–0.4 mm long, the lobes deltate to ovate-triangular, 0.6–0.8 mm long and wide, apically acute or acuminated, rarely obtuse, attenuate to a rounded tip, conspicuously brown punctate, the margin entire, lepidote; corolla cupuliform, carnose, 1.5–2.5 mm long, the tube 0.5–1.0 mm long, the lobes ovate to broadly ovate, 1.2–1.7 mm long, 0.7–0.9 mm wide, apically attenuate to a round, cucullate tip, at times with a few, scattered lepidote scales without, glabrous without, glandular-granulose within over the entire surface, punctations brown, submarginal, the margin entire, glabrous; stamens 1.5–1.6 mm long, adnate 0.5–1.0 mm to corolla tube, the staminal tube 0.3–0.4 mm long, carnose, bearing lobes alternating with the apically free portions of the filaments 0.1–0.2 mm long, the filaments flat, 0.3–0.4 mm long, erect, glabrous, the anthers dorsifixed less than 1/4 from base, ovate-triangular, 0.6–0.7 mm long, 0.4–0.5 mm wide, apically attenuate to a rounded tip, basally cordate, slightly dorsally reflexed, the connective epuncate; pistillode lageniform, 1.1–1.2 mm long, hollow, costate basally, sparingly translucent lepidote, pellucid-punctate. *Pistillate inflorescence* as in stamineate but a spike, (2–)6–16 cm long, 6–10-flowered; peduncle 0.6–0.8 mm long; floral bracts 0.5–0.6 mm long, 0.3–0.4 mm wide. *Pistillate flowers* as in staminate, but staminodes 1.2–1.3 mm long, adnate 0.5–1.0 mm to corolla tube, the staminodial tube 0.5–0.6 mm long, carnose, bearing lobes alternating with the apically free portions of the filaments 0.1–0.2 mm long, those apical portions flat, 0.3–0.4 mm long, erect, glabrous, the antherodes dorsifixed less than 1/4 from base, deltate, 0.7–0.8 mm long and wide, apically attenuate to a rounded tip, basally cordate, slightly dorsally reflexed, the connective epuncate; pistil pyriform, 1.4–1.5 mm long, the ovary 1–1.2 diam., the style not differentiated, the stigma punctiform, the placenta patelliform, bearing 2–3 naked ovules. *Fruit* globose, purple at maturity, 0.5–1.0 cm long, 0.6–1.0 cm diam., the endocarp smooth, the embryo curved, 3.5–4.0 mm long.

*Distribution.*—Guayana Highland of Venezuela and Brazil, and sandstone
formations in Bolivia and Peru (reported for the first time here), 600–2,300 m in Venezuela, 850–950 m in Bolivia, and 760–850 m in Peru.

Ecology and conservation status.—*Cybianthus lepidotus* is restricted to large cloud forest formations in transition zones between sandstone and diabasic intrusions. It is often associated with species of *Erythroxylum*, which are also edaphic endemics. It is a widespread, but locally infrequent species and therefore, should be considered threatened.

Etymology.—The epithet refers to the densely lepidote vestiture of the vegetative and floral parts of the plant.


*Cybianthus lepidotus*, restricted to sizeable cloud forests in transition zones between sandstone and diabasic intrusions, is most easily recognized by its long, lax spikes. When sterile, it may be confused with *Cybianthus roximae* (Steyerm.) G. Agost., but may be easily distinguished by the branchlets 2–2.5 (nor 3.5–4.5) mm in diameter. It may also be confused with *Cybianthus punctatus* (Mez) G. Agost. and *C. cardonae* G. Agost. For a discussion of the differences between these taxa in sterile condition, see Pipoly (1992a).

The area of Bolivia in which this species has been collected is of biogeographic interest because it also supports several other Guayana Highland taxa in the Ericaceae and Clusiaceae. Its new discovery in Bagua Province of Amazonas, Peru, reinforces thematic map data from satellite imagery that indicated tepui-like vegetation could be expected in the area. It is interesting that C. Díaz et al. 7252 from Peru, and B. Krukoff 10987 from Bolivia, are qualitatively and quantitatively identical to specimens of *Cybianthus lepidotus* from Cerro Duida, Amazonas, Venezuela.


*Shrub or small tree to 2 m tall. Branchlets straight, subterete, 2–3 mm diam., densely lepidote. Leaves alternate; blades coriaceous, obovate, 3–8(–12) cm long, 1.2–2(–5.0) cm wide, apically acute or short-acuminate, basally cuneate, decurrent on the petiole, midrib depressed above, prominently raised below, the secondary veins 14–18 pairs, planar above, conspicuous below,
glabrous and smooth above at maturity, densely lepidote below, the margin revolute; petioles marginate, 0.5–1 cm long, densely lepidote. **Staminate inflorescence**: a raceme or panicle with 2 racemose branches from base, 2–3 cm long; rachis, and pedicels densely lepidote; peduncle 0.1–0.3 cm long; pedicels cylindrical, 0.9–1.5 cm long; floral bracts chartaceous, narrowly ovate, 1–2 mm long, densely lepidote adaxially. **Staminate flowers** 4-merous; calyx carnose, cotyliform, 1.2–1.8 mm long, sparsely to densely lepidote without, glabrous within, the tube 0.2–0.3 mm long, the lobes triangular to deltate, 0.8–1 mm long, 0.6–0.8 mm wide, apically attenuate to a rounded tip, inconspicuously pellucid punctate, the margin entire, lepidote; corolla carnose, campanulate, 3.2–3.4 mm long, the tube 1.8–2 mm long, densely lepidote without, the scales overlapping, glabrous within, the lobes ovate or ovate-triangular, 0.8–0.9 mm long, 0.3–0.4 mm wide, symmetric, apically attenuate to a rounded tip, inconspicuously pellucid punctate, densely lepidote without, glandular-granulose within, the margin entire, glandular-granulose; stamens 2.6–2.7 mm long, the tube carnose, conspicuous, equalling the corolla tube, 1.8–2 mm long, lobate, the lobes alternating with the filaments ca. 0.1 mm long, the apically free portions of the filaments flat, 0.1–0.2 mm long, the anthers dorsifixed, ovate, 0.6–0.9 mm long, 1.8–1.9 mm wide, somewhat curved distally, apically apiculate to subapiculate, basally cordate, the connective inconspicuously brown punctate; pistillode conic, 1.5–2 mm long, translucent glandular-lepidote basally, hollow. **Pistillate inflorescence**: as in staminate but 3–3.5 cm long; peduncle 0.1–0.4 cm long; pedicels cylindrical, 0.9–1.5 mm long; floral bracts chartaceous, linear-lanceolate, 1.3–1.5 mm long, densely lepidote adaxially. **Pistillate flowers** as in staminate but calyx 1.2–1.4 mm long, sparsely to densely lepidote without, glabrous within, the tube ca. 0.2 mm long, the lobes deltate, 1–1.2 mm long and wide, apically attenuate to a rounded tip, inconspicuously pellucid punctate, the margin entire, lepidote; corolla, staminodes and pistil unknown. **Fruit** globose, 5–8 mm long and in diam., exocarp carnose, black.

**Distribution.**—Eastern slopes of the Andes, Colombia, Peru and Bolivia, 1,980–2,850 m.

**Ecology and conservation status.**—The species occurs in primary cloud forest, a life zone being cleared rapidly for cultivation throughout the Andes, which may account for the paucity of collections. Within subgenus *Conoviorpha*, *Cybianthus laxus* is the species most in danger of extinction.

**Etymology.**—The specific epithet is Latin for “cheerful or bright,” and probably refers to the plant’s aesthetically pleasing appearance, having the same general form as many species of *Vaccinium*, *Myrsine dependens*, other Ericaceae, and other diminutive Andean shrubs. The thick juicy exocarp is said to be very tasty although slightly acidic (T. Dudley, pers. comm.).
Representative specimens examined. COLOMBIA. Boyaca: Arcabuco, NE of town, 2,650 m, 11 Nov 1965 (stam. fl), L. Uribe s.n.(COL); Sierra Nevada del Cocuy, path from Laguna to Cobugón, near Alto del Oso, 2,900 m, 27 Aug 1958 (stam. fl), P. Grubb et al. 744 (K).

PERU. Amazonas: Prov. Luya, Drto. Camporredondo, Anexo Tullanya, between Pájaco Tigre and Palma, 06° 04' 35'' S, 78° 21' 45'' W, 2,500–2,600 m, 9 Dec 1996 (fr), J. Campos et al. 3161 (BRIT, HUT, MO, USM); Along Rd. E of Chachapoyas between Pipos and Molinopampa, 06° 15' S, 77° 40' W, 1,980–2,340 m, 14 Feb 1985 (pist. fl, fr), J. Luteyn & E. Cotton 11414 (NY, TEX, US, USM); E of Chachapoyas, 2,000 m, without sure (stam. fl), A. Weberbauer 4354 (G).


Huánuco: Prov. Huánuco, Carpish Hills, trail to summit from W entrance, 2,700–2,850 m, 09° 42' S, 76° 05' W, 2 Mar 1985 (stam. fl), B. Stein & C. Todzka 2292 (MO, USM).

Cybianthus laevis is easily recognized by its small leaves, short petioles, subsessile anthers and thick, juicy exocarp. It is known outside of Peru from only two other collections, one from the department of Boyacá, Colombia and the other from Nor Yungas, Bolivia. A recent collection from Luya Province in western Peru (J. Campos et al. 3161) is referred here because of its thin, angulate branchlets, and the thick exocarp of its fruits, despite the larger, thinner leaves. It is expected in Ecuador, in either Napo or Santiago-Zamora Provinces.


Shrub or small tree to 16 m tall. Branchlets straight, terete, 3–5 mm diam., densely lepidote. Leaves alternate, at times approaching pseudoverticillate at some nodes; blades coriaceous, elliptic to obovate, 7–12.7 cm long, (2.6–)3.5–5 cm wide, apically acuminate, the acumen 1.2–1.6 cm long, basally acute to obtuse, decurrent on the petiole, midrib depressed above, prominently raised below, the secondary veins 10–25 pairs, prominently raised below, densely lepidote at first, then pustulate above at maturity, sparsely lepidote below, the margin revolute; petioles canaliculate, 1–1.5 cm long, densely lepidote. Staminate inflorescence: a panicle with 1–4 racemes branching from the base, (2–)3–8 cm long; peduncle, rachis and pedicels densely lepidote; peduncle 0.1–0.2 cm long; floral bracts chartaceous, ovate, 0.7–1 mm long, 0.5–0.6 mm wide, apically attenuate, densely lepidote abaxially, pedicels cylindrical, 0.5–1 (–1.2) mm long. Staminate flowers 4–5-merous; calyx green, cotyliform, 0.8–1.2 mm long, lepidote without, glabrous within, the tube 0.3–0.4 mm long, the lobes ovate to deltate, 0.7–0.8 mm long,
0.5–0.8 mm wide, apically attenuate to a rounded tip, the margin lepidotely, inconspicuously brown punctate; corolla translucent green, chartaceous, campanulate, 2–2.6 mm long, the tube 0.6–1.2 mm long, glabrous or sparsely lepidotely externally, glabrous internally, the lobes ovate to narrowly ovate, 1.2–1.8 mm long, 0.5–1.1 mm wide, asymmetric, apically rounded or attenuate to a rounded tip, sparsely lepidotely externally, the scales not overlapping, sparsely glandular-granulose internally, inconspicuously brown punctate, the margin glandular-granulose; stamens 1.4–2 mm long, the tube chartaceous, conspicuous, longer than the corolla tube, 0.8–1.2 mm long, elobate, the apically free portions of the filaments 0.2–0.4 mm long, the anthers linear-lanceolate, 0.7–0.9 mm long, 0.2–0.3 mm wide, somewhat recurved distally, attenuate to a round or acute tip, the connective conspicuously brown punctate; pistillode obclaviform, 1–1.5 mm long, translucent glandular-lepidotely basally. 
Pistillate inflorescence: like the staminate but, 2–7 cm long; peduncle 0.1–0.2 cm long; floral bracts 0.7–1 mm long, 0.4–0.5 mm wide; pedicels 0.2–0.5 mm long. 
Pistillate flowers as in staminate but calyx 0.9–1.1 mm long, the tube 0.3–0.7 mm long, the lobes deltate, 0.5–0.6 mm long, 0.4–0.5 mm wide, apically subacute to obtuse; corolla 1.3–1.7 mm long, the tube 0.2–0.3 mm long, the lobes ovate, 1–1.4 mm long, 0.7–0.9 mm wide, apically obtuse; staminodes 1–1.2 mm long, the tube longer than the corolla tube, 0.3–0.4 mm long, the apically free portions of the filaments 0.2–0.3 mm long; the antherodes 0.6–0.7 mm long, 0.2–0.3 mm wide, pistil obnapiform, 1.3–1.4 mm long, 1–1.1 mm diam., the ovary 0.6–0.7 mm long, translucent glandular-lepidotely basally, the style 0.5–0.6 mm long, conspicuously brown punctate, the stigma punctiform, the placenta globose, ovules 3, apically exposed. Fruit subglobose, 0.3–0.8 mm long, 0.4–0.9 mm diam., the exocarp thin, black.

Distribution.—Amazonian Ecuador through Peru to Bolivia, at 122–1,500 m elevation.

Ecology and conservation status.—Cybianthus peruvianus occurs on the eastern slopes of the Andes in moist or wet lowland and premontane forests on white sands, especially in transition zones, where brownish sand-clay mixtures occur.

Etymology.—The epithet refers to the type locality, in (Moyobamba) Peru.

Local name.—Peru: “Tarrafa caspi.” (Quichua), “uchi yacushnum” (Aguaruna).

Representative specimens examined. ECUADOR. Napo: Cantón Aguarico, Reserva Faunística Cayabeno, Laguna Zancudo Cocha (Iripari), SE side of Laguna, 00° 33’ S, 75° 32’ W, 230 m, 28 Sep 1991 (fr), W. Palacios et al. 7761 (BRIT, MO, QCNE); Cantón Orellana, Sector Huashito, 20 km N of Coca, PALMORIENTE property, 00° 20’ S, 77° 05’ W, 250 m, 3–21 Nov 1989 (fr), E. Guidiño 137 (BRIT, MO, QCNE); Sendero to Palma Roja, 28 Apr 1986 (stam. fl), J. Jaramillo 8522 (QCA). Zamora-Chinchipe: Cantón Nangariza Campamento Miazi, along Río Nangaritza, 900 m, 19 Feb 1994 (fr), H. van der Wof et al. 13280 (BRIT, MO, QCNE); Hill above military post, 04° 18’ S, 78° 40’ W, 1,000 m, D. Neill & W.
Cybianthus peruvianus is most closely related to C. comperuviana Pipoly (herein described), but may be recognized by its longer, canaliculate petals, revolute leaf margins, shorter pedicels, asymmetric, lepidote corolla lobes, and linear-lanceolate anthers. Field studies near Iquitos have shown
Fig. 12. Cybanthus comperuvianus Pipoly. A. Habit, showing inflorescence of racemes or malformed panicles. B. Staminate flower and axillar bract, showing floral densely lepidote floral bract as long as pedicel, and lepidote calyx margins. C. Opened staminate flower, showing staminal tube longer than apical free portions of the filaments, lobes glandular-granulose adaxially and crenulate margins. A–C, drawn from holotype, by Linny Heagy.
it is a ridgetop species in the lowlands, with a density of approximately 2–4 individuals per hectare.

8. Cybianthus compervianus Pipoly, sp. nov. (Fig. 2E, 12). Type: BRA-ZIL. MATO GROSSO: Sta. Anna da Chapada, 1903 (stam. fl), G. Malme 3483 (holotype: S; isotypes: G, GH, R, S).

Cybianthus compervianus Agostini ex Pipoly in Killeen et al., Guia Arb. Boliv. 570. 1993. *nom. nud.* Agostini (1972) provided the first description of this species in his dissertation, but never published it. I subsequently annotated herbarium specimens with the name, fully intending to publish it, but it was still not validly published when it appeared in *Guia de Arboles de Bolivia*, without Latin description or reference to type. Presumably, the name was obtained by them based on herbarium determinations, and thus a *nom. nudum* and invalid. Validation of the name is indicated here, with the citation of holotype above and the Latin diagnosis, and accompanying description, provided below.

Species haec cum C. peruvianus saepenumero confusus est, sed laminis membranaceis (non coriaceis), secus margines planis (nec revolutis), petiolis marginatis (non canaliculatis) 0.5–1 (nec 1–1.5) longis, pedicellis 1.5–2.5 (non 0.7–1.0) mm longis, corollis staminaribus salverformibus (non campanularis) staminoscendis.

*Shrub or small tree* to 6 m tall. *Branchlets* angulate, 1.5–2 mm diam., densely lepidote. *Leaves* alternate; membranaceous, elliptic, narrowly elliptic, to obovate, 9–13(–17) cm long, 3–5(–6) cm wide, apically acuminate, basally acute, decurrent on the petiole, the midrib slightly depressed above, prominently raised below, pusticulate above, densely lepidote below, the secondary veins 20–30 pairs, the margin flat; petioles marginate, 0.5–1 cm long, densely lepidote. *Staminate inflorescence*: a raceme, rarely a malformed panicle with 2 branches from the base, 1–3 cm long; peduncle 0.1–0.5 cm long; floral bracts membranaceous, ovate, 1.3–1.5(–2.0) mm long, ca. 0.6 mm wide, subglabrous, sparsely lepidote above and densely lepidote below, apically acute, slightly shorter than or as long as the pedicels, entire; pedicels cylindrical, 1.2–2.5 mm long, sparsely lepidote. *Staminate flowers* whitish-green, 4(–5)-merous, membranaceous; calyx cupuliform, 1–1.2 mm long, the tube 0.3–0.6 mm long, the lobes triangular to deltate, 0.6–1 mm long, 0.5–0.7 mm wide, apically attenuate to a rounded tip, sparsely lepidote without, glabrous within, conspicuously brown punctate, the margin entire, sparsely ferrugineous-lepidote; corolla salverform, 2.2–2.6 mm long, the tube 1–1.2 mm long, the lobes ovate to ovate-triangular, 1.2–1.6 mm long, 0.8–1 mm wide, apically rounded or attenuate to a rounded tip, glabrous without, glandular-granulose throughout within, the margin minutely crenulate, glandular-granulose, conspicuously brown punctate; stamens 1.8–2.2 mm long, adnate 1.2–1.5 mm to corolla tube, staminal tube 1.6–1.9 mm long, elongate, longer than the apically free portions of the filaments 0.2–0.3 mm long, the anthers deltate to triangular, slightly distally curved, 0.7–0.8 mm long, 0.5–0.6 mm wide, apically apiculate, basally broadly cordate, the connective incon-
spicuously brown punctate; pistillode lageniform, 1.0–1.2 mm long, 0.3–0.4 mm wide, the ovary 0.4–0.5 mm long, densely translucent glandular-lepidote near base, the style 0.5–0.6 mm long, the stigma punctiform. *Pistillate* inflorescence as in stamineate but pedicel 1.5–2.5 mm long. *Pistillate flowers* as in stamineate but calyx 1.0–1.2 mm long, the tube 0.3–0.6 mm long, the lobes deltate, 0.6–1 mm long and wide, corolla, staminodes and pistil unknown. *Fruit* globose, 5–7 mm long, 6–8 mm diam.

**Distribution.**—Ecuador southward to Bolivia and adjacent Brazil, 400–1,200 m elevation.

**Ecology and conservation status.**—*Cybianthus comperuvianus* occurs in primary premontane forests on sandstone and limestone, in relatively sparse populations (testa collectore). Therefore, it should be considered threatened.

**Etymology.**—The specific epithet refers to the fact that *Cybianthus comperuvianus* has long been confused with *C. peruvianus*.

**Local name.**—Peru: “wewe” (Jivaro); “uchi apikna” (Huambisa); “Cumalilla” (Spanish).


Cybianthus conperuvianus was first recognized as a novelty by Agostini (1972). Despite the fact that over 25 years has past since its first recognition, pistillate flowers are still unknown, reinforcing the concept that the within the genus they are ephemeral (Pipoly 1983a, 1992). Cybianthus conperuvianus is most closely related to C. peruvianus but is easily distinguished by its long pedicels, salverform staminate corolla, and membranaceous leaves.


Shrub or tree to 7 m tall. Branchlets terete, 2–3 mm diam., densely lepidote. Leaves alternate; blades membranaceous to chartaceous, narrowly obovate to elliptic, symmetric, (8–)9–12(–18.5) cm long, 3–4.5(–5.7) cm wide, apically abruptly acuminate to caudate, the acumen 1–2 cm long, basally cuneate, decurrent on the petiole, midrib flat or slightly depressed on the upper surface, prominently raised below, the secondary veins 12–25 pairs, pubulate above, sparsely lepidote below, the margin flat; petioles canaliculate, 0.5–0.8(–1.5) cm long, densely lepidote. Staminate inflorescence: a raceme or panicle with 1–2 branches from base, 1–3 cm long; peduncle, rachis and pedicels densely lepidote; peduncle 0.1–0.2 mm long; floral bracts chartaceous, narrowly ovate, longer than the pedicels, 1.3–1.5 mm long, 0.2–0.3 mm wide, apically attenuate, densely lepidote abaxially; pedicels cylindrical, 1–1.2 mm long. Staminate flowers 4-merous; calyx carnose, subcupuliform, 1–1.2 mm long, sparsely lepidote without, glabrous within, the tube 0.3–0.4 mm long, the lobes triangular, 0.8–1(–1.2) mm long, 0.5–0.7 mm wide, apically attenuate to a rounded tip, conspicuously brown punctate, the margin lepidote;
corolla carnose, campanulate, 2.8–3.2 mm long, the tube 1.2–1.8 mm long, glabrous, the lobes ovate, 1.3–1.8 mm long, 0.8–1 mm wide, erect to spreading, apically attenuate to a round tip, prominently or conspicuously brown punctate, sparsely lepidote without, densely glandular-granulose on the upper half within, the margin entire, glandular-granulose; stamens 2.2–2.6 mm long, the staminal tube conspicuous, carnose, 1.2–1.6 mm long, lobate, the lobes to 0.2 mm long, the apically free portions of the filaments 0.4–0.6 (–7) mm long, the anthers triangular, 0.7–0.9 mm long, 0.4–0.5 mm wide, slightly distally recurved, dehiscent by narrow introrse slits, apically attenuate to an apiculate tip, basally cordate, the connective inconspicuously brown punctate; pistillode elongate, conic, 1.2–1.8 mm long, densely translucent glandular-lepidote basally. *Pistillate inflorescence* as in staminate but 1–3 cm long; floral bracts 1–1.3 mm long, ca. 0.2 mm wide; pedicels 0.6–0.9 mm long. *Pistillate flowers* as in staminate but calyx ca. 1 mm long, the tube 0.1–0.2 mm long, the lobes 0.8–1 mm long, 0.4–0.6 mm wide; corolla, staminodes and pistil unknown. *Fruit* subglobose, 4–6 mm long, 5–7 mm diam., exocarp thin, pellucid punctate.

**Distribution.**—Venezuela, Ecuador, Peru, Amazonian Brazil, and reported here for the first time from Bolivia, from 70–700 m.

**Ecology and conservation status.**—*Cybianthus guyanensis* subsp. *pseudoicacoreus* inhabits igapó forests of South-Central and Western Amazonia. It occurs in these forests on deep white sands just below the floodline. It is periodically inundated, but not for long periods. Quantitative fieldwork in Peru has shown it occurs in populations of 8–10 individuals > 2.5 cm DBH per hectare.

**Etymology.**—The subspecific epithet refers to the growth habit of the plant, somewhat reminiscent of *Ardisia* (subgenus *icacoreus*) *guyanensis* (Aublet) Mez.

Representative specimens examined. **ECUADOR.** Napo: Cantón Aguarico Reserva Etnica Huaroani, Maxus Oil Hwy., km 60–61, S of Río Tivacunco, 00° 51' S, 76° 26' W, 250 m, 21–25 Oct 1993 (fr), M. Anestra & J. Andi 925: Maxus Petroleum pipeline Rd., km 68, 10 km SW of Río Tivacunco, 00° 49' S, 76° 26' W, 240 m, 13 Dec 1993 (fr), D. Neill et al. 10303 (BRIT, MO, QCNE). (BRIT, MO, QCNE); Estación Experimental INIAP-Payamino, 5 km NE of Coca, 00° 26' S, 77° 01' W, 250 m, 18–26 Feb 1986 (fr), W. Palacios et al. 1049 (MO, NY, QCNE), (stam. fl), W. Palacios et al. 1050 (MO, NY, QAME), 00° 25' S, 77° 00' W, 250 m, 29 Nov 1986 (fr), D. Neill 7494 (MO, QAME); Parque Nacional Yasuní, Lagunas de Garza Cocha, shore of Río Garza, 01° 01' S, 75° 47' W, 200 m, 22 Sep 1997 (fr), C. Corón & N. Gallo 3063 (MO, QCNE), trail behind the house, 850 m, 27 Apr 1986 (fr), J. Jarantillo 8501 (QCA). **PERU.** Loreto: Prov. Maynas, Iquitos, G. Tesmann 3650 (NY), 100 m, 3–11 Aug 1929 (fr), E. Killip & A. C. Smith 27005 (F, NY, US); Mishuyacu, near Iquitos, 100 m, 1930 (stam. fl), G. Klug 1412 (F), Feb 1932 (fr), G. Klug 2565 (F, NY), 24 Sep 1929 (stam. fl), E. Killip & A. C. Smith 29871; Ddto. Alto Nanay, trail leading N from N end of Sta. María de Nanay, 5 Mar 1968 (stam. fl), D. Simpson & J. Schanke 784 (F, US); Ddto. Indiana, Explorama Lodge, halfway between Indiana and mouth of Río Napo, 03° 28' S, 72° 50' W, 130 m, 26 Jun 1983 (fr), A. Gentry et al. 42183 (AMAZ, MO), Far

**Cybianthus guyanensis** subsp. *pseudoicacoreus* is one of three subspecies. The species is defined by the autapomorphic contorted anthers of the stamens and staminodes (Pipoly 1992a). The three subspecies may be separated in the following key.

1. Leaf blades symmetric; calyx subcupuliform; corolla chartaceous or carnose, the lobes erect to spreading; apically free portions of the filaments shorter than the anthers; anthers narrowly triangular or ovate-triangular, apically apiculate, dehiscent by narrow, introrse slits.
   2. Petioles canaliculate and winged, (1–1.5–1.9–2.3) cm long; staminate peduncle 0.2–0.5 cm long; floral bracts shorter than the pedicels, 0.7–0.8 mm long; pedicels 0.5–1 mm long; corolla chartaceous, 2.3–2.6 mm long, the lobes elliptic; staminal tube 0.9–1.1 mm long; apically free portions of the filaments 0.2–0.4 mm long. .................................. subsp. **guyanensis**
   2. Petioles canaliculate, 0.5–0.8(–1.5) cm long; staminate peduncle 0.1–0.2 cm long; floral bracts longer than the pedicels, 1.3–1.5 mm long; pedicels 1–1.2 mm long; corolla carnose, 2.8–3.2 mm long, the lobes ovate; staminal tube 1.2–1.6 mm long; apically free portions of the filaments 0.4–0.6 (7) mm long .................................. subsp. **pseudoicacoreus**

1. Leaf blades asymmetric; calyx coryliform; corolla membranaceous, the lobes reflexed-recurved; apically free portions of the filaments longer than the anthers; anthers ovate, apically acute, dehiscent by wide, sublaxicorise slits.

................................................................. subsp. **multipunctatus**

**Cybianthus** subsp. *multipunctatus* (A. DC.) Pipoly is distributed in eastern Amazonia and the Guianas in premontane forests on lateritic and white sands of the Roraima Superimposed Sediments, while subsp. **guyanensis** is located principally in central Amazonia in igapó forests (Pipoly 1992a). Subspe-
Fig. 13. Cybianthus timorensis Pipoly. A. Habit, showing paniculate inflorescences. B. Branchlet apex. C. Adaxial leaf surface, showing midrib slightly raised but canaliculate. D. Abaxial leaf surface, showing lepidote scales and prominently raised midrib. E. Section of raceme, showing coriaceous, deltate floral bracts, coryliform calices, obcordate anthers with distally recurved apiculae. F. Pistillate flower bud. G. Pistillate corolla with one lobe removed, showing lageniform pistil and subsessile antherodes. A–E, drawn from holotype. F–G, drawn from Timand 1047. Figure drawn by Linda Ellis.
cies *pseudoicacoreus* is distributed south-central and western Amazonia, along banks of smaller streams on deep white sands. Subspecies *pseudoicacoreus* and *guyanensis* are sympatric only in central Brazilian Amazonia, and differences in their ecology are not known in sufficient detail. In Ecuador and Peru, subspecies *pseudoicacoreus* may be most easily confused with *C. comperruvianus* Pipoly, but may be recognized by the thicker branchlets, longer floral bracts, and carnosan perianth.

10. **Cybianthus timanae** Pipoly, sp. nov. (Fig. 13). **Type:** PERU. JuNÍN: Prov. Saripo, Gran Pajonal, Mapati, ca. 12 km SW of Chequitauco, 10° 45' S, 74° 23' W, 1,300 m, 7 Apr 1984 (stam. fl), D. Smith 6782 (holotype: MO; isotypes: BRIT, US, USM).

Proper ramulos graciles angulatos, laminas ellipticas vel ob lanceolatas, ad apices acuminatas ad bases acutas, inflorescentiam paniculatam, calycem coryliformem, necnon tubum staminarem staminodiaremque inconspicuo, *C. occignatensis* arcte affinis, sed ab ea nervis secundariis 16–40 (non 8–12)–jugis, perianthiiis chartaceis (non coriaceis), corolla coryliformi (non campanulata), lobis corollinis laevibus (non verrucosis), ad apices acuminatis (nect attenuatis), conspicue (nect inconspicue) atro–punctatis, pistilo lageniformi (nect obnapiformi) peracule separabilis.

Subshrub to 1 m tall. Branchlets angulate, 2–2.5 mm diam., densely lepidote. **Leaves** alternate; blades chartaceous, elliptic to ob lanceolate, (8–) 9.5–15(–19) cm long, (2.7–)3–5.5(–6.5) cm wide, apically abruptly acuminate, caudate, the acumen 1–2.2 cm long, basally acute, recurrent on the petiole, smooth and nitid above, pallid and moderately lepidote below, midrib slightly raised and canaliculate above, not recurrent on the petiole, prominently raised below, secondary veins 16–40, brochidodromous, planar to somewhat impressed above, not bullate, the margin flat, entire; petioles canaliculate, (1.3–)1.5–2(–2.2) cm long, glabrous above, densely lepidote below. **Staminate inflorescence** : a panicle of 2–8 racemes branched from base, (3–)4–6(–7) cm long; peduncle 3–7 mm long; rachis densely lepidote; floral bracts coriaceous, deltate, 0.6–0.8 mm long and wide, apically acute, somewhat cucullate, densely lepidote above and below, the margin entire; pedicels cylindrical, 1–2.5 mm long, densely lepidote. **Staminate flowers** 4–merous, cream; calyx chartaceous, coryliform, 0.7–1 mm long, the tube ca. 0.2–0.3 mm long, the lobes ovate–triangular, 0.5–0.7 mm long, 0.3–0.4 mm wide, apically acute, moderately lepidote, the margin entire, somewhat involute; corolla chartaceous, coryliform, 2–2.4 mm long, the tube ca. 0.2 mm long, the lobes ob lanceolate, 1.8–2.2 mm long, 0.8–1 mm wide, apically subacuminate, sparsely lepidote apically near margin, prominently black ponticate and punctate–lineate without, densely glandular–granulose throughout within, the margin glabrous, entire; stamens 1.4–1.6 mm long, the tube conspicuous, chartaceous, 0.1–0.2 mm long, eblate, the apically free portions of the filaments terete, 0.4–0.6 mm long, the anthers obcordate, 0.6–0.7 mm long, 0.3–0.4 mm wide, apically apiculate, anther and apiculum distally recurved,
the connective prominently black punctate dorsally; pistilode conic, 1.2—1.4 mm long, 0.3—0.4 mm wide, hollow, densely translucent glandular-lepidote. *Pistillate inflorescence* as in staminate, but (1—)1.5—3 cm long; peduncle 2—4 mm long; floral bracts 0.4—0.6 mm long and wide; pedicels obconic, 0.6—0.9 mm long, sparsely lepidote, conspicuously black punctate. *Pistillate flowers* as in staminate but translucent green; calyx 0.7—0.9 mm long, the tube ca. 0.2 mm long, the lobes 0.5—0.7 mm long, 0.3—0.4 mm wide, sparsely lepidote, corolla 1.2—1.5 mm long, the tube ca. 0.2 mm long, the lobes oblong to oblanceolate, 0.9—1.3 mm long, 0.4—0.6 mm wide, apically obtuse to subacuminate; staminodes 0.6—0.8 mm long, the tube conspicuous, chartaceous, ca. 0.1 mm long, the antherodes subsessile, 0.6—0.7 mm long, 0.3—0.4 mm wide; pistil lageniform, 1.2—1.4 mm long, 0.3—0.4 mm wide, hollow, densely translucent glandular-lepidote, the ovules 2—3, partially immersed on the placenta. *Fruit* slightly depressed-globose, 4.5—5.5 mm long, 5.5—7.5 mm diam., the exocarp thin, black at maturity.

**Distribution.**—Southeastern Ecuador to Cusco Peru, at 720—1,300 m elevation.

**Ecology and conservation status.**—*Cybianthus timanae* usually occurs in wet premontane forest on sandstone soils. The restricted distribution of *Cybianthus timanae* indicates it should be considered a threatened species.

**Etymology.**—The species is named for Martín Timán de la Flor, former Peruvian Field Associate of the Missouri Botanical Garden, and currently a graduate student at the University of Texas at Austin. Martín is specializing in the systematics of high altitude Caryophyllaceae.

**PARATYPES.** **ECUADOR.** Zamora-Chinchipe: Nangaritza Cantón; lower slopes of Cordillera del Cóndor, above Pachicúcuta, Río Nangaritza Valley, 04° 07' S, 78° 38' W, 1,000—1,200 m, 6 Dec 1990 (fr), D. Neill & W. Palacios 9556 (BRIT, MO, QCNE); Río Nangaritza, Shame, confluence of Rios Nangaritza and Numpatakaine, 04° 20' S, 78° 40' W, 1,000 m, 7 Dec 1990 (fr), D. Neill 9602 (BRIT, MO, QCNE); Pachicúcuta, Rd. to Hito, Cordillera del Cóndor, 04° 07' S, 78° 37' W, 1,000—1,100 m, 19 Oct 1991 (pist. fl bud), W. Palacios et al. 8346 (BRIT, COL, MO, QCNE), 20 Oct 1991 (stam. fl), W. Palacios et al. 8407 (BRIT, COL, MO, PORT, QCNE, USM); Parroquia Pachicúcuta, NE of military camp, 900 m, 6 Dec 1990 (fr), J. Jaramillo & E. Grajalva 13419 (COL, QCA). **PERU.** Cajamarca: Cutervo National Park, 12 km NE of San Andrés de Cutervo, Transect 3, 06° 10' S, 78° 40' W, 2,230 m, 10 Sep 1991 (ster.), A. Gentry *et al.* 74630 (BRIT, MO, USM). Cusco: Prov. Quispicanchi, Camaniti, Maniri, along trail parallel to Río Maniri to Quebrada Garrote, 15° 17' S, 70° 48' W, 720 m, 17 Oct 1990 (pist. fl), M. Timán 1047 (BRIT, CUZ, MO, US, USM).

*Cybianthus timanae* is most closely related to *C. occigranatensis* (Cuatrec.) G. Agostini, but may be easily separated by its more numerous secondary veins, chartaceous perianth parts, cotyliform corolla with smooth, conspicuously black punctate, acuminate lobes, and lageniform pistil. The involute calyx lobes and the obconic pedicels of the pistillate flowers are also extremely rare within the subgenus.
Fig. 14. *Cybianthus cuatrecasasii* Pipoly. A. Habit, showing irregularly shaped, basally branched panicles. B. Staminate flower, habit, showing coryliform calyx, infundibuliform corolla. C. Opened staminate flower, showing inconspicuous staminal tube and lageniform pistillode. D. Opened pistillate flower, showing obnapiform pistil and subsessile antherodes. A–C, drawn from holotype. D, drawn from A. Gentry et al. 53960. Figure drawn by Juan Pinzón.

11. *Cybianthus cuatrecasasii* Pipoly (Fig. 14), Caldasia 18(3):285. 1996.

**Type:** COLOMBIA. HUILA: Municipio La Plata, Vereda Agua Bonita, Finca Merenberg, cerca del Cementerio (Jardín Botánico), 22 Abr 1982 (stam. fl) J. H. Torres 1054 (HOLOTYPE: COL).

Dioecious tree to 6 m tall. Branchlets narrowly angulate, 3–4 mm diam.,
densely appressed-lepidote, the scale margins frequently overlapping. Leaves alternate; blades chartaceous, elliptic or oblanceolate, 8–20 cm long, 3.5–6.5(–6.9) cm wide, apically acuminate, the acumen (0.5–)1.0–1.5(–2.0) cm long, basally acute, slightly decurrent on the petiole, midrib impressed above, prominently raised below, the secondary veins 26–34 pairs, inconspicuous above, prominently raised below, sparsely lepidote above at first, then pustulate and glabrescent, densely appressed-lepidote below with margins fimbriate and overlapping, the blade margin flat, entire; petioles canaliculate, (1.0)1.3–1.7(–2.0) cm long, densely appressed-lepidote. Stamine inflorescence: an irregular panicle with 2–4 basal branches, 4–8 cm long; peduncle, rachis and pedicels densely lepidote; peduncle 0.1–0.4 cm long; floral bracts chartaceous, triangular, subequalling the pedicels, 1.2–1.5 mm long, ca. 0.6 mm wide, apically attenuate, densely lepidote below, the margin entire, glabrous; pedicels cylindric, 1.0–1.5 mm long. Stamine flowers 4-merous; calyx carnose, cotyliform, 1.3–1.4 mm long, the tube 0.2–0.4 mm long, the lobes triangular or ovate-triangular, 1.0–1.2 mm long, 0.6–0.9 mm wide, apically attenuate, conspicuously brown punctate, the margin entire, regular, with few scales; corolla chartaceous, infundibuliform, 3.0–3.5 mm long, the tube 1.2–1.3 mm long, the lobes ovate, 2.0–2.2 mm long, 1.0–1.2 mm wide, apically rounded, carinate medially, densely lepidote without and along the margins, glandular-granulose toward the apex and along the margins within, inconspicuously brown punctate, the margins regular, entire; stamens 2.5–3 mm long, the staminal tube membranaceous, inconspicuous, 1.2–1.3 mm long, hyaline, e lobate, glabrous, the apically distinct filaments adnate to the corolla lobe above the staminal tube 0.3–0.5 mm and apically free 0.1–0.3 mm, glabrous, the anthers ovate, 0.8–1.0 mm long, 0.5–0.6 mm wide, distally reflexed, apically apiculate, the apiculum slightly inflexed, basally cordate, the connective dark, eglandular; pistilode lageniform, 1.6–1.8 mm long, densely glandular-lepidote basally. Pistillate inflorescence: as in the staminate except a simple raceme, 4.4–10 cm long; peduncle 0.2–0.5 cm long; floral bracts lanceolate, 1.2–1.5 mm long, 0.3–0.4 mm wide; pedicels 0.7–1.3 mm long, incrassate in fruit. Pistillate flowers similar to the staminate except calyx 1.4–1.7 mm long, the tube 0.2–0.4 mm long, the lobes ovate, 1.3–1.5 mm long, 0.6–1.2 mm wide; corolla 3.5–4.0 mm long, the tube 0.9–1.1 mm long, the lobes elliptic, 2.7–3.1 mm long, 0.9–1.3 mm wide, apically acute; staminodes similar to stamens but 3.0–3.2 mm long, the staminodial tube 1.0 mm long, the apically free portion of the filaments adnate to corolla lobes 1.3–1.5 mm and apically free ca. 0.1 mm, the antherodes subdeltate, 0.8–1.1 mm long and wide, (always longer than wide), apically acute, basally sagittate; pistil obnapiform, 1.8–2.0 mm long, the ovary 0.9–1.0 mm long, 1.2–1.5 mm diam., densely translucent glandular-lepidote, the style 0.9–1.1 mm long, the stigma bilobate, not capitate, the placenta deeply cupuliform,
Cybianthus cuatrecasasii is unique within subgenus Conomorpha because of its infundibuliform corolla and subapical portions of the filaments adnate to the corolla lobe. The overlapping covering scales of the abaxial leaf surface, branchlets and inflorescence rachis is found otherwise only in Cybianthus crotonoides (Mez) G. Agostini, a species endemic to the Guayana Highland. This species has been confused with Cybianthus peruvianus (Mez) G. Agostini,
but is easily separated from it by the infundibuliform corolla, long pedicels and eglandular connectives. *Cybianthus cuatrecasasii* is closely related to *C. laetus* (Mez) G. Agostini and *C. occigranatus* (Cuatrec.) G. Agostini, from which it is easily distinguished by its infundibuliform corolla, apical portions of the filaments adnate to the corolla and lack of lobes on the staminal and staminodial tubes.


Terrestrial dioecious shrubs or small trees. Roots positively geotropic. Trunk distinguishable, leptocaulous, the growth dynamics following Rauh’s Architectural Model (Halle et al. 1978). Branchlets tomentose, with dendraid or stellate ferrugineous trichomes or both. Cataphylls and pseudocataphylls absent. Leaves alternate, petiolate, tomentose, glabrescent. Inflorescence a simple raceme or rarely a spike, the peduncle 0.1–0.5 cm long, the staminate racis tortuous or lax, the pistillate rigid and erect or rarely lax. Flowers 4- or 5-merous; calyx coryliform, valvate, epuncate, inconspicuously pellucid or conspicuously brown or orange punctate, glabrous, tomentose, or glandular-granulose, rarely bearing translucent glandular scales, the margins glandularciliate; corolla campanulate, the lobes valvate, glandular-granulose only along margins without, but over the entire surface within, epuncuate or inconspicuously pellucid or conspicuously brown or orange punctate, and punctate-lineate, medially and basally glabrous, glandular-granulose or with a few stellate trichomes; stamens and staminodes with filaments basally connate into a conspicuous or inconspicuous tube, the tube elobate or bearing small lobes alternate with the apically free filaments, the anthers elongate, triangular, distally curved, rarely erect, dorsifixed 1/4–1/2 from base, acutely cone, basally cordate, dehiscent by wide longitudinal slits; staminodes resembling stamens but reduced in size, the sterile anthers without pollen or at times producing abortive pollen; pistil obnariiform, the ovary translucent glandular-lepidote, the style short, truncate with a punctiform stigma; pistillode lageniform, the ovary translucent glandular-lepidote, hollow the style elongate and curved apically, the nonfunctional stigma capitate. Fruit drupaceous, one-seeded, the exocarp thin.

*Cybianthus subgenus Laxiflorus* contains 6 species, 3 of which have been recorded from Peru. To date, none are known from Ecuador, but we may expect *Cybianthus spicatus* (Kunth) G. Agostini in sandstone areas in the Cordillera del Cóndor area.
KEY TO SPECIES OF CYBIANTHUS SUBGENUS LAXIFLORUS

1. Inflorescence rachis black punctate; calyx lobes coriaceous, deltate, medially carinate, basally rugose; fruit depressed-globose, broader than long; large trees to 18 m tall, *terra firme* "varillal seco" [dry, on white sand] forests.

12. *C. nestorii*

1. Inflorescence rachis epunctate; calyx lobes chartaceous, widely to narrowly ovate-triangular, medially thickened but flat; basally smooth; fruit globose, as broad as long; shrubs or small trees to 10(–12) m tall; riparian gallery forests, either periodically flooded (várzea or igapó) or "varillal húmedo" [wet, white or brown sand] forests.

2. Leaf blades chartaceous, the tertiary veins prominently raised above; calyx lobes longer than broad; staminal and staminodial tubes inconspicuous; receptacle or pedicel or both enlarged in fruit; seasonally inundated forests (várzea or igapó) ........................................ 13. *C. spicatus*

2. Leaf blades coriaceous, the tertiary veins not visible from above; calyx lobes broader than long; staminal and staminodial tubes conspicuous; neither receptacle nor pedicel enlarged in fruit; forests with poor drainage on sand, but non-inundating, ("varillal húmedo") ...........

14. *C. fulvopulverulentus* subsp. magnoliifolius

12. *Cybianthus nestorii* Pipoly, sp. nov. (Fig. 15). **Type:** PERU. LORETO; Prov. Maynas, Mishana, on Río Nanay, 03° 55' S, 73° 35' W, 150 m, 20 Jan 1985, **R. Vásquez & N. Jaramillo 6122** (holotype: MO; isotypes: AMAZ, F, NY, US, USM).

*Ob folia coriacea, rhachides inflorescentiariis atro-punctato-lineatos, lobis calycinis deltatis inter se aquilatos coriaceosque, C. delato valde arce affinis sed ab ea habitu arboreo (non fruricoso) usque ad 18 (non 3) m, laminis anguste elliptricis vel anguste oblanceolatis vel anguste oblongis (non obovatis) 9.5–18(–28), (nce 3.2–4.4) cm longis, 3.2–4.6 (nce 1.7–2.8) cm latis, inflorescentiis 5–7 (non 1–4.2) cm longis, lobis calycinis 1.8–2 (non 1.3–1.7) mm longis, carinatisque (nce planisque) denique secus marginem minute erosis (nce undulatis), statim separatibils.*

*Tree* to 18 m tall. *Branchlets* terete, 5–7(–15) mm diam., appressed ferrugineous dendroid tomentose. *Leaves* alternate; blades thinly coriaceous, narrowly elliptic to narrowly oblanceolate, rarely narrowly oblong, (9.5–)11.5–14(–18) cm long, (3.2–)4–6 cm wide, apically obtuse, emarginate, rounded or acute, basally acute to attenuate, decurrent on the petiole, glabrous and nitid above, glabrous and nitid but pallid below, midrib slightly raised above, prominently raised below, decurrent through length of petiole above and below, the secondary veins (14–)20–47 pairs, prominulous (slightly raised) above and below, inconspicuously pellucid punctate and punctate lineate below, the margin entire, glabrous, revolute; petioles marginate, (2.2–)2.5–3.2(–3.7) cm long, glabrous. *Staminate inflorescence* unknown. *Pistillate inflorescence* an erect raceme, 5–7 cm long, the rachis black punctate-lineate, ferrugineous glandular-granulose, glabrescent; floral bracts coriaceous, linear, minute, 1–1.1 mm long, 0.2–0.3 mm wide, apically acute, densely glandular-granulose below, glabrescent, the margin glandular-cili-
Fig. 15. *Cybianthus nestorii* Pipoly. A. Habit, showing depressed-globose fruits and leaf blades with prominent secondary veins and revolute margins. B. Portion of infructescence, showing depressed-globose fruit and carinate, rugose calyx lobes with erose, sparsely glandular-ciliolate margins. C. Abaxial leaf surface, showing prominently raised midrib and prominent secondary veins. D. Branchlet apex, showing appressed dendroid tomentum. A–D, drawn from holotype, by Linda Ellis.
ate; fruiting pedicels cylindrical, 2–4 mm long, densely glandular-granulose, minutely black punctate apically. *Pistillate flowers* unknown; fruiting calyx coriaceous, 1.8–2 mm long, the tube 0.3–0.5 mm long, the lobes deltate, 1.3–1.6 mm long, 1.4–1.7 mm wide, apically acute, medially carinate, rugose basally, the margin minutely erose, sparsely glandular-ciliolate; corolla, staminodes and pistil unknown. *Fruit* depressed-globose, 4–6 mm long, 6–8 mm diam., black at maturity, inconspicuously pellucid punctate.

**Distribution.**—Known only from the Río Nanay Drainage Basin, Maynas Province, Department of Loreto, Peru, at 150 m elevation.

**Ecology and conservation status.**—*Cybianthus nestorii* occurs in “varillal seco” habitats, consisting of tall *terra firme* (non-inundating), relatively dry forest on deep white sands. It is a rare species and thus, should be considered threatened.

**Etymology.**—It is a pleasure to dedicate this species to Nestor Jaramillo, of Iquitos, Peru, prodigious collector, and authority on plant collecting in tropical forests. Nestor, with his supervisor, Rodolfo Vásquez, form one of the most formidable botanical exploration teams in South American botany.

**Paratypes:** PERU. Loreto: Prov. Maynas, Drt. Iquitos, Puerto Almendras, UNAP, Tree No. 324, Tree inventory, 03° 48’ S, 73° 25’ W, 122 m, 17 Jan 1993 (ster.), C. Grández. N. Jaramillo et al. 5321 (BRIT, MO, UNAP), Tree No. 373 (ster.), C. Grández. N. Jaramillo et al. 5370 (BRIT, MO, UNAP, USM); Tree No. 651 (ster.), C. Grández. N. Jaramillo et al. 5642 (BRIT, MO, UNAP).

*Cybianthus nestorii* is unique within the subgenus because of its autapomorphic depressed-globose fruits and carinate calyx lobes. Other characters which readily separate it from its closest relative, *Cybianthus deltatus* Pipoly, of the Río Guainía drainage basin of Venezuela, include its much larger arborecent habit, larger elliptic to narrowly oblanceolate leaves, longer inflorescences, and longer, minutely erose calyx lobes.


*Conomorpha laxiflora* var. *latifolia* Miq. in Mart., Fl. Bras. 10:303. 1856. *Conomorpha latifolia* (Miq. in Mart.) Mez in Engl., Pflanzenr. IV. 256(Heft 9):255. 1902. **Type:** VENEZUELA.
Shrub or small tree to 12 m tall. Branchlets thin to moderately thick, (3.5–) 4–8–(20) mm diam., appressed to floccose-dendroid and stellate ferrugineous tomentose, the stellate hairs often appearing furfuraceous, glabrescent. Leaves alternate; blades thinly coriaceous to chartaceous, to membranaceous, ovate, elliptic, obovate or rarely oblanceolate, (4.5–)6–17.5(–21) cm long, 2.9–8(–11.5) cm wide, apically acute, rounded, obtuse or rarely emarginate, basally acute to cuneate, glabrous, pubulate and often nitid above, sparsely ferrugineous puberulent and minutely glandular-lepidote below, the midrib, secondary and tertiary veins prominently raised above and below, the midrib decurrent to the base of the petiole, pellucid or black punctations obscure below, the margin slightly revolute, entire; petioles distinctly marginate, (1–)1.5–3.2(–4) cm long, stellate and dendroid ferrugineous tomentose, early glabrescent. Stamine inflorescence: a simple raceme, lax, (3–)6–9(–12.5) cm long, the rachis pubescent, glandular-granulose with scattered stellate and dendroid ferrugineous trichomes, glabrate; floral bracts chartaceous, linear-lanceolate, 0.7–1.7(–2.2) mm long, densely ferrugineous tomentose, early caducous; pedicels cylindrical, 0.9–2.1(–3) mm long, glabrous to densely glandular-granulose. Stamine flowers (4–)5-merous, chartaceous, cream to yellow, with a sweet odor; calyx shallowly cotyliform, 1.5–2.5 mm long, the tube 0.3–0.6 mm long, glandular-granulose at first, glabrescent, the lobes ovate or ovate-triangular, (1.2–)1.4–2 mm long, 0.9–1.3 mm wide, acute to abruptly acuminate apically, somewhat cordate basally, prominently thickened medially, conspicuously punctate, the margins mostly entire, but occasionally erose apically, glandular-ciliate; corolla campanulate, 3.6–4.8 mm long, the tube 1–1.2 mm long, the lobes ovate, 2.1–3.4 mm long, 1.2–
2.6 mm wide, slightly reflexed at anthesis, obtuse to acute apically, epunctate or conspicuously brown punctate; stamens 1.6–2.2 mm long, the tube membranaceous, inconspicuous, 1–1.5 mm long, the apically free portions of the filaments 0.3–0.55 mm long, the anthers elongate-triangular, 0.7–1.2 mm long, 0.2–0.3 mm wide, dorsifixed ca. 1/3 from base, apically acute, basally cordate, distally recurved, the connective inconspicuously brown punctate; pistillode lageniform, 1.3–1.8 mm long, the ovary 0.6–0.9 mm long, 0.5–0.75 mm diam., densely translucent glandular-lepidote, the style elongate, 0.8–1.3 mm long, slightly curved apically, the stigma capitate, 0.1–0.2 mm long. **Pistillate inflorescence** as in staminate, erect, (3.3–)4.5–13(–17.5) cm long; floral bracts 0.5–2.4 mm long; pedicels 1.3–1.8 mm long, accrescent in fruit to 3.1 mm long, the receptacle or pedicel or both incrassate in fruit. **Pistillate flowers** as in staminate but chartaceous, yellow; calyx cotyliform, 1.3–1.9 mm long, the tube 0.6–0.9 mm long, the lobes widely to narrowly ovate, 1.1–1.7 mm long, 0.9–1.5 mm wide, erect, sparsely brown punctate, prominently thickened below, the margins entire or occasionally erose apically; corolla 2.7–3.5 mm long, the tube 0.7–0.9 mm long, the lobes 1.6–2.7 mm long; staminodes as in stamens but 1.6–2.1 mm long, the tube chartaceous, conspicuous, 0.7–1.1 mm long, the apically free portions of the filaments 0.3–0.5 mm long, the antherodes 0.6–0.9 mm long, 0.2–0.3 mm wide, at times producing abortive pollen; pistil obnapiform, 1.6–2.2 mm long, the ovary 0.8–1.2 mm long, 0.9–1.2 mm diam., densely translucent glandular-lepidote, the placenta cupuliform, ovules 4, partially imbedded, the stigma capitate, 0.1–0.2 mm long. **Fruit** globose, 2.5–6 mm long and in diam., prominently black punctate-lineate, with a few persistent lepidote glandular scales below the usually persistent style base, green then purple, then black.

**Distribution.**—Venezuela, Colombia, Peru, Brazil and Guyana, in inundated forests (várzea and igapó), from 100–400 m.

**Ecology and conservation status.**—**Cybianthus spicatus** is restricted to primary riparian habitats on white sandy soils. It is common in igapó and várzea, but the latter only when sufficient quantities of sand exist, a mixed várzea type. While it is a widespread species, it is sensitive to soil compaction, and should be considered threatened.

**Etymology.**—The epithet refers to the inflorescence shape, which is a raceme bearing flowers on short pedicels, thus appearing spicate.

Representative specimens examined. **PERU.** Huánuco: Cerros del Sirá, SW slope of the Río Lulla Pichis, 1190 m, 12 Jul. 1969 (fr), J. Wolfe 12295 (F, NA); 100 m, 22 Jul 1969 (fr), T. Dudley 13124 (F, NA); Prov. Pachitea, region of Pucallpa, W part of Sirá Mountains and adjacent lowland, ca 24 km SE to 26 km ESE of Puerto Inca, next to Campamento Pato Rojo, 09° 27' S, 74° 46' W, 1,000 m, 27 Jan 1988 (pist. fl), W. Morawetz & B. Wallnöfer 12-27188 (BRIT, MO, W, WU), 1,320 m, 1 May 1988 (fr), B. Wallnöfer 111-1588 (BRIT, W, WU), 1,230 m, 13 Jun 1988 (fr), B. Wallnöfer 112-13688 (BRIT, W, WU). San Martín:
Lamas, on old trail from San Antonio de Cumbasa, S of Shapajilla, upper slopes of Cerro Isco, 06° 22' S, 76° 23' W, 600—800 m, 5 Oct 1986 (bud), S. Knapp et al. 8514, (fr), S. Knapp et al. 8517 (MO, US, USM).

Cybianthus spicatus is a polymorphic ochlospecies, sensu White (1962), Prance (1972) and Pipoly (1983a), with many semi-isolated populations throughout the Amazon and eastern Guayana Floristic Province (Maguire 1979). These localized populations have produced several seemingly distinct ecotypes, resulting in overdescription. Collections of Cybianthus spicatus from Peru match the type of Conomorpha gracilis A. C. Smith, described from Guyana, in every detail. Fieldwork conducted in Guyana, Venezuela, Brazil and Peru since my earlier treatment (Pipoly 1983a), where I discuss the four ecotypes present within the species, and the synonymy rationale, has confirmed the concept that Cybianthus spicatus is a polymorphic ochlospecies.

Steyermark (1981) discussed the fact that Richard Schomburgk's collections attributed to Guyana are now known to be from Venezuela.


Conomorpha rigida Mez, Repert. Spec. Nov. Regni Veg. 16:420. 1920. syn. nov. TYPE: BRAZIL, AMAZONAS; "Hylaea," without date (fr), E. Ule 8722 (HOLOTYPE: B-desr., F Neg. 4831). Despite searches of herbaria housing significant Ule collections, no duplicates of the type have been located. Therefore, I select a neotype herewith: TYPE: GUYANA [BRITISH GUIANA]. Orealla Savanna, Corentyne River, Sep 1879 (fr), E. Imbrian B 9 (NEOTYPE here designated: K; ISOTYPE: BRG). The neotype was annotated by Mez in 1901, but was not mentioned in the protologue.

Shrub or tree to 10 m tall. Branchlets mostly thick, (3—)5.2—12 mm diam., glabrate or densely stellate and dendroid ferrugineous tomentose and glandular-granulose, at times glabrescent. Leaves alternate, at times clustered and approaching pseudoverticillate; blades coriaceous, elliptic, oblanceolate, ovate or obovate, 7.2—21.7 cm long, (2.2—)3.6—9.5(—17.1) cm wide, apically obtuse, acute, rounded or emarginate, basally obtuse to acute (rarely acuminate), sparsely pitted with superimposed glandular lepidote scales and glabrous or glandular-granulose, at times sparsely ferrugineous tomentose above and below, glabrescent, punctate, the margin entire and revolute; petioles marginate, (1.3—)1.6—4.2(—4.6) cm long, ferrugineous tomentose, and glandular-granulose, glabrescent. Staminate inflorescence: a simple, tortuous raceme, rarely lax, (3.6—)4.5—15 cm long, the rachis maroon, opaque, glandular-granulose or with a few scattered dendroid ferrugineous trichomes, glabrescent; floral bracts chartaceous, linear-lanceolate, 0.8—3.6 mm long, ca. 0.1—0.2 mm wide, densely ferrugineous tomentose, caducous; pedicels cylindrical, (0.2—)2.9—3.6 mm
long, densely glandular-granulose, glabrescent. **Staminate flowers** 4- or 5-merous, chartaceous, white, cream or yellow; calyx deeply cotyliform, 0.9–2.6 mm long, densely glandular-granulose then glabrescent, the tube 0.3–0.7 mm long, unequally divided, the lobes chartaceous, ovate to ovate-triangular, 0.6–1.9 mm long, 1.1–2.4 mm wide, obtuse to acute or acuminate apically, prominently orange punctate, densely ferrugineous tomentose and ferrugineous glandular-granulose or partially glabrescent or ferrugineous glandular-granulose and then sometimes totally glabrescent, the margins extremely undulate, entire, densely glandular-ciliate; corolla campanulate, (2.8–)3.3–4.7(–5.5) mm long, the tube (0.6–)0.9–1.4(–1.7) mm long, the lobes ovate, (2–)2.2–3.1(–4) mm long, (1.2–)1.5–2.4(–2.8) mm wide, the lobes highly reflexed at anthesis, obtuse to acute apically, conspicuously orange punctate and punctate-lineate, at times scattered ferrugineous trichomes before anthesis without, the margin entire; stamens (2.4–)2.8–3.4 (–3.8) mm long, the staminal tube 0.8–1.1 mm long, the apically free portions of the filaments 0.6–0.9 mm long, the anthers elongate-triangular, (0.8–)1–1.4 mm long, apically acute, basally cordate, dorsifixed ca. 1/4 from base, distally recurved or rarely and aberrantly erect; pistillode (1.6–)1.9–2.5 mm long, the ovary 0.7–1.1 mm long, 0.7–1.2(–1.4) mm diam., densely translucent glandular-lepidote, the style elongate, curved, 1–1.6 mm long, the stigma 0.1–0.2 mm long. **Pistillate inflorescence** as in stamineate but erect (3–)4–11.4 cm long, the rachis green then red; floral bracts 0.7–2.9 mm long, ca. 0.1–0.2 mm wide; pedicels cylindrical, (0.2–)0.6–1.5(–2) mm long. **Pistillate flowers** as in stamineate but dull yellow to brown; calyx 1.2–2.6 mm long, the tube 0.4–0.7(–1) mm long, the lobes 0.7–2 mm long, 1.3–2.4 mm wide; corolla (2.7–)3.2–3.5(–4) mm long, the tube 0.6–1.2 mm long, the lobes 2–2.3(–2.6) mm long, 1.1–1.5 mm wide; staminodes as in stamens but 2.4–2.9 mm long, the staminodial tube 0.7–0.9 mm long, the apically free portions of the filaments 0.7 mm long, the antherodes triangular, 0.6–0.9 mm long; pistil obnapiform, 1.9–2.5(–3) mm long, the ovary (0.7–)0.9–1.6 mm long, (0.7–)1.3–1.7(–2.2) mm diam., densely translucent glandular-lepidote, the style thick, (0.4–)0.6–0.9(–1.3) mm long, the stigma pseudocapitate, very minutely 4-lobed, up to 0.3 mm long. **Fruit** globose, 3–9 mm long and in diam., green, then red, then black, in conspicuously pellucid punctate.

**Distribution.** —Venezuela, Guyana, Surinam, French Guiana, Brazil (Amazonas, Roraima, Pará, Mato Grosso) and reported here for the first time from Peru and Bolivia 50–500(–850) m.

**Ecology and conservation status.** —**Cybianthus fulvopulverulentus** subsp. *magnoliifolius* is extremely common in wet tepui savannas, but is rare in Peru in varillal humedo (wet sandy, non-inundating) habitats. It is anticipated, but has not yet been collected, in Ecuador.

**Etymology.** —The epithet, ‘fulvopulverulentus’ refers to the rusty tomen-
tum of the species, forming a powdery like vestiture on the adaxial leaf surface, caducous as the leaf matures. The subspecific epithet refers to the shape and shiny adaxial leaf surface, giving the general impression of a *Magnolia* leaf.


Specimens cited here are the first known from Peru and Bolivia. Those collections represent remarkable disjunctions, the closest population known heretofore occurring approximately one degree north of the Rio Negro in southern Venezuela near the Brazilian frontier, or halfway across Brazil to the east, on Serra do Cachimbo, state of Mato Grosso. To date, no specimens are known from Ecuador.

In my previous treatment (Pipoly 1983a), I included *Comomorpha rigida* in the synonymy of *Cybianthus fulvopulverulentus* (Mez) G. Agostini subsp. *fulvopulverulentus*. The type at Berlin had been destroyed and I synonymized it based on the description and photo. However, the discovery of two duplicates of the Imthurn gathering annotated by Mez permitted neotypification of the name with the Kew specimen and its inclusion here. Populations represented by this collection differ from the type of subspecies *magnoliifolius* only in their diminutive stature and vegetative parts.


Terrestrial, erect, monoaxial *subshrubs* or *treelets* to 2(–)5 m tall. Roots positively geotropic. Bark mostly brown, smooth, longitudinally fissured or transversely checked. Trunk distinguishable, leptocaulous, monoaxial, following morphogenetic dynamics of Corner’s Architectural Model (Hallé et al. 1978), growth rythmic. Stems terete distally, sparingly to densely glandular-papillate, at times with rufous hydropotes or orange glandular lepidote scales, without lenticels. *Cataphylls* alternate or pseudoverticillate, alternating with pseudoverticils of leaves, or apparently axillary to them, linear-subulate to acicular, rigid to membranous, keeled or flat, prominently punctate or punctate-lineate, glabrous, glandular-papillate, bearing hydropotes, or orange lepidote scales. Leaves pseudoverticillate or alternate, apically acute to rounded, often mucronulate, basally symmetric or asymmetric, acute, obtuse, or ta-
pering, rarely auriculate, the venation camptodromous, to brochidodromous, apically acute or attenuate to rarely rounded, mucronulate or not, basally acute, cuneate, or rarely obtuse, at times subauriculate, symmetric or asymmetric, black or pellucid punctate, bearing hydropoten, at times with orange glandular lepidod scales or glandular papillae, the margin opaque or scarious, entire, subentire, undulate and sparse dentate or pectinate-dentate, flat or inrolled, the teeth vascularized or not; petioles pulvinate (basally swollen), canalicate, except rarely marginate distally. Inflorescence pinnately to tripinnately paniculate, (rarely reduced to a pseudoraceme), pyramidal to columnar, the branches spicate or racemose (rarely glomerate); inflorescence bract linear-subulate, indistinguishable from the cataphylls; branch bracts membranous, linear, subulate; floral bracts linear-lanceolate, subulate, subtending or rarely on the pedicel, variously punctate, glandular-papillate or glabrous; pedicels terete, thin, or obsolete. Flowers unisexual or bisexual, 4–5(–6)-merous, homomorous or heteromorous; calyx coteiform, at times unequally divided, the lobes valvate, spreading, linear-subulate or rarely subdeltate, apically acute, attenuate or rarely premorse, pellucid to black punctate, the margin entire or erosive-serulate, glabrous or glandular-ciliate; corolla rotate to subrotate, the lobes valvate, linear-subulate, apically acute, rounded or attenuate, essentially glabrous without, densely glandular-granulose throughout within, pellucid or black punctate, the margin irregular, entire; stamens and staminodes similar, the staminodes reduced in size, partially connate to form a conspicuous or inconspicuous tube, at times bearing lobes alternating with apically free filaments, the tube adnate to the corolla, at times so as to mimic epipetalous stamens, the apically free portions of the filaments terete or flat, glabrous or glandular-granulose, the anthers dorsifixed, as wide or wider than long, apically rounded, obtuse or emarginate, basally cordate to deeply cordate, dehiscent by wide longitudinal slits; pistillode lageniform, clavate or conic, hollow, or entirely absent; pistil obpyriform, subglobose, obturinante or clavate, the ovary terete, sparsely to densely translucent glandular lepidod, glandular-papillate or glabrous, the placenta umbonate, 2–3(–4)-ovulate, the ovules immersed in the placenta ca. 1/2 their length, the style short or vestigial, the stigma large, capitate, the margin lacinate, the lacinae with large lobes, the stigma early caducous. Fruit globose to depressed-globose, the exocarp sometimes fleshy, the mesocarp and endocarp stony, black or pellucid punctate, one-seeded, the testa corrugate, the embryo cylindrical, transverse.

Distribution.—From the Darién of Panama southward through the Andes of Colombia, Ecuador, Peru and Bolivia to Rondônia, Brazil, at elevations of sea level–2,200 m elevation.

Ecology.—Members of Cybianthus subgenus Comomyrsine occupy the forest floor, growing in sheltered areas under cliffs, and in other shady areas. The monoaxial stems are weak and break easily when trampled. They are
extremely sensitive to soil compaction and occur mostly in areas where leaf litter accumulates.

Pipoly (1987) demonstrated that *Cybianthus* subgenus *Comomyrsine* is most closely related to subgenus *Triadophora* by the monaxial habit. The cataphylls of *Comomyrsine* without petiolar structures, as opposed to the petiolate pseudocataphylls found in subgenus *Triadophora*, serve to further distinguish *Comomyrsine*. Likewise, the caducous, oversized stigma with lacinate lobes is unique to subgenus *Comomyrsine*. The subgenus contains 8 species, of which 7 occur in Ecuador and Peru.

KEY TO SPECIES OF *CYBIANTHUS* SUBGENUS *COMOMYRSINE*

1. Leaves 5.7–29 cm long; stems less than 1 cm diameter.
2. Stems apices bearing orange hydropotes; leaf blades linear-lanceolate, 1.6–4.0 cm wide, the margin repand to undulate; petioles 0.6–1.0 cm long; inflorescence pseudoracemose, the flowers glomerulate. 15. *C. verticalloides*
3. Stems apices bearing rufous glandular-papillae or with rufous hydropotes; leaf blades ovate, obovate, oblanceolate, elliptic, or oblong, (4.0–), 10–22(–30) cm wide, the margin regular, entire or minutely straight-serrulate; petioles (1.0–)1.5–5(–21) cm long; inflorescence pyramidal-bipinnate paniculate, or a columnar thyrsoid panicle; never a pseudoraceme, the flowers spicate, corymbose, or rarely cymose.
4. Stems apices sparsely glandular-papillate, bearing rufous hydropotes; leaf bases broadly rounded, the margins scarious; petioles progressively longer acropetally along the stem, 2.0–4.5 cm long; inflorescence paniculate, the flowers corymbose; pedicels 1.0–2.5 mm long; sepals deltate; petals cucullate apically, the margin glandular-granulose; filaments glabrous. 16. *C. croatii*
5. Stems apices densely glandular papillate, without hydropotes; leaf bases acute, to acute with a rounded base, the margins opaque; petioles subequal along stem, slightly shorter acropetally, 1.6–2.0 cm long; inflorescence pinnately paniculate, the flowers spicate or racemose; pedicels absent; sepals ovate-lanceolate; petals flat, the margin glabrous; filaments glandular granulose. 17. *C. humilis*

1. Leaves (16–)31–105 cm long; stems 1–5 cm diameter.
2. Leaves oblong to elliptic, apically rounded or rarely acute, not mucronulate, basally abruptly acute to broadly rounded; petioles (2.5–)5 cm long; flowers homomeros, 4– or 5-merous.
3. Shrub or tree to 5 m tall; inflorescence a pyramidal panicle, the branches spicate, the flowers sessile to subsessile; leaf base symmetric; cataphylls (2.5–)3.5–5.0 cm long. 18. *C. sprucei*
4. Semi-woody shrubs to 1(–3.5) m tall; inflorescence a columnar, thyrsoid panicle, the branches racemose, the flowers on pedicels 2.3–5.0 mm long; leaf base asymmetric; cataphylls 0.6–2.5 cm long. 19. *C. simplex*
5. Leaves chartaceous, 31–55 cm long, the margin flat, entire; cataphylls
6. Leaves chartaceous, 31–55 cm long, the margin flat, entire; cataphylls

Shrub to 1 m tall. Stem terete, 5–8 mm diam., sparingly rufous glandular-papillate and bearing orange hydropotes, early glabrescent, the bark horizontally checked. Cataphylls chartaceous, subulate, (1.2—)1.5—2.1 mm long, 0.9–2.1 mm wide, flat, apically long-attenuate, basally somewhat decurrent, sparingly glandular-papillate and orange lepidote above and below, black punctate. Leaves pseudoverticillate; blades chartaceous, linear-lanceolate, 12–20 cm long, 1.6–4.0 cm wide, apically long-attenuate, basally acute, greyish-green above and pallid green below when fresh (teste Cuatrec.), sparingly rufous glandular-papillate and orange lepidote above and below at first, persistent only below, inconspicuously pellucid-punctate, midrib planar above, prominent below, the secondary veins 8–12 pairs, prominent below, the margin inrolled except revolute basally, undulate to a vascularized blunt tooth at nerve end, translucent throughout its length but not scarious; petioles canaliculate, 0.6–1.0 cm long, 0.5–1.0 mm diam., glabrous, swollen basally at point of attachment. Stamine Inflorescence: a pseudoraceme, 10–12 cm long; peduncle ca. 1 cm long, the rachis glandular-papillate, the flowers glomerulate; inflorescence branch bracts membranous, subulate, 5.5–7.0 mm long, 1.2–2.0 mm wide, minutely glandular-papillose puberulent, glabrescent, prominently black lineate-punctate, the margin entire; floral bracts similar to branch bracts except 0.9–2.0 mm long, 0.2–0.5 mm wide; pedicels obsolete to cylindrical to 1.3 mm long, prominently black punctate. Stamine flowers: 5–6-merous, lilac; calyx membranaceous, subcylindrical, 1.5–2.3 mm long, unequally divided, the tube to 0.2 mm long, the lobes linear-lanceolate, subulate, 1.3–2.0 mm long, 0.4–0.7 mm wide, apically long-attenuate, flat, punctate, glabrous, the margin irregular, entire, glabrous; corolla rotate, chartaceous, 2.5–4.0 mm long, the tube opaque, 0.8–1.5 mm long, the lobes hyaline, ovate, 2.1–3.0 mm long, 1.4–1.9 mm wide, reflexed 180°, apically acute to rounded, moderately glandular-granulose throughout within except densely so along margin, glabrous without, punctate, the margin irregular, entire; stamens 3.0–3.5 mm long, the tube 0.8–1.5 mm long, epistome, elobate, glabrous, the apically free portions of the fila-
ments thick (base of filament as wide as anther), terete, glabrous, 1.5–2.0 mm long, ventrally reflexed apically, the anthers subglobose, wider than long, 0.3–0.5 mm long and wide, apically rounded to obtuse, basally barely cordulate, the connective prominently black punctate dorsally; pistillode ovoid, ca. 0.9–1.3 mm long, 0.6–0.8 mm diam. *Pistillate inflorescence* resembling staminate, but 4.5–6.5 cm long, the glomerules mostly reduced or a single flower; branch bracts and floral bracts identical, membranous, sublate, 2.8–4.0 mm long, 0.7–1.0 mm wide, sparsely glandular-papillate, prominently black punctate, the margin erose; pedicels (1.5–)1.8–3.2 mm long. *Pistillate flowers* as in staminate but white; calyx chartaceous, cotyliform, 2.2–2.7 mm long, hyaline, the tube 0.3–0.4 mm long, the lobes 1.9–2.3 mm long, 0.7–1.1 mm wide, apically attenuate, at times rufous-papillate apically; corolla rotate, 2.5–3.2 mm long, the tube 0.9–1.0 mm long, the lobes widely ovate, 1.6–2.2 mm long, 1.2–1.5 mm wide, apically rounded to acutish, glandular-granulose within and along margin, the margin regular; staminodes similar to stamens but 1.6–1.9 mm long, the tube 0.9–1.0 mm long, the apically free portions of the filaments terete, 0.7–0.9 mm long, the antherodes globose, often malformed, 0.2–0.3 mm long, 0.3–0.4 mm wide, apically obtuse, basally obtuse to rounded or cordulate, the connective prominently black punctate ventrally; pistil obpyriform, 2.1–2.5 mm long, 1.2–1.6 mm diam, the ovary 1.6–1.8 mm long, translucent-lepidote, glandular-papillate, prominently black punctate, style 0.5–0.7 mm long, the stigma capitate, 4–5-lobed, each lobe lacinate, to 0.6 mm long, the placenta deeply cupuliform, 2 ovulate. *Fruit* globose, 7–7.5 mm long and diam., prominently black punctate, exocarp thin.

**Distribution.**—Previously considered endemic to the Western Cordillera of the Andes, on the cliffs (Farallones) of Cali, in the Department of Valle, Colombia, at 1,900–2,600 m, but reported for the first time here from Napo, Ecuador, at 200 m elevation.

**Ecology and conservation status.**—*Cybianthus verticilloides* is a rare species in lowland and premontane forest, growing near watercourses. Given that it has well-known uses, *C. verticilloides* might be suitable for cultivation. However, at present nothing is known regarding its natural population dynamics. Given the rapid urban development around Cali, and its apparent rarity in Ecuador, this species should be considered endangered.

**Etymology.**—The specific epithet refers to the strikingly pseudoverticillate phyllotaxis.

**Local names and uses.**—Colombia: “verticilado” (Spanish); Ecuador: “Carnerupachapanga,” “Yanacarneru” (Quichua), “Carnero Negro” (Spanish). Used to get rid of small fish in the urinary tract that cause bleeding and pain.

Specimens examined. **COLOMBIA.** Valle del Cauca: Río Cali riverbed, above Río Pichindé, El Robal, 2,640 m, 25 Jul 1946 (fr), J. Chacrescas 21721 (COL, F); Peñas Blancas, 2,200
Cybianthus verticilloides appears to be most closely related to C. gondotianus, by the symapomorphic vascularized leaf teeth. However, C. verticilloides is defined by the autapomorphic horizontally checked bark, the orange hydropotes of the branchlets, and the linear-lanceolate leaf shape.

16. Cybianthus croatii Pipoly, sp. nov. (Fig. 4A, 16). Type: ECUADOR. PASTAZA: Along Rd. between Diez de Agosto and Arajuno, 18 km NE of main Puyo-Macas Rd., 8.2 km NE of Diez de Agosto, 01° 27’ S, 77° 51’ W, 970 m, 4 May 1984 (stam. fl). T. Croat 59009 (HOLOTYPE: MO).

Quoad habitum deminutum petiolos brevistipitatis et laminas chartaceas, C. humilen valde cognatum, sed ab ea basibus laminaribus obtusis vel rotundatis (non acutis) inflorescentis paniculatis cum ramulis floriferis corymbosis (ne triinnati-paniculatis cum ramulis floriferis spicatis vel racemosi) petalis ad apicem cucullatis (ne planis) ad marginem glandulari-papillosis (ne glabris) filamentis glabris (ne glandulari-granulosis) antherarum connectivis manifeste punctatis (ne epunctatis) prompte cognoscitur.

Subshrub to ca. 15 cm tall. Stem terete, ca. 4 mm diam., bearing rufous hydropotes and sparingly glandular-papillate. Leaves alternate; blades chartaceous, ovate to elliptic, 5.7–14 cm long, 4.0–7.5 cm wide, apically acute, the tip mucronulate, basally obtuse to rounded slightly decurrent on the petiole, bearing rufous hydropoten above and below, midrib slightly impressed distally, slightly raised proximally above, prominent below, the secondary veins 4–9 pairs, barely visible above, prominent below, without collecting vein, the margin scarious, subentire or entire; petiole deeply canaliculate, decurrent on stem, at times appearing to form a small sheath, (1.5–)2.0–4.5 cm long, 0.2–0.3 cm diam., increasing in length acropetally along stem. Cataphylls membranaceous, alternate, subulate, 6–12 mm long, 0.6–1.2 mm wide, located just below center of internode, psuedoverticillate, apically acicular, keeled, conspicuously black punctate-lineate, bearing hydropoten and glandular papillae. Inflorescence bract subulate, 3.9–4.0 mm long, 2.0–3.0 mm wide. Staminate inflorescence: supraaxillary, paniculate, 1.2–3.5 cm long, appearing succulent, the branches racemose, the rachis densely glandular-papillate; peduncle 0.5–1.0 cm long; inflorescence branch bracts linear-lanceolate, 1.8–2.2 mm long, 0.4–0.6 mm wide, conspicuously punctate, glandular-papillate; floral bracts subtending and equal to the pedicels, 1.0–2.5 mm long. Staminate flowers homomerois, 4-merous, green; calyx cotyliform, membranaceous, 1.2–1.5 mm long, more or less equally divided, hyaline, the tube 0.2–0.3
Fig. 16. *Cybianthus croatii* Pipoly. A. Habit, showing stem with small, acicular cataphylls, acropetally longer petioles, and supraaxillary inflorescences. B. Staminate flower bud, showing sparsely glandular-papillate, cotyliiform calyx. C. Open staminate corolla, showing cucul late lobe apices, suborbicular anthers and conic pistillode. D. Open pistillate corolla, showing oblate antherodes, subglobose pistil. A–C, drawn from holotype. D, drawn from *L. Albert de Escobar 3744*. Figure drawn by Peggy Duke.
mm long, the lobes deltate, 1.0—1.2 mm long and wide, apically acute to somewhat acuminate, prominently black punctate, sparsely glandular-papillate without, the margin irregular, entire, glandular-papillate at first, glabrescent; corolla subrotate, carnose, 2.4—2.7 mm long, the tube 0.7—0.8 mm long, translucent, the lobes opaque, oblong, 1.7—2.1 mm long, 0.9—1.0 mm wide, apically rounded to obtuse, cucullate, sparingly glandular-papillate without, densely glandular-granulose within, prominently black punctate without, especially at apex, the margin entire, glandular-granulose; stamens 2.5—2.6 mm long, the tube conspicuous, carnose, 0.7—0.8 mm long, subtruncate, the apically free portions of the filaments terete, 0.9—1.0 mm long, epunctate, glabrous, erect except slightly recurved ventrally at point of attachment to anther, the anthers suborbicular, 0.7—0.8 mm long and wide, apically rounded, deeply cordate basally, the connective epunctate ventrally, prominently black punctate dorsally; pistilode conic, 1.3 mm long, 0.7 mm wide, densely translucent-lepidote, conspicuously black punctate, hollow. Pistillate inflorescence: as staminate, but 2.5—3.5 cm long; pedicels 0.6—1.1 mm long. Pistillate flowers as in staminate but calyx 1.3—1.5 mm long, equally divided, the tube 0.2—0.3 mm long, the lobes triangular, 0.9—1.2 mm long, 0.5—0.7 mm wide, apically acuminate, sparsely glandular-papillate along margin without; corolla subcampanulate, the lobes 1.3—1.5 mm long, the tube to 0.2 mm long, the lobes suborbicular, 1.1—1.3 mm long, 1.0—1.1 mm wide, apically rounded to obtuse, minutely glandular-granulose along margin without and throughout; staminodes as in stamens but 0.9—1.0 mm long, the tube, ca. 0.2 mm long, the apically free portions of the filaments 0.2—0.3 mm long, the antherodes oblate, 0.4—0.5 mm long, 0.5—0.6 mm wide, apically truncate, basally obtuse, the connective prominently black punctate ventrally; pistil subsphero-globosel, 0.6—0.7 mm long and diam., densely translucent-lepidote, conspicuously black punctate, the placenta deeply cupuliform, bearing 2 ovules, the style barely discernible, to 0.1 mm long, stigma subcapitate, the margin lacinate, early caducous. Fruit unknown.

Distribution.—Known only from the type (Ecuador) and from Antioquia, Colombia, at 970—2,440 m elevation.

Ecology and conservation status.—Cybianthus croatii occurs in premontane and montane wet forest, where it is locally common in protected areas near forest margins. Because of its restricted habitat, it is presumed to be threatened.

Etymology.—It is with great pleasure that I dedicate this species to Thomas B. Croat, pre-eminent authority on the systematics of Neotropical Araceae, indefatigable collector, gentleman, scholar, and the P. A. Schulze Curator of Botany at the Missouri Botanical Garden. During the tropical botany course I took from him in Costa Rica in 1977, I was first shown and became intrigued with the systematics and population biology of the Myrsinaceae.
Cybianthus croatit is the smallest myrsinaceous shrub that exhibits Corner's Model (Hallé et al. 1978). It is interesting to note that with each successive pseudowhorl of cataphylls, an inflorescence is produced, followed by a larger leaf with a longer petiole. This species appears to be most closely related to another diminutive plant, C. humilis, known only from the Department of Antioquia, Colombia and adjacent Chocó, and from Ecuador. The synapomorphy which defines the Cybianthus humilis-C. croatit clade is the scarious leaf margin, known elsewhere only in subgenus Grammadenia (Pipoly 1987, unpubl. data). However, because that subgenus occurs on the other side of the generic cladogram presented by Pipoly (1987), it is most parsimonious to hypothesize that the margin has arisen independently in these distant lineages. The pistilode is present in both of these species, and I have chosen to postulate that this represents a reversal because it is the most parsimonious conclusion. Cybianthus croatit is defined by the autapomorphic rufous stem hydropotes and the acropetally longer petioles. Despite the fact that the distribution of this species entirely overlaps that of C. humilis, it appears that C. croatit is restricted to montane and cloud forests, where C. humilis is restricted to premontane pluvial forests and subpáramo thicket. This is yet another example of sister species in altitudinally adjacent habitats, already reported in Cybianthus subgenus Laxiflorus (Pipoly 1983) C. subgenus Microanomorpha (Pipoly 1983b) and C. subgenus Conomorpha (Pipoly 1992a). Whether this supports the concept of speciation by peripheral isolation (parapatric) is unknown. Further studies of the respective population biologies of the subgenus are needed.

17. Cybianthus humilis (Mez) G. Agostini (Fig. 3F), Acta. Biol. Venez. 10:163, 1980. Weigelia humilis Mez in Engl., Pflanzenr. IV. 236(Heft 9):291, 1902. TYPE: ECUADOR. Without locality, 1896 (stam. fl.), A. Sodiro 100/14 (HOLOTYPE: B-dest., F Neg.: 4856; LECTOTYPE, here designated: COLOMBIA, ANTIOQUIA: 2,650–2,800 m, 1 Apr 1880 (stam. fl.), W. Kalbreyer 1534 (K). Although Mez (1902) did not specifically mention the Sodiro collection as the type, he cited the Sodiro and the Kalbreyer specimens in the protologue. However, the photograph clearly shows that a drawing of a dissection accompanies the Sodiro specimen, while that of Kalbreyer does not, suggesting that the Sodiro specimen formed the principal element upon which the description was based. Unfortunately, no duplicates of that Sodiro collection have been located. Mez also annotated the Kalbreyer sheet at K, and thus I designate it as the lectotype.


Subshrub to 25 cm tall. Stem terete, 3.5–4.0 mm diam., densely glandular-papillate, early glabrescent. Cataphylls in alternating nodes with leaves, membranaceous, subulate, 10–13 mm long, 1.7–2.6 mm wide, apically long-
attenuate, keeled, midrib prominent below, prominently black punctate and lineate-punctate, glandular-papillate, glabrescent, the margin opaque, flat, entire. *Leaves* subopposite; blades chartaceous, elliptic to narrowly elliptic, 15–20(–27) mm long, (4.0–)7.0–8.5 cm wide, apically acute to subacuminate, terminating in an inconspicuous micro, basally acute, bearing hydropoten above and below, inconspicuously pellucid punctate, midrib somewhat impressed above, prominent below, the secondary veins 6–11 pairs, slightly impressed above or not, prominently raised below, not united by a submarginal collecting vein, the margin entire, opaque, subrevolute; petioles canaliculate, thin, 1.0–2.0 cm long, 2.0–2.5 mm diam., glabrous, not decurrent on the stem. *Inflorescence bracts* similar to cataphylls, but 1.2–1.3 mm long, 1.5–2.2 mm wide. *Staminate inflorescence*: a bipinnate panicle, 3.5–15(–19) cm long, the rachis densely glandular-papillate, the branches spicate or rarely racemose, appearing subglomerulate apically; inflorescence branch bracts membranaceous, subulate, 3–4.5 mm long, 0.3–0.5 mm wide, densely and prominently black punctate-lineate, sparingly papillate; pedicels essentially obsolete, to 0.3(–2) mm long; floral bract membranaceous, ovate, asymmetric, 2.3–2.8 mm long, 0.9–1.2 mm wide, apically abruptly acuminate, medially keeled, epunctate, the margin erose, stipitate glandular-papillate. *Staminate flowers* 4–5-merous; calyx membranaceous, cotyliform, 1.5–2.0 mm long, tube 0.2–0.3 mm long, the lobes ovate to lanceolate, 1.3–1.7 mm long, 0.5–1.3 mm wide, unequally divided, apically acuminate to acute and often erose or premorse, glandular papillose-puberulent without, the margin erose, glabrous; corolla chartaceous, appearing subrotate, 3.7–4.5 mm long, the tube 1.1–1.5 mm long, the lobes linear-lanceolate to oblance, 2.4–3.2 mm long, 1.0–1.5 mm wide, often unequal, apically long-attenuate to obtuse, moderately rufous glabrous- granulose throughout within, sparsely glandular-papillate without, hyaline, the margin entire, glabrous; stamens 3.0–3.9 mm long, the tube 1.1–1.5 mm long, coriaceous, conspicuous, sparsely glandular-granulose, elobate, the apically free portions of the filaments basally as wide or wider than anther, then tapering apically, 1.9–2.4 mm long, terete, glandular-granulose, the anthers oblate, 0.4–0.5 mm long, 0.6–0.7 mm wide, apically truncate, basally subcordate, the connective epunctate; pistillode glabrous lageniform, 1.4–1.6 mm long, 0.8–1.0 mm wide, the stigma punctiform. *Pistillate inflorescence*: as in the staminate but 7–10 cm long, 4–6 cm wide; inflorescence branch bracts 2.5–3.5 mm long, 0.2–0.3 mm wide; peduncle 1–2.5 cm long; floral bracts 1–1.5 mm long; pedicels obsolete. *Pistillate flowers* unknown; fruiting calyx as in staminate but 1.3–1.5 mm long, the tube ca. 0.2–0.3 mm long, the lobes 1.1–1.2 mm long, 0.2–0.3 mm wide. *Fruit* globose, reddish-purple when fresh, 4–6 mm long and diam. when dried, the exocarp thin, conspicuously pellucid punctate.
Distribution.—Known only from Colombia and Ecuador, at 1,450–2,700 m elevation.

Ecology and conservation status.—Cybianthus humilis grows in deep shade among rocks at the margins of premontane pluvial forests. Populations observed in Colombia grew only in undisturbed areas with deep shade, leaf litter and organic humus. Because of the apparently restricted habitat, this species should be considered threatened.

Etymology.—The specific epithet refers to the low habit of the plant.

Local names and uses.—Colombia (Chocó): “Hierba del palo grande.” Ground to make crude syrups; syrup applied externally to cure cuts, taken internally to cure internal infections, clean the stomach and against chills. Given that it is a shade species, the common name probably refers to its frequency in shaded areas near large trees.

Specimens examined. COLOMBIA. Antioquia: Mpio. Urrao, Parque Nacional Las Orquideas, Vereda Calles, permanent inventory for premontane pluvial forest, right bank of Rio Calles, 06°32’ N, 76°19’ W, 1,450 m, 27 Nov 1993 (fr), J. Pipoly et al. 17186 (COL, JAUM, MO), 1,450–1,500 m, 29 Nov 1993 (fr), J. Pipoly et al. 17361 (COL, JAUM, MO); without locality and date, (stam. fl), F. Lehmann s.n. (F, K). Chocó: Mpio. de Quibdó, Corregimiento San Francisco Iché, Quebrada Caledonia along Caledonia Rd., 9 Apr 1987 (stcr.), F. García & J. Echavarría 259-A (COL, CHOCO, MO). Nariño: Mpio. Barbacoas, Corregimiento Ortiz y Zamora, Vereda El Barro, Reserva Natural Río Ñambi, ca. 5 km W of Altaquera, faldas occidentales de la Cordillera Occidental, 01°18’ N, 78°08’ W, 1,350–1,400 m, 3 Sep 1997 (stcr.), J. Pipoly, A. Cogollo, et al. 21240 (BRIT, FMB, JAUM, PSO). Quindío: Mpio. De Salento, Estación Navarro, Alto San Ignacio, 2,850 m, 23 Nov 1990 (stam. fl), P. Franco et al. 3209 (COL, MO), Risaralda: Mpio. Sta. Rosa, Camino de Herradura entre Térmales y Páramo Sta. Rosa, Cordillera Central, vertiente Occidental, Hacienda El Margarital, 2,500 m, 18 Aug 1980 (fr), J. Idrobo et al. 9671 (COL, MO), ECUADOR. Napo: Cantón El Chaco, Proyecto Hidroeléctrico Coca, Punto ST3, right bank of Río Quijos, ca. 10 km S of Reventador, 1,500 m, 3–5 Oct 1990 (fr), W. Palacios 5950 (MO, QCNE). Pichincha: Cantón Quito, Parroquia Calacalí, Reserva Geobotánica Pululahua, 00°01’ N, 78°35’ W, 1,800–2,000 m, 29 Jul 1989 (stam. fl), C. Cerván 7184 (MO, QCNA); Mindú, 26 Jun 1876 (stam. fl), E. André 3819 (K).

Cybianthus humilis is most closely related to C. croattii, by virtue of its synapomorphic scariosus leaf margin. The autapomorphies that distinguish C. humilis from all other species of the subgenus include the premorse apices of the calyx lobes, the unequal corolla division, and the oblape anther shape.


**PANAMA. DARIEN:** Cana, Cuasi Trail, Dtto. Cheijana, 1000 m, 10 Mar 1940 (stam. fl), M. E. Terry & R. A. Terry 14940 (holotype: F-2 sheets; isotypes: A, MO).


**Shrub to tree** to 5 m, flowering from less than 1 m. **Stem** terete, 1.3–2.5 cm diam. below uppermost leaves, swollen at nodes, semi-woody, glandular-papillate-puberulent, glabrescent. **Cataphylls** few, alternate, coriaceous, subulate, (2.5–)3.0–5.0 cm long, 2–4 mm wide, strongly keeled, densely glandular-papillose-puberulent, glabrescent, conspicuously black punctate, the margin opaque, regular, entire. **Leaves** pseudoverticillate; blades chartaceous, widely oblong to elliptic, rarely widely obovate, (26–)31–75 cm long, (6.5–)10–30 cm wide, apically rounded, obtuse or rarely acutish, not mucronulate, basally abruptly subcuneate, asymmetric, slightly decurrent on petiole, bearing a few hydropoten above, moderately rufous glandular-papillate and with a moderate number of hydropoten below, prominently red or black punctate, the margin regular, opaque, entire; petioles stiff, (2.5–)5.0–14(–23) cm long, 0.3–0.9 cm diam., slightly to moderately canaliculate, swollen basally, sparingly glandular-papillate, glabrescent. **Staminate Inflorescence:** a pyramidal bipinnate thyrsoid panicle, 9–16.5(–19) cm long, 9–17(–22) cm wide, the branches subspicate, the rachis densely glandular-papillose-puberulent; peduncle 0.5–2.0 cm long; inflorescence branch bracts chartaceous, linear-lanceolate, 8.5–12.9 mm long, 0.6–0.9 mm wide, apically narrowly acute, conspicuously black punctate, densely glandular-papillate, gabrescent, flat, the margin opaque, regular, entire; floral bracts membraneous, linear, 1.5–2.0(–2.5) mm long, 0.5–0.6 mm wide, subulate, hyaline, densely glandular-papillose puberulent, the margin entire, glandular-papillate; pedicels obsolete to 0.2 mm long. **Staminate flowers** homomerous, 4-merous, coriaceous, subsessile, racemose, 4–5-merous, white in bud, green in anthesis, then crimson; calyx coriaceous, subcotyliform, unequally divided, 0.9–1.1 mm long, the tube 0.1–0.2 mm long, the lobes linear-lanceolate, 0.7–0.9 mm long, 0.2–0.5 mm wide, apically subulate, keeled, brown punctate-lineate or punctate medially, sparsely glandular-papillate, the margin irregular, subentire to erose, densely glandular-ciliate; corolla subrotate, 2.0–2.9 mm long, the tube 0.2–0.3 mm long, the lobes narrowly ovate to lanceolate, (1.7–)1.9–2.3(–2.6) mm long, 0.9–1.0(–1.5) mm wide, reflexed 135° from tube at anthesis, apically attenuate, densely glandular-granulose throughout within and along margin within and without, inconspicuously pellucid punctate, the margin entire, somewhat irregular, densely glandular-granulose; stamens exerted to slightly shorter than the corolla lobe, 1.6–2.2 mm long, the tube ca. 0.5 mm long, conspicuous, coriaceous, taller than the corolla tube, elobate, opaque, epunctate, glabrous, the apically free portions of the filaments terete, thicker than the
anthers, 0.8–1.6 mm long, ventrally recurved at anthesis, epunctate, glabrous, the anthers subglobose, ca. 0.3 mm long, 0.4–0.5 mm wide, apically rounded, basally cordulate, dorsifixed near base so as to appear basifixed, the connective prominently red or black punctate dorsally; pistillode normally absent, occasionally conic, to 1 mm long, 0.3 mm wide, densely translucent-lepidote. *Pistillate inflorescence* resembling staminate in all features, but smaller, 2.5–3.5(–13) cm long, 3.5–8.0(–12.5) cm wide; peduncle 0.5–1.5 cm long; inflorescence branch bracts 3.0–3.5(–5.0) mm long, to 0.6 mm wide, at times somewhat cucullate; floral bracts 2.0–2.6 mm long, ca. 0.5 mm wide, pedicels virtually obsolete, or cylindrical to 0.1 mm long in flower, accrescent and incrassect to 2.0 mm long, 1.0–1.5 mm diam. in fruit. *Pistillate flowers* as in staminate, forming a condensed spike on the inflorescence branches; calyx subcupuliform, 1.2–1.4 mm long; the tube to 0.1–0.2 mm long, the lobes 0.9–1.1 mm long, 0.9–1.0 mm wide, widely ovate, apically acute; corolla rotate, 2.7–2.9 mm long, the tube 0.6–0.7 mm long, the lobes oblong to elliptic, 2.0–2.2 mm long, 0.9–1.0 mm wide, apically acute; stamnodes 1.5–1.6 mm long, the tube 1.0–1.1 mm long, the apically free portions of the filaments 0.4–0.5 mm long, the antherodes malformed, 0.2–0.3 mm long, 0.3–0.4 mm wide; pistil obturinate, 1.5–1.6 mm long, densely translucent-lepidote and prominently pellucid punctate, the style obsolete, the stigma capitulate, 0.2–0.3 mm long, subsessile, 4–many-lobed, the lobes 1.3–2.3 mm long, viscid, bright crimson, the placenta ovoid, the ovules 2, born on side of placenta. *Fruit* subglobose, 5.0–9.0 mm long, 9–14 mm diam., fleshy, the exocarp thick, orange at maturity, prominently black punctate. *Bisexual Inflorescence* resembling staminate in all features except: 3.7–14.5 cm long, 2.5–12.5 cm wide; inflorescence branch bracts and floral bracts and pedicels as in pistillate. *Bisexual flowers* spicate, less crowded than in the pistillate, more crowded than staminate; calyx cotyliform, (4–)5-parted, 1.0–1.2 mm long, the tube ca. 0.2 mm long, the lobes narrowly ovate to narrowly triangular, 0.8–1.0 mm long, 0.3–0.4 mm wide, apically acute to narrowly acute; corolla 4-lobed, rotate, 2.0–2.7 mm long, the tube ca. 0.3 mm long, the lobes oblong, 1.7–2.4 mm long, 0.9–1.2 mm wide, apically acute; stamens 1.2–1.5 mm long, the tube ca. 0.5 mm long, the apically free portions of the filaments 0.6–0.7 mm long, the anthers oblate, 0.3–0.4 mm long, ca. 0.5 mm wide; pistil as in pistillate flowers except 1.2–1.4 mm long, the ovary 1.0–1.1 mm long, 0.7–0.9 mm diam., the style short, 0.1–0.2 mm long, the stigma capitulate, to 0.2 mm long, the lobes 0.9–1.1 mm long, the placenta ellipsoid, the ovules 2–3, borne on side of placenta. *Bisexual fruit* subglobose, as in pistillate, but 4–5 mm long, 5–7 mm diam.

*Distribution.*—From Darién, Panama to Loreto, Peru, from 0–1,700 m elevation.

*Ecology and conservation status.*—*Cybianthus sprucei* is a ridgetop species,
occurring in premontane wet and rainforests and also in lowland forests on forest margins of exposed hilltops. This species, as opposed to its closest congener, *Cybianthus simplex*, occurs in areas of high incident light for at least part of the day. Because *Cybianthus sprucei* continues to reproduce in spite of mild forest intervention, it is not considered threatened or endangered.

**Etymology.**—This species was named in honor of Richard Spruce, ardent collector and student of the Andean and Amazonian flora.

**Local names and uses.**—Colombia: “margoañide,” “Tunda” Spanish (Valle del Cauca, Colombia); Ecuador: “urcu tahucu” (Quichua); ground and a vapor bath is taken to “send evil away” and to treat body pains, headaches, internal colds; Peru: “kurúp” (Jivaros); the root is mashed and boiled, and the decoction is drunk to “strengthen” the body.

Specimens examined. **PANAMA.** Darién: Cerro Pirrê, 10–20 Jul 1977 (bisex. fl, fr), *J. Folsom 4544* (MO, PMA); on ridge of Cerro Pirrê, 08°00' N, 77°45' W, 1,000–1,080 m, 14 Sep 1989 (fr), G. McPherson 14066 (BRIT, MO). **COLOMBIA.** Cauca: Río Micay, en Guayabal, 5–20 m, 25 Feb 1943 (pist. fr), *J. Cuatrecasas 14138* (COL, F, US); Distrito Cauca, El Tambo, 900 m, Apr 1937 (stam. fl), *K. von Sneden 1615 S*. Choćó: Along Rd. between Quibdó and Medellín, Km 207.5, 0–200 m, 18 Dec 1980 (pist. fl, fr), *T. Croat & A. Cogollo 32257* (COL, JAUM, MO); Alto del Buey, 1,200–1,800 m, 8 Jan 1973 (pist. fl, fr), A. Gentry & E. Forero 7317 (COL, F, MO). Nariño: La Guayacana, Funes, 24 Jun 1951 (stam. fl), *R. Castañeda 2873* (COL, F); Ricaurte, 1,300 m; 18 Apr 1941 (bisex. fl), *K. von Sneden A612 bis* (S); Reserva Natural La Plandada, 7 km above Chucunes on Rd. between Tiquerres and Ricaurte, along Sendero La Vieja, 01°06' N, 77°54' W, 1,780–1,850 m, 7 Mar 1990 (fr), *T. Croat 71155* (MO, PSO). **VALLE DEL CAUCA.** Pacific coast, Río Naya, Puerto Merizalde, 5–20 m, 22 Feb 1943 (bisex. fl), *J. Cuatrecasas 14053* (COL, F); Río Yurumangú, 550 m, 28 Jan–10 Feb 1944 (pist. fl, fr), *J. Cuatrecasas 15743* (COL, F, US); Río Calima, Choćó region, La Trojita, 5–50 m, 20 Feb 1944 (stam., pist. fl-sheets mixed), *J. Cuatrecasas 16272* (COL, F, US); Río Cajambre, Barco, 5–80 m, 30 Apr 1944 (fr), *J. Cuatrecasas 17625* (COL, F, US); Bajo Calima, 15 km N of Buenaventura, Cartón de Colombia concession, Juanchaco region, 05°56' N, 77°08' W, 500 m, 27 Mar 1986 (stam. fl), A. Gentry et al. 33713 (COL, MO); Concesión Pulpép/Cuenca, 03°55' N, 77°00' W, 100 m, 7 Mar 1985 (fr), *M. Monsalve 767* (COL, CUC, MO), 19 Mar 1985 (stam. fl), *M. Monsalve 790* (CUC, MO), 21 Mar 1985 (stam. fl), *M. Monsalve 797* (CUC, MO), 12 Mar 1986 (stam. bud), *M. Monsalve 981* (CUC, MO), 24 Aug 1°86 (fr), *M. Monsalve 1124* (CUC, MO); Bahía de Malaga, near mouth of Quebrada La Sierpe, 04°00' N, 77°15' W, 0–20 m, 17 Feb 1983 (stam. fl), A. Gentry et al. 40453 (COL, MO); 18 km E of Buenaventura, 50 m, 14 Feb 1939 (fr), *E. Killip & H. Gentry 33279* (BM, COL, NY, US); Buenaventura, Jun 1901 (pist. fl, fr) F. Lehmann B. T. 651 (K, NY). **PUTUMAYO.** Umbria, 00°54'3 N, 76°10' W, 325 m, Jan–Feb 1931 (stam. fl), G. Klug 2108 (US). **ECUADOR.** Bolívar: Along first 15 km of Chilanes-El Tambo, 2,400 m, 18 Jul 1991 (stam. fl), H. van der Werff et al. 12430 (BRIT, MO, QCNE); along Rd. Chilanes-San Pablo, 6 km outside Chilanes, 2,600 m, 21 Jul 1991 (fr), H. van der Werff et al. 12561 (MO, QCNE). Morona-Santiago: 15 km N of Macas, Rd to Río Upano, 02°07' S, 78°08' W, 1,250 m, 20 Feb 1987 (bisex. fl), *J. Boblin et al. 1493* (GB); Cordillera de Cutucu, W slopes along trail from Logroño to Yaupi, 02°46' S, 78°06' W, 1,200 m, 10 Nov 1976 (stam. fl), M. Madsen et al. 3204 (US). **NAPo.** Cantón Archidona, Carretera Hollín-Loreto, Río Huataraco, 2 hrs walk from Guagua Sumaco,
Cybianthus sprucei was misinterpreted by Mez, and confused with C. simplex (Mez 1902). From there, Weigelitta panamensis was described based primarily on subtle differences and geography. Finally, Cuatrecasas described Weigelitta purpurea from the Chocó floristic region of Colombia, notable only for its narrower leaves, the secondary veins more arcuate, and some quantitative floral characteristics.

Cybianthus sprucei is most closely related to C. simplex because of the homogenous flowers, long petioles and non-mucronulate leaf apices. However, Cybianthus sprucei may easily be separated from C. simplex because of its arborecent habit, pyramidal panicle with spicate branches, symmetric leaf base and longer cataphylls.


Semi-woody subshrub to 1(−3.5) m tall. Stem terete, 1–5 cm diam., sparsely glandular-papillate, glabrescent. Cataphylls few, spirally arranged in internodal areas, coriaceous, subulate, 6.5–26.5 mm long, 1.12–1.7 mm wide, keeled, densely and prominently black punctate and punctate-lineate, sparsely glandular-papillate, the margin flat, entire. Leaves pseudoverticillate; blades membraneous, elliptic to oblong, (34.5–)38–46.5(–80) cm long, (12.5–)
13.5–18.5 (–32.5) cm wide, apically broadly acute or rounded to a short acumen, rarely acute, basally asymmetric, broadly rounded or rarely abruptly acute, slightly decurrent on the petiole, hydropetes few above, numerous below, often sparsely glandular-papillate below, conspicuously black punctate, the margin irregular, hyaline when juvenile, opaque at maturity, flat, entire; petioles rigid, deeply canaliculate, 7–17 (–21) cm long, 4–6 mm diam., slightly marginate at junctions of the blade, expanded basally and slightly decurrent on stem, sparsely glandular-papillate, glabrescent. Inflorescence bracts membranaceous, linear-lanceolate, 17–25 mm long, 2–4 mm wide, apically long-attenuate, hyaline, densely and prominently black punctate-lineare, the margin irregular, entire; peduncle (1.2–)2.4–4.5 cm long. Staminate inflorescence: a thyrsoid panicle (columnar) 11–28 (–54) cm long, bi- or tripinnate, the primary branches subopposite, each branch pyramidal-paniculate, the flowers racemose; inflorescence branch bracts linear-lanceolate, subulate, (50–)61–72 mm long, 0.5–1.3 mm wide, apically long-attenuate, medially keeled, hyaline, glandular-papillose throughout, the margin entire; floral bracts early caducous; pedicels 2.3–3 (–5) mm long, glandular-papillate and -ciliolate. Staminate flowers 5-merous, green to greenish-white when fresh; calyx membranaceous, subcotyliform, 1.1–1.4 mm long, equally divided, the tube 0.2 mm long, the lobes lanceolate to lanceolate-subulate, apically narrowly acute to long-attenuate, hyaline, punctate, the margin erose-dentate; corolla coriaceous, rotate, 2.2–3.1 mm long, the tube 0.3–0.7 mm long, the lobes linear-lanceolate, 1.5–2.6 mm long, 0.9–1.1 mm wide, reflexed distally 180° from the tube, the apically subulate, densely glandular-granulose throughout within and along the margin, epunctate, the margin regular, entire; stamens 1.0–2.3 mm long, the tube conspicuous, coriaceous, 0.3–0.7 mm long, the apically free portions of the filaments terete, as wide as the anthers, 1.0–1.1 mm long, ventrally recurved, the anthers connivent at first, subglobose, 0.4–0.5 mm long, 0.5–0.6 mm wide, apically rounded, basally cordulate, dorsifixed just above the base, the connective prominently black punctate dorsally; pistillode absent. Pistillate inflorescence: as in staminate but 16–30 cm long; inflorescence branch bracts ovate-subulate, 4.5–7 mm long, 1.5–2 mm wide, the margin irregular, erose; floral bracts membranaceous, linear-subulate, 1.6–2 mm long, 0.4–0.6 mm wide, apically long-attenuate, densely glandular-papillose puberulent, the margin irregular-entire; pedicel terete, 1–10 mm long, translucent, glandular-puberulent. Pistillate flowers green; calyx coriaceous, 0.6–1 mm long, unequally divided, the tube 0.2–0.3 mm long, the lobes ovate to widely ovate, 0.4–0.7 mm long and wide, acutely acute, often moderately glandular-papillate without, the margin irregular, erose; corolla 1.5–1.7 mm long, the tube 0.4–0.5 mm long, the lobes oblong, 1.0–1.2 mm long, 0.7–0.8 mm wide, acipically acute, reflexed 135°
from tube, glandular-papillate without; staminodes 0.8–1.2 mm long, the tube inconspicuous, membranaceous, 0.4–0.5 mm long, glabrous, elobate, the apically free portions of the filaments 0.3–0.4 mm long, the antherodes subglobose, 0.2 mm long, 0.3 mm wide, apically rounded, basally cordulate; pistil subglobose, 0.8–1.1 mm long, the ovary 0.6–0.8 mm long, 1.0–1.2 mm diam., densely translucent-lepidote, the style short, thick, 0.1 mm long, 0.7 mm diam., the stigma capitate, the margin lacinate, with numerous lobules to 0.2 mm long, the placenta umbonate, the ovules 3, exposed apically 1/3 their length on the placenta. **Fruit** subglobose, 4–5 mm long, 5–8 mm diam., red, exocarp somewhat thick, juicy, prominently black punctate.

**Distribution.**—Endemic to the slopes of the Western Cordillera of the Andes in Colombia and Ecuador, 60–2,200 m.

**Ecology and conservation status.**—*Cybianthus simplex* occurs in premontane wet and rainforests, occasionally in the understory of ridgetop forests. This species occurs in deep shade under the shrub stratum of the forest. It occurs more frequently in primary forest wet enough to maintain *Chusquea* populations, but can survive in disturbed forests as long as the shrub and *Chusquea* populations exist. Because of its habitat flexibility, it is not considered threatened or endangered.

**Etymology.**—The epithet “simplex” refers to the monoaxial habit of the species.

Specimens examined. **COLOMBIA.** Nariño: Mpio. Barbacoas, Corregimiento Ortíz y Zamora, Vereda El Barro, Reserva Natural Río Nambi, ca. 5 km W de Altaquer, faldas occidentales de la Cordillera Occidental, 01° 18’ N, 78° 08’ W, 1,350–1,400 m, 1 Sep 1997 (stam. fl), J. Pipoly, A. Cogollo, et al. 21026, 21046, 21051, 21053 (BRIT, FMB, JAUM, PSO), 2 Sep 1997 (bisex. fl), J. Pipoly, A. Cogollo et al. 21109 (BRIT, JAUM, PSO), (ster.) J. Pipoly, A. Cogollo et al. 21131, 21148 (BRIT, PSO), (pist. fl, fr), J. Pipoly, A. Cogollo et al. 21173 (BRIT, FMB, JAUM, PSO), 1,490–1,500 m, 4 Sep 1997 (stam. fl), J. Pipoly, A. Cogollo et al. 21294 (BRIT, FMB, JAUM, PSO), (pist. fl), J. Pipoly, A. Cogollo et al. 21296 (BRIT, FMB, JAUM, PSO), 1,350–1,400 m, 5 Sep 1997 (stam. fl), J. Pipoly, A. Cogollo et al. 21326 (BRIT, JAUM, PSO), (ster.), J. Pipoly, A. Cogollo et al. 21328 (BRIT, JAUM, PSO), 1,350–1,450 m, 6 Sep 1997 (ster.), J. Pipoly, A. Cogollo et al. 21417 (BRIT, FMB, JAUM), 7 Sep 1997 (fr), J. Pipoly, A. Cogollo et al. 21469, 21471, 1,450–1,500 m, 8 Sep 1997 (stam. fl), J. Pipoly, A. Cogollo et al. 21520 (BRIT, FMB, JAUM, PSO), (ster.), J. Pipoly, A. Cogollo et al. 21524 (BRIT, JAUM, PSO), along trail from main Pasto-Tumaco Rd. to Río Nambi, departing main Rd. at Escuela Mixta El Mirador, 7 km W of Altaquer, 01° 18’ N, 78° 04’ W, 1,100 m, 26 Feb 1992 (fr), T. Croat 72394 (JAUM, MO); Corregimiento Altaquer, Vereda el Barro, Reserva Natural Río Nambi, W slope, W Cordillera, 01° 18’ N, 78° 08’ W, near Cabaña Fundación FELCA, 1,325 m, 11 Dec 1993 (fr), J. Betancur et al. 4857 (COL, MO); La Planada, Finca Salazar, 7 km above Riaucrte, 01° 08’ N, 77° 58’ W, 1,750 m, 29 Nov 1981 (pist. fl, fr), A. Gentry et al. 35188 (BRIT, COL, MO, US); La Planada, S of Riaucrte, 7 km from Tumaco-Pasto Rd., 01° 10’ N, 77° 58’ W, 1,800 m, 24 Jul 1986 (stam. fl), A. Gentry et al. 35055 (MO, PSO); trail to Hondon, 6-12 km SW of La Planada, 01° 04’ N, 78° 02’ W, 1,750–1,800 m, 5 Jan 1988 (fl bud), O. de Bonavides & R. Keating 60411 (MO, PSO); Valley of Río Guiza, Rd. from El Espino to Tumaco, ca. 21 km W of
Ricaurte, on 01° 15' N, 78° 07' W, 1,000 m, 7 Dec 1988 (stam. fl), B. Hamme 17150 (JAUM, MO), ECUADOR. Bolivar: Hacienda Changuil, LA 16; 02° 06' S, 79° 10' W, 500 m, 17 Aug 1995 (stam. fl), X. Cornejo & C. Bonifaz 4339 (GUAY, MO). Carchi: Prominent hillcrest directly N of Lita, on S side of Rio Mira, E of Rio Baboso, W-facing slope, 00° 53' N, 78° 27' W, 760 m, 7 Aug 1994 (stet.), B. Boyle 3473 (MO, QCNE), Steep N-facing slope S of Baboso, S side of Rio Baboso, 00° 53' N, 78° 27' W, 750 m, 11 Aug 1994 (stet), B. Boyle 3399 (MO, QCNE); Rio Blanco drainage above Chical, tributary of Rio San Juan, 12 km W of Maldonado, 1300–1500 m, 25 Sep 1979 (bisex. fl), A. Gentry & G. Shup 26565 (MO, QCNE); Cantón Tulcán, Parroquia Tobar Donoso, Reserva Indígena Awá, Centro El Baboso, 00° 53' N, 78° 25' W, 1,800 m, 17–27 Aug 1992 (stam. fl), G. Tipaz et al. 1709 (BRIT, MO, QCNE), (stam. fl), G. Tipaz et al. 18886 (MO, QCNE), (fr), G. Tipaz et al. 1924 (MO, QCNE); 6 km above Maldonado, just below Puente de Palo, 00° 54' N, 78° 06' W, 2,275 m, 23 May 1993 (stam. fl), B. Boyle & J. Bradford 1878 (MO, QCNE); Trail from Pañón to Gualpi Chichó, Reserva Indígena Awá, 1.5 km past Rio Blanco, 00° 51' N, 78° 16' W, 1,000–1,450 m, 14 Jan 1988 (stam. fl), W. Hoover et al. 2456 (MO, QCNE); SE Trail, Gualpi Chichó area of Awá Reserve, 00° 58' N, 78° 16' W, 1,330 m, 19 Jan 1988 (pist. fl, fr), W. Hoover et al. 2809 (MO, QCNE); Trail along ridge and forest slope to NW of Awá encampment, Gualpi Chichó area near Finca Rodríguez, 00° 58' N, 78° 16' W, 1,258–1,323 m, 19 Jan 1988 (fr), W. Hoover et al. 3358 (MO, QCNE). Cotopaxi: Rio Guara, ca. 20 km NW of El Corazón, 250 m, 19 Jun 1967 (stam. fl), B. Sparre 17091 (S), 20 Jun 1967 (pist. fl), B. Sparre 170818 (S). El Oro: 11 km W of Las Piñas on new Rd. to Sta. Rosa, 850 m, 8 Oct 1979 (stam. fl), C. Dodson et al. 9101 (MO, SEL); Hacienda Buenaventura, 12 km W of Las Piñas on Rd. to Machala, 05° 48' S, 79° 46' W, 1,000 m, 1 Mar 1991 (stam. fl), M. Kessler 2601 (GOET, MO); New Rd. Sarabay-Balsay-Velacruz, ca. 8 km SE of Zaracay, 400 m, 30 Apr 1980 (stam. fl), G. Harling & L. Anderson 18778 (GB). Guayas: Cordillera Chogón-Colonche, Cerro Los Pontones, 01° 44' S, 08° 40' W, 500 m, 2 Jul 1994 (stam. fl), X. Cornejo & C. Bonifaz 2979 (GUAY, MO). Loja: Tierra Colorada, 1 km E of Landara, 8 km E of Mercadillo, 04° 02' S, 79° 57' W, 1,500 m, 9 Feb 1991 (pist. fl, fr), M. Kessler 2401 (BRIT, GOET). Manabí: Machalilla National Park, zona de San Sebastián, 01° 36' S, 80° 42' W, 600–700 m, 21 Jan 1991 (fr), A. Gentry et al. 72499 (MO, QCNE). Pichinch: Quiito-San Juan Chiriboga-Sto. Domingo de los Colorados Rd., Branch km 59, 18 km NW of Rd., 1,700–2,000 m, 27 Sep 1986 (bud), V. Zak 1350 (MO, US); Quiito-Aloag-Sto. Domingo de los Colorados, km 94, 10 km S of Rd., W slopes of Volcán El Corazón, 00° 21' 30" S, 78° 51' 15" W, 1,300–1,500 m, 25 Dec 1986 (fr), V. Zak 1545 (MO, US); 15 ha. Patch of forest in Cooperativa Sta. Marta No. 2, along Río Verde, 2 km SE of Sto. Domingo de Los Colorados, 530 m, 5 Feb 1979 (fr), C. Dodson et al. 7597 (MO, SEL); Reserva Flórsica-Ecológica “Río Guajiloto,” Km 59, Quiito-Santo Domingo de los Colorados, 3.5 km NE of Rd., lower slopes of Volcán Pichinch, 00° 13' 53" S, 78° 48' 10" W, 1,800–2,200 m, 28 Dec 1985 (fr), J. Jaramillo 8298 (MO, QCA); Cantón Quiito, Parroquia Nanegal, Reserva Maquipucuna, along Inca Trail to Río Tulambah, ca. 5 airline km SE of Nanegal, 00° 07' N, 78° 38' W, 1,350 m, 15 Sep 1989 (fr), G. Webster & P. Delprate 27594 (DAV, QCA), along trail between Río Umaacha and Río Tulambah, 00° 07' 5" N, 78° 38' 5" W, 1,200–1,500 m, 7 Jul 1990 (fr), G. Webster et al. 27795 (DAV, QCA); Montañas de Maquipucuna, Cerro Sosa, 00° 05' N, 78° 37' W, 1,950 m, 3 Jul 1991 (fr), G. Webster 28702 (DAV, QCA), 1,750 m, 3 Jul 1991 (stam. fl), G. Webster et al. 28710 (DAV, QCA), on ridge between Base Camps 1 & 2, 00° 05' 5" N, 78° 37' W, 1,800–1,900 m, 6–7 Jul 1991 (fr), G. Webster & B. Castro 28769 (DAV, MO, QCA); along Río Umaacha near Hacienda El Carmen, 00° 07' 7.5" N, 78° 38' W, 1,250 m, 6–7 Jul 1991 (fr), G. Webster et al. 28796 (DAV, QCA). Quininde: Bilsa Biological Reserve, Montañas de Maché, 35 km W of Quinindé, 5 km W of Sta. Isabel, SE ridge trail, 00° 21' N, 79° 44' W, 400–600 m, 21
This species has often been confused with *Cybianthus sprucei*, owing to variation in leaf morphology and inflorescence size. However, recent field studies conducted at the Río Ñambí Natural Reserve of Nariño, Colombia, have revealed that juvenile individuals have obtuse to somewhat broadly rounded, asymmetric leaf bases with long petioles, while mature individuals have tapering, asymmetric leaf bases. The confusion was due, in part, to precociously flowering individuals, detectable by their extremely small flowers, or to reiterative shoots, detectable by the renewal shoot visible below the "bayonet", that bears juvenile leaves and pink flowers. While the largest individuals of *Cybianthus simplex* may approach the size of many *C. sprucei*, the large pith of the stem in the former renders them extremely weak, and the stems may easily be snapped by hand, while the pith of *C. sprucei* is relatively smaller, and the stems can be bent without snapping in the field.

*Cybianthus simplex* is most closely related to *C. sprucei*, but may be separated from it by the columnar, thyrsoid panicles with racemose branches, the pedicellate flowers, asymmetric leaf base and shorter cataphylls. Populations corresponding to the type of *Weigeltia chamaephyta* differ from the type of *C. simplex* in floral structure, directly attributable to the fact that the former is based on a pistillate, and the latter a staminate collection. However, the autapomorphic columnar thyrsoid panicle leaves no doubt that they are synonymous. Because no further collections have been made in the region from which the type was collected, I defer neotypification until collections from that area are available.


Monomaxial treelet to 1(–2) m tall. Stems terete, (0.6–)1–1.7 cm diam., glandular-papillate at first, glabrescent. Cataphylls alternate in a high spiral, coriaceous, subulate, 15–45 mm long, 0.5–2(–3.5) mm wide. Leaves pseudoverticillate; blades chartaceous, oblanceolate to oblanceolate-oblong, (22–)31.3–55.5 cm long, 8.5–19.6(–23) cm wide, apically acute or broadly rounded to a small acutish tip, mucronate, the mucron to 0.5 mm long, the blade gradually tapering to an abruptly obtuse base appearing auriculate, to 1.5 cm wide, midrib slightly raised above, prominently raised below, the secondary veins 12–16 pairs, with prominent marginal and submarginal collecting veins, slightly sunken above, prominently raised below, glabrous above, with Rufous hydropoten below; petiole deeply canaliculate, 1–2 cm long, ca. 3.5–
4 mm diam., densely glandular-papillate adaxially. **Staminate inflorescence**: a pyramidal, bipinnate panicle, (3–)5.5–29 cm long, 5–15 (–26) cm wide, the branches racemose, densely glandular-papillate, succulent, then drying hyaline; peduncle 3–5.5 cm long; branch bracts membranaceous, subulate, 6.5–8 mm long, 0.5–1.5 mm wide; pedicels cylindrical, 1.2–1.8 mm long, sparsely glandular-papillate, glabrescent; floral bracts membranaceous, subulate, inserted on the pedicel about at middle, longer than the pedicel, 1.5–2.5 mm long, 0.1–0.2 mm wide, hyaline, densely glandular-papillate, the margin entire. **Staminate flowers** pink, heteromerous, the calyx 5-merous, the corolla 4-merous; calyx deeply membranaceous, cupuliform, 0.9–1.1 mm long, the tube 0.1–0.2 mm long, unequally divided, the lobes deltate to subdeltate, 0.6–0.9 mm long, 0.2–0.7 mm wide, highly reflexed at anthesis, apically acute, epunctate, hyaline, densely glandular-papillate, the margin glabrous, entire; corolla carnos, subrotate to rotate, 2–3 mm long, the tube 0.5–0.8 mm long, the lobes ovate, 1.5–2 mm long, 1.1–1.6 mm wide, apically acute, distally recurved 90° from tube axis at anthesis, opaque, densely glandular-granulose within and along margin, sparsely glandular-papillate along margins without, epunctate or sparingly and inconspicuously pellucid punctate, the margin entire; stamens 2.2–2.9 mm long, subequal to corolla lobe or exserted, the tube conspicuous, carnos, 0.5–0.8 mm long, hyaline, glabrous, oblate, the apically free portions of the filaments terete, 1.6–2.2 mm long, free from corolla, proximally recurved, the anther oblate, 0.3–0.5 mm long, 0.5–0.8 mm wide, always wider than long, apically emarginate to rotate, basally widely cordate, the connective prominently black punctate dorsally, conspicuously black punctate ventrally; pistillode absent or to 1 mm long, 0.1–0.3 mm wide, densely glandular-papillate. **Pistillate inflorescence** as in staminate but 6.5–9 (–10.5) cm long, erect, not succulent, opaque, densely glandular-papillate; peduncle 1–2 cm long; branch bracts 2–3 mm long, 0.2–0.3 mm wide; pedicels subobscure or cylindrical, to 1.2 mm long, incrasate and accrescent in fruit to 1.5 mm long; floral bracts inserted on pedicel, longer than the pedicel, 1–1.3 mm long, 0.2–0.3 mm wide. **Pistillate flowers** as in staminate but pink to pinkish-white; calyx 0.9–1.2 mm long, the lobes unequally divided, the smaller linear-lanceolate, 0.8–0.9 mm long, 0.3–0.4 mm wide, the larger deltate, 1.0–1.1 mm long and wide; corolla rotate, 2.6–2.9 mm long, the tube 0.9–1 mm long, the lobes elliptic, 1.7–2.0 mm long, 0.6–0.7 mm wide, reflexed at anthesis, distally recurved 180° from tube axis, glabrous without, sparsely glandular-granulose within, the margin slightly irregular; staminodes very poorly developed, 1.2–1.5 mm long, the tube 0.9–1.0 mm long, the apically free portions of the filaments 0.3–0.6 mm long when developed, recurved proximally, the anthers badly formed, at times consisting of 2–3 prominently punctate glands at filament apex, or otherwise as in the stamens, ovate to subglobose, 0.2–0.3 mm long,
0.3–0.4 mm wide, apically irregular, obtuse, emarginate or retuse, basally cordate, the connective when distinguishable prominently black punctate dorsally, conspicuously punctate ventrally; pistil clavate to lageniform, 3–3.5 mm long, the ovary 0.9–1.1 mm long, 1.2–1.5 mm diam., densely papillate, the style 2.1–2.4 mm long, the stigma large, capitate, with 4 principal lobes, each irregularly laciniate-lobulate, early caducous, the placenta deeply cupuliform, the ovules 2, buried for 1/2 their length. Fruit depressed-globose, 5–6 mm long, 7–9 mm wide, prominently black punctate, the exocarp thin. Bisexual inflorescence: as in staminate but 4–13 cm long. Bisexual flowers as in staminate flowers but calyx 1.1–1.9 mm long, the tube 0.2–0.3 mm long, the lobes unequally divided, deltaxe to elliptic, the smaller 0.6–0.7 mm long and wide, the larger 0.9–1.6 mm long, 0.5–0.6 mm wide, otherwise as in pistillate flowers; corolla 2.6–2.8 mm long, the tube ca. 0.6 mm long, the lobes narrowly ovate, 2.0–2.2 mm long, 1.2–1.3 mm wide, recurved distally 90° from tube, sparsely glandular-granulose within, glandular-papillate along the margin; stamens as in staminate flower, but 2.2–2.7 mm long, always slightly shorter than corolla tube, the tube ca. 0.6 mm long, the apically free portions of the filaments 2.0–2.2 mm long, the anthers widely ovate, ca. 0.3 mm long, 0.5–0.6 mm wide, apically obtuse to emarginate, basally widely cordate; pistil 2.7–2.9 mm long, the ovary 0.8–0.9 mm long, 0.6–0.7 mm diam., densely glandular-papillate, the placenta deeply cupuliform, the ovules 2, buried for 1/2 length. Bisexual fruit depressed-globose, 5–6 mm long, 6–7 mm wide, prominently black punctate, the exocarp thin.

Distribution.—Colombia (Amazonas, Chocó, Nariño, Valle del Cauca, ), Ecuador (Chimborazo, Napo and Pichincha), Peru (Amazonas, Loreto, San Martín) and Brazil (Acre), growing at sea level–2,530 m elevation.

Ecology and conservation status.—Cybanthus kayapii is locally common in small populations at the high water line in primary “tahuampa” habitats (várzea forest), along white water rivers, or rarely in premontane habitats along the edge of pools fed by creeks. The species is not known to be cultivated and occurs only in areas where deep leaf litter and alluvial deposits are left after flooding action. It appears that the species can easily be destroyed by soil compaction as a result of trampling, and thus, it should be considered threatened.

Etymology.—The epithet commemorates Rubio Kayap, an indigenous Aguaruna Peruvian plant collector who worked with Brent Berlin, known for his great knowledge of Amazonian flora and ethnobotany.

Local names and uses.—Colombia: “Hierba de palo grande” (Spanish). Ground in crude syrups to cure cuts, internal infections, to clean the uterus and the stomach. Ecuador: “putush” (Shuar). Used against intestinal parasites and for chronic rectal bleeding (colo-rectal carcinoma 0); 10 lbs. of root boiled in 8 liters of water, down to one liter; 8 cc given as enema before bed; useful
for “dysentery.” Peru: “mantaya,” “kugkuima muspari” (Aguaruna); used to disinfect dog and insect bites; “napi tsuake” (Huambisa). Brazil: used in curare cf. B. Krukoff 7663.

Representative specimens examined. COLOMBIA. Amazonas: Mpio. Leticia, Parque Nacional Natural Amacayacu, Centro Administrativo Mata-mata, trail to Amacayacu, km 4, 03° 47' S, 70° 15' W, 120 m, 25 Sep 1991 (stam. fl), A. Rudas & A. Prieto 3147 (COL, FMB, MO), 110–120 m, 28 Oct 1991 (fl bud), J. Pipoly & J. Murillo 15483 (COL, FMB, MO), Quebrada de Agua Padre, ca. 1.5 km NE of junction with Río Amacayacu, permanent inventory plot, 200–220 m, 11 Nov 1991 (stcr.), J. Pipoly et al. 15896 (COL, FMB, MO), 15 Nov 1991 (stam. fl), J. Pipoly et al. 16075 (COL, FMB, MO); Río Loretoyacu, 100 m, Oct 1946 (bisex. fl), R. E. Schultes & G. Black 8427 (US). Chocó: Bahía de Solano, 13–18 Apr 1982 (pist. fl, fr), R. Dressler 6036 (COL, FLAS, MO); Mpio. de Quibdó, Corregimiento San Francisco Iché, Quebrada Caledonia along Caledonia Rd., 9 Apr 1987 (stcr.), F. García & J. Echavarría 259-A (COL, CHOCO, MO). Nariño: Mpio. Ricaurte, Reserva Natural La Planada, 1,800 m, 13 Nov 1993 (fr), C. Restrepo 723 (BRIT, MO, PSO); La Planada, Finca Salazar, 7 km above Ricaurte, 01° 08' N, 77° 58' W, 1,750 m, 27 Nov 1981 (fr), A. Gentry et al. 33506 (MO, PSO). Nariño: Mpio. Barbacoas, Corregimiento Ortiz y Zamora, Vereda El Barro, Reserva Natural Río Nambí, ca. 5 km W of Altaquer, faldas occidentales de la Cordillera Occidental, 01° 18' N, 78° 08' W, 1,350–1,400 m, 3 Sep 1997 (stcr.), J. Pipoly, A. Cogollo, et al. 21241 (BRIT, FMB, JAUM, PSO). Valle del Cauca: Río Calima, región del Chocó, La Trojita, 5–50 m, 20 Feb 1944 (stam. fl), J. Cuatrecasas 16272 (COL, F, US); Mpio. El Cairo, Cerro del Ingles, summit, Cordillera Occidental, Serranía de los Paraguas, limit Valle/Chocó, El Cairo-Río Blanco Hwy, 1 hour in jeep from El Cairo, 2,400 m, 1 Jan 1987 (pist. fl), P. Silverstone-Sopkin et al. 2871 (CUCV). ECUADOR. Carchi: Cantón Tulcán, Parroquia Tobar Donoso, Reserva Indígena Awá, Centro El Baboso, 00° 53' N, 78° 25' W, 1,800 m, 17–27 Aug 1992 (stam. fl), G. Tipaz et al. 17106 (MO, QCNE). Esmeraldas: Cantón San Lorenzo, Parroquia Ricaurte, Reserva Indígena Awá, Comunidad Balsareño, Río Palabí, 01° 09' N, 78° 31' W, 100 m, 15–29 Apr 1991 (fl bud), D. Rubio & C. Quevedo 1335 (MO, QCNE). Chimborazo: Cordillera Occidental, “El Carmen,” Sibambe, 2,450 m, 22 Aug 1943 (pist. fl), M. Acosta-Salóis 5544 (F, QCNA); on slopes of Chimborazo Volcano, (pist. fl, fr), A. Sudiro 100/14 (B, destr. QA?, n.v.). Morona-Santiago: Basin of Río Morona, Río Mangosuy, Nayumbíme, 45 km SE of Sucua (by air), 200 m S of Don Luís Najamte’s house, ca. 02° 43' S, 77° 38' W, 300 m, 27 Feb 1990 (fr), C. Limbach 140 (QCA, NY). Napo: Anisranza, Shingupino Forest, between Ríos Napo and Tena, 8 km SE of Tena, 01° 00' S, 77° 50' W, 450 m, 17 Sep 1960 (stam. fl), P. Griebb et al. 1633 (K, NY); Cantón Archidona, Carretera Hollín-Loreto, Río Huitaraco, 2 hrs by foot from Guagua Sumaco, 00° 43' S, 77° 32' W, 800–1,000 m, 23–30 Aug 1989 (fl bud), C. Cerón & M. Factos 7641 (MO, QCNE); Cantón Tena, 17 Oct 1939 (stam. fl), E. Asplund 9396 (S); 3 km E of Caserío Huamání, N of Carretera Hollín-Loreto, 00° 43' S, 77° 36' W, 1,200 m, 17 Sep 1988 (fr), F. Hurtado & A. Alvarado 503 (MO, QCNE). Pichincha: Along Rd. from Tandayapa to Mindó, 10 km from Tandayapa, 2,530 m, 16 Dec 1979 (fr), T. Croat 49361 (MO, QCNA). PERU. Amazonas: Prov. Bagua, Drro. Imaza, Comunidad Aguarruna de Kampietza (PUJAIM), property of Juan Mayán, 740 m, 6 Oct 1994 (pist. fl), C. Díaz et al. 7265 (BRIT, HUT, MO, USM); Prov. Condecanqui, Drro. El Cenepa, NE region of Marañón Drainage Basin, Río Cenepa, Comunidad Turino, 04° 33' S, 78° 10' W, 350 m, 21 Nov 1993 (pist. fl, fr), R. Vásquez et al. 18395 (AMAZ, BRIT, HUT, MO, USM); Río Cenepa, vicinity of Huampamí, ca. 5 km E of Chavez Valdivia, 04° 30' S, 78° 30' W, Quebrada Chigkishinuk, 10 Apr 1973 (fr), E. Ancash 211 (MO), 11 Aug 1978 (pist. fl), E. Ancash 1405 (MO); Trail one day walk from Huampami to Shim, creek running into Nahim, 600 m, 27 Nov 1972
Fig. 17. *Cybianthus anthracophyllus* Pipoly. A. Habit, showing pleiochasium with sympodial branches. B. Staminate flower, showing lanceolate-subulate corolla lobes, elobate staminal tube, and conic, vestigial pistillode. C. Pistillate flower, showing attenuate-acicular calyx lobes and obturbinate pistil. A, C, drawn from holotype. B, drawn from Bravo & Gomez 49. Figure drawn by Peggy Duke.
Cybianthus kayapii may be confused with *C. sprucei* (Hook. f.) G. Agostini, but may be recognized by the shorter petioles, heteromorous flowers and mucronate leaf apices. However, the leaf blades with mucronulate apices and subauriculate bases, and heteromorous flowers indicate *Cybianthus kayapii* is more closely related to *C. anthuriophyllus*. From *Cybianthus anthuriophyllus*, *C. kayapii* may be separated by the much smaller, flat, entire leaves with entire margins, the deltate calyx lobes with entire margins, and the carnose corolla.

21. **Cybianthus anthuriophyllus** Pipoly, sp. nov. (Fig. 17). **Type**: ECUADOR. **Napo**: Cantón Gonzalo Pizarro, Río Tigre, affluent of Río Dashino, entering from 73 km of Rd. from Lumbaque to El Reventador, 10 km S of Lumbaque, 00° 05' S, 77° 24' W, 900–1,100 m, 18–21 Feb 1987 (pistil. fl, fr), W *Palacios & D. Neil* 1584 (holotype: US; isotypes: K, MO, QCNE).

Ob folia ob lanceolata ab lamina ad petiolum gradatim contracta, a primo intuitu cum *C. kayapii* confusa est, sed ab ea marginibus laminaribus revolutis serrulatisque ( nec integerrimis planisique) inflorescentiis 28 (non 8–15) cm longis, pleiochasia cum ramulis floriferis cymosis ( nec bippinatipaniculatis cum ramulis floriferis racemosis) lobulis calycinis subulatis ( nec ovatis) praelare distat.

*Almaoxial* treelet to 0.6 m tall. *Stems* terete, weakly woody, ca. 2 cm diam., sparsely glandular-papillate, glabrescent. *Cataphylls* tightly pseudoverticillate, coriaceous, linear-subulate, 4.0–6.5 cm long, 0.3–0.6 cm wide, densely and prominently punctuate-lineate, sparingly glandular-papillate, glabrescent. *Leaves* pseudoverticillate, erect; blades coriaceous, narrowly lanceolate, (56–) 104–110 cm long, (14.5–) 17–22 cm wide, apically broadly rounded or rounded to a minute abrupt submucronate acumen 2 mm long, the blade gradually tapering to the petiole, almost obtusish basally, midrib slightly raised above,
prominently raised below, the secondary veins ca. 42 pairs, impressed above, prominently raised below, nitid and epunctate above, purple (when fresh), inconspicuously punctate and papillate-puberulent below, the papillae erect, rufous, the margin thin, opaque, inrolled, prominently straight-serrulate, the teeth alternatively larger and smaller (ca. 1 mm and 0.5 mm long, respectively); petiole deeply canaliculate, thick, ca. 1.5 cm long, 0.8 cm diam., sparingly glandular-papillate. **Staminate inflorescence**: a pyramidal thyrsoid panicle, ca. 16 cm long, 23 cm wide, the branches psedoruacemose (sympodial), the rachis densely glandular-papillate, the peduncles longer below, shorter above; inflorescence branch bracts linear-lanceolate, 7–9 mm long, 2–3 mm wide, apically attenuate-acicular, sparingly glandular-papillate, the margin entire; floral bracts acerose, 2–3 mm long, 0.4–0.8 mm wide; pedicels 1.0–2.5 mm long, angular, thin, the longer pedicels in the lower portion of the inflorescence, the shorter ones above, densely glandular-papillate, the papillae persistent. **Staminate flowers** heteromorous, membranaceous, hyaline, the calyx (5–)6-merous, the corolla 5-merous; calyx subcotyliform 3.7–4.7 mm long, 0.4–0.7 mm wide, apically acuminate-acicular, prominently keeled, the keel thickened hyaline, epunctate, sparingly glandular-papillate except densely so along the margin, the margin entire; corolla subtubate, 7.4–10 mm long, the tube 0.7–0.9 mm long, the lobes lanceolate-subulate, 6.3–9 mm long, 2.7–3.2 mm wide, the apically long-acuminate, highly reflexed, sparingly glandular-papillate without, very sparingly glandular-granulose within above the junction within tube the margins densely glandular-papillate, entire; stamens 2.2–4.1 mm long, the staminal tube conspicuous, coriaceous, 1.4–1.8 mm long, glabrous, elobate, the apically free portions of the filaments ventrally recurved, 0.8–0.9 mm long, flat, glabrous, the anthers ovate, 0.3–0.4 mm long and wide, apically and basally emarginate, dorsifixed less than _ length, the connectives prominently black punctate ventrally and dorsally; pistillode conic, vestigial–0.8 mm long or absent. **Pistillate inflorescence** a pleiochasmium, with branches cymose (sympodial), the rachis densely glandular-papillate, the peduncles 1–3 cm long, longer below, shorter above; inflorescence bracts resembling cataphylls but smaller, 1.3–1.6 cm long, 1.0–1.3 mm wide, conspicuously punctate-lineate; inflorescence branch bracts linear-lanceolate, 1.2–1.5 mm long, 0.2–0.4 mm wide, apically attenuate-acicular, sparingly glandular-papillate, the margin entire; floral bracts acerose, longer than the pedicels, 0.5–1.0 cm long; pedicels angular, thin, 1.2–7.5 mm long, the longer pedicels in the lower portion of the inflorescence, densely glandular-papillate, the papillae persistent. **Pistillate flowers** as in staminate but calyx 6-merous, (2.1–)3–4.1 mm long, the tube 0.3–0.7 mm long, 0.5–1.0 mm wide, apically long-attenuate-acicular; corolla (from dried remnants) subtubate, hyaline, 5.0–7.1 mm long, the tube 1.0–1.3 mm long, the lobes linear-subulate, 4.0–5.8 mm long, 1.1–1.5 mm wide at base, apically
subulate, highly reflexed, twisted and distally recurved at anthesis; stamiodia 1.2–1.3 mm long, the staminodial tube 0.9–1.2 mm long bearing well-developed lobes alternate with the apically free filaments, the filaments 0.3–1.1 mm long, flat, glabrous, the antherodes malformed, mostly consisting of undifferentiated tissue surrounding prominent black punctations or suborbicular and 0.1–0.5 mm long, 0.1–0.6 mm wide, always wider than long, apically emarginate, dorsifixed slightly less than _ length, the connectives prominently black punctate dorsally; pistil obturbinate, 2.5–3.0 mm long, the ovary 1.0–1.5 mm long, 0.8–1.3 mm wide, densely papillate and prominently black punctate, the style 1.3–1.7 mm long, densely glandular-papillate, the stigma large, capitiate, lobes, the lobes laciniate, each lobe to 0.4 mm long, early caducous, the placenta widely conic, bearing 4 uniseriate, exposed ovules, the ovules on the periphery of the placenta. Bisexual fruit pink, globose, 4–6 mm long and diam., the punctuation prominent, brown when fresh (testa coll.), red or black upon drying, the exocarp thin.

_Distribution._—Amazonian (“Oriente”) Ecuador and adjacent Peru (Loreto), 160–300(–1,100) m elevation.

_Ecology and conservation status._—Cybianthus anthuriophyllus grows in primary tropical wet forest and premontane wet forest on _terra firme_ above the high water contour. It is found in primary forest as well as in secondary, but it is not known whether the plant is cultivated in secondary forest situations. At this time, the species can be considered locally common but not threatened.

_Etymology._—The specific epithet refers to the unique shape of the adult leaves, held erect _in vivo_ and reminiscent of _Anthurium crassinervium_ (Araceae).

_Local names and uses._—Ecuador: “namáuk” (Achuar Jivaros); “Acuari” (dialect unknown); “challuo panga” (Quichua). Peru: “kutúkipish,” “takushía,” “mutúpash,” “kurúp” (Mayna Jivaros), “sierra panga” (Quichua). Leaves crushed and used as a fish poison ( _W. Lewis et al. 14051_); inner stem is scraped and an infusion given to dogs to drink to improve their hunting abilities and to enhance their stamina ( _W. Lewis et al. 11153_); stem is scraped and its juice put into a dog’s nose to produce sneezing ( _W. Lewis et al. 10475_), or to “make it an attack dog against thieves” ( _Lewis et al. 12853_).

**Paratypes.** _ECUADOR_. Napo: Cuyabeno-Punta Arenilla; Sep 1981 (stam. fl), E. Bravo & P. Gómez 49 (QCA); Canton Orellana, Yasuni National Park, Maxus Rd. and pipeline construction project km 10, 00° 29' S, 76° 34' W, 250 m, 29 Jun 1994 (fr), N. Pitman 448 (MO, QCNE). Pastaza: Kapawi (Amuntai), rio Pastaza; Village area, 02° 31' S, 76° 48' W, 235 m, 25–29 Jul 1989 (ster.), _W. Lewis et al. 14051_ (MO). _PERU_. Loreto: Prov. Alto Amazonas, Puranchim, rio Sinchiyacu, 02° 50' S, 76° 55' W, 200 m, 3–7 Dec 1988 (ster.), _W. Lewis et al. 14390_ (MO); Washintsa and vicinity, rio Huasaca, 03° 20' S, 76° 20' W, 185 m, 16–26 Jun 1986 (ster.), _W. Lewis et al. 11153_ (MO); Prov. Loreto: Nueva Jerusalem and vicinity, rio Macusari, 02° 55' S, 76° 15' W, 220–300 m, 29 Dec 1985–3 Jan 1986 (fr), _W. Lewis et al. 10475_ (MO); Pampa Hermosa and vicinity, rio Corrientes, 1 km S of junc-
tion with Río Mucusari, 03° 15' S, 75° 50' W, 160 m, 3–20 Dec 1985 (stam. fl), W. Lewis et al. 10340 (MO); Vista Alegre, Río Tigre, 02° 40' S, 75° 35' W, 230 m, 17 Mar 1987 (ster.), W. Lewis et al. 12853 (MO).

*Cybianthus anthuriophyllus* is unique within subgenus *Connomyrsine* by its small, marginal pectinate leaf serrations and pleiochasial inflorescence, appearing paniculate, but with sympodial primary and secondary branches, and thus, cymose. The leaves appear subsessile, with the blade gradually tapering to the deeply canaliculate petiole, a feature found otherwise only in its closest congener, *Cybianthus kayapii*. However, *Cybianthus anthuriophyllus* is clearly distinct from *C. kayapii* because of the inrolled, pectinate-serrulate leaf blade margin, the much longer, pleiochasial inflorescence, and subulate calyx lobes. The extremely long cataphylls are the best developed in the subgenus.


As here interpreted, *Cybianthus* subgenus *Triadophora* is monotypic. Its only species, *C. schlimii*, is easily recognized by its monoaxial habit and autapomorphic rufous glandularomentum of malpighiaceous trichomes, leaf blades with subepidermal fibers and pseudocataphylls (here defined as petiolar cataphylls). The first full description of *Cybianthus schlimii* is provided, along with complete synonymy and complete exsiccatae for Ecuador and Peru, and representative ones for other areas.


_Monaxial tree_ to 5 m. _Stem_ terete, 0.8–2.0 cm diam., the wood dense, minutely rufous glandular appressed tomentose, the trichomes malpighiaceous, early glabrescent. _Pseudocataphylls_ produced only irregularly, chartaceous, subulate, ca. 2.0–3.0 cm long, 0.5–1.0 cm wide, apically acute, mucronate, densely rufous puberulent, black lineate-punctate, the margin entire; petiole subobsolete, to 0.2 cm long. _Leaves_ tightly pseudoverticillate; blades chartaceous, elliptic, oblong or oblanceolate, 25–65 cm long, 5.5–20 cm wide, apically acute or subacuminate, mucronate, the macro often sclerified, the acumen 0.5–3.0 cm long, base long-attenuate, the blade decurrent on the upper portion of the petiole, midrib slightly elevated above, prominent below, the secondary veins 9–13 pairs, prominent, the marginal veins loop connected, conspicuously striolate by subepidermal fibers, these visible above and below, sparsely rufous puberulent above, moderately puberulent below, at times glabrescent, hydropotes absent, sparsely to densely punctate or lineate-punctate below, the margin opaque, irregular, entire to roughly serrate; petioles canaliculate, 1.0–3.0(–10) cm long, 0.5–1.0 cm diam., abruptly swollen basally, puberulent, glabrescent. _Staminate Inflorescence_ a pinnate or bipinnate columnar panicle 13–40 cm long, 3–20 cm wide, the rachis densely glandular-papillate and rufous puberulent, the flowering branches racemose; peduncle 8–15 cm long; inflorescence bract chartaceous, ovate, 9–15 mm long, 2.4–4.5 mm wide, apically acute, densely rufous glandular puberulent, conspicuously black punctate and lineate-punctate, the margin opaque, entire; inflorescence branch bracts membranaceous, linear, 10–13 mm long, 1.9–2.1 mm wide, apically narrowly acute, mucronulate, minutely rufous puberulent, orange furfuraceous lepidote, densely and conspicuously black lineate-punctate, the margin opaque, entire; floral bracts membranaceous, subulate, 0.8–1.3 mm long, 0.2–0.4 mm wide, sparsely rufous puberulent, the margin entire; pedicel terete, 2.0–4.5 mm long, prominently black punctate, densely papillate and rufous puberulent. _Staminate flowers_ 3(–4)-merous, light purple, then dull yellow; calyx chartaceous, cupuliform, 0.9–1.8 mm long, the tube 0.3 mm long, the lobes subdeltate, 0.7–1.6 mm long, 0.9–1.2 mm wide, apically acute, densely rufous puberulent, glabrescent, densely and prominently black punctate, the margin flat, wide, hyaline, densely ciliolate, the cilia often caducous; corolla rotate, chartaceous, 3.0–5.0 mm long, the tube hyaline, 0.8–1.0 mm long, the lobes elliptic or oblong, 2.2–4.0 mm long, 1.6–2.2 mm wide, apically obtuse to rounded, subcucullate, involute, distally recurved 180° relative to tube, sparsely rufous puberulent without, very sparsely glandular-granulose within basally, often glabrescent, very densely and prominently black punctate except margin hyaline, irregular, glabrous,
entire; stamens 2.4–3.5 mm long, the tube membranaceous, inconspicuous, 0.8–1.0 mm long, hyaline, epunciante, glabrous, eëbate, the apically free portions of the filaments 1.8–2.3 mm long, sparsely or epunciante, sparsely rufous puberulent at first, glabrescent, the connective prominently punctate, or inconspicuously so, the punctation orange, red or black, the anthers cordate, 0.5–0.6 mm long, 0.7–1.0 mm wide, apically subacute to rounded, base deeply cordate, dorsiﬁxed at point less than 1/5 distance from apex; pistillode none or conic, to 1.0 mm long, densely and prominently black punctate and rufous papillate. *Pistillate inflorescence* as in stamine but more columnar, (3.5–)8.0–18.5 cm long, (2.0–)3.5–6.0 cm wide, the branches subcorymbose to rarely racemose; peduncle 1.5–6.8 cm long; inflorescence bract ovate to elliptic, 4.5–12 mm long, 1.9–4.0 mm wide, conspicuously black punctate; inflorescence branch bracts 5–15 mm long, 0.5–2.5 mm wide; floral bracts 0.9–2.0 mm long, 0.3–0.6 mm wide; pedicels terete, 2.0–4.0 mm long, accrescent to 5.0 mm long and incrassate to 2.0 mm diam. in fruit. *Pistillate flowers* as in stamine but 3-merous, calyx purple, corolla yellow; calyx subcorymbose, 1.8–2.0 mm long; the tube 0.2–0.3 mm long, the lobes subdeltate to widely ovate, 1.6–1.8 mm long, 1.6–2.2 mm wide, apically acute, the margin slightly c rev, conspicuously long glandular-ciliate, the cilia often caducous; corolla 4.2–5.0 mm long, the tube 0.3–0.5 mm long, the lobes oblong, 3.2–4.5 mm long, 2.3–2.6 mm wide, apically obtuse, somewhat cucullate, relieved ca. 45° from tube axis, densely puberulent without, sparingly glandular-granulose basally within; staminodes to 2.5 mm long, the tube membranaceous, inconspicuous, to 0.5 mm long, the filaments adnate to corolla lobe ca. 0.5 mm long, then apically free to 1.0 mm long, thick, terete, rarely punctate, the antherodes cordate, ca. 0.6 mm long, 0.7–0.8 mm wide, apically acute to apiculate, base widely cordate, the connective punctate, prominently or not; pistil clavate to obnabiform, 4.0–5.2 mm long, the ovary 1.8 mm long, 0.5–1.6 mm wide, prominently black punctate and rufous puberulent, the style to 1.3 mm long, densely rufous puberulent, the stigma capitate to lobed, 3(–4)–lobed, the placenta deeply cupuliform, bearing 2 ovules exposed apically. *Fruit* globose, 1.0–1.3 cm long, 1.0–2.0 cm diam., at maturity, the exocarp bright orange to red-orange, prominently black punctate.

**Distribution.**—From the Atlantic Slope (Dpto. Río San Juan) Nicaragua, to state of Pando, Bolivia and adjacent Amazonia of Brazil, 0–1,800 m.

**Ecology and conservation status.**—*Cybianthus schlimii* occurs in a variety of habitats, from lowland to premontane tropical moist, wet and pluvial forest. It is locally common, but restricted to primary forest. Therefore, it should be considered threatened.

**Etymology.**—The species is named for Louis Joseph Schlim, a Belgian plant collector working for J. J. Linden in Brussels, who collected extensively around
Caracas to the Venezuelan Andes, and from there, to the grasslands of Meta and the Sabana de Santafé de Bogota, Colombia, during the period 1841-1852. Schlim also collected with Nicolas Funck later in Venezuela.

Local names and uses.—Peru: “napi tsuake” (Huaumbisa).

Representative specimens examined. NICARAGUA. Río San Juan: El Relos, midpoint between El Castillo and Delta de San Juan, 0–50 m, 23 Mar 1961 (stam. fl), G. Bunting & L. Licht 775 (F, NY). COSTA RICA. Alajuela: 15 km NW of Arenal by air, 2 km NW of Nuevo Arenal on Rd. to Tilarán, then 3 km NE on Rd. to San Rafael de Guatuso, then 2 km W on Rd. to Finca Cote, 10° 34’ N, 84° 54’ W, 700 m, SE side of Lago Cote, 30 Apr 1983 (fr), R. Liesser et al. 15903 (CR, MO, WIS). Heredia: Zona Protectora, N slopes of Volcán Barba, between Río Peje and Río Guacimo, along Quebrada Canarana, 300–400 m, 18 Jan 1983 (stam. fl), M. Grayum & G. Shatz 3170 (CR, DUKE, MO); Finca La Selva, Río Puerto Viejo 2 km E of jct with Río Sarapaqui, 10° 26’ N, 84° 00’ W, 100 m, 14–17 Jun 1968 (stam. fl), W. Burger & R. Stolze 5803 (CR, F, MO, NY). Limón: Near Finca Castilla, 30 m, 24 July 1936 (ster.), C. Dodge & V. Goerz 9283 (F, MO). San José: Estación Carrillo, Cañón del Río Sucio, 450–700 m, 12 Nov 1983 (pist. fl), I. Chacón & G. Herrera 1720 (CAS, CR, MO, NY). PANAMA. Bocas del Toro: Cerro Bony, above Quebrada Hurón, 180–400 m, 13 Apr 1968 (fr), J. Kirkbridge & J. Duke 610 (MO). Colón: Base of Cerro Bruja, along Río Escandaloso, above Mina Boquerón, No. 2, 47.5 km from Transisthmian Hwy on Rd. to Salamanca, 09° 30’ N, 79° 32’ W, 10–200 m, 18 Mar 1982 (stam. fl), S. Knapp & W. J. Kress 4282 (MO, NY, PMA). Darién: Río Tuquesa, Tuquesa Mining Co. camp, Charco Peje, 250 m, 7 Jul 1975 (stam. fl), S. Mori 7015 (MO, SCZ). Panamá: Cerro Campana, 800 m, 22 Jun 1967 (fr), T. Croat 17167 (MO). San Blas: Trail from Río Estadí to Cerro Banega, 300–530 m, 09° 23’ N, 78° 51’ W, 21 Dec 1985 (stam. fl), G. de Nevers & H. Herrera 6642 (CAS, MO, PMA). COLOMBIA. Antioquia: 6 km E of Guapa, 53 km S of Turbo, 240 m, 13 May 1945 (stam. fl), O. Haught 4660 (US); Mpio. Anorí, Corregimiento de Providencia, Buenes Aires, 500–600 m, 4 Feb 1972 (fr), D. Sojarto 3205 (HUA, MO, NY); Vicinity Planta Providencia, 26 km S, 23 km W (by air) of Zaragoza, 07° 13’ N, 75° 03’ W, valley of Río Anorí between Dos Bocas and Anorí, 1 Jun 1976 (fr), J. Shepard 323 (COL, WIS); Vicinity Medellín, 20 Aug 1927 (stam. fl), R. Toro 356 (MEDEL, NY); Medellín-Bogotá Hwy, sector Río Samaná-Río Claro-San Luis, 400–1,000 m, 24 Aug 1982 (fr), J. Hernández & S. Hoyas 483 (COL, HUA); Mpio. Urrao, Boundary of Parque Nacional Natural Las Orquídeas, Vereda Calles, Permanent Inventory, Premontane Rainforest, left bank of Río Calles, 06° 32’ N, 76° 19’ W, 1,450–1,500 m, 30 Nov 1993 (stec.), J. Pipoly et al. 17406 (BRIT, JAUM, MO). Boyacá: Region of Cerro Chapón, extreme W part of Boyacá, NW of Bogotá, 2,300 m, 31 Jul 1932 (fr), A. Lawrence 370 (A, NY, S); El Umbo region, 1,000 m, 12 Oct 1932 (stam. fl), A. Lawrence 530 (A, BM, F, G, GH, MO, NY, S, US, UC, US). Chocó: Mpio. Quibdó, Quebrada La Platina, Hwy to Medellín, 25 Sep 1983 (fr), L. Arias et al. 134 (MO); Mpio. San José del Palmar, along Río Torito (affluent of Río Habita), W slopes, 850–950 m, 15 Mar 1980 (fr), E. Forero et al. 7350 , 16 Mar 1980 (fl bud), E. Forero et al. 7393 (COL, MO), Vereda Portachuelo, Hacienda Barro Blanco, 1,350 m, 15 Jan 1983 (fr), P. Franco et al. 1325 (COL); Río Mecana, ca. 10 km E of Mecana, 06° 15’ N, 77° 25’ W, 100 m, 7 Mar 1983 (stam. fl), A. Gentry & A. Juncosa 41072 (COL, MO, JAUM), 710–880 m, 8 Jan 1984 (stam. fl), A. Juncosa 1769 (COL, MO, JAUM); Mpio. Novita, vereda Curundó, left bank, Río Ingara, 550 m, 1 Dec 1983 (fr), P. Franco et al. 1059 (COL); Río Nuquí, 400 m, 25 Jan 1947 (stam. fl), O. Haught 5479 (COL, US); La Mojarra, upriver from Istmína, 05° 12’ N, 76° 37’ W, 30–60 m, 5 Nov 1983 (fr), A. Juncosa 1255 (COL, JAUM, MO, NY); S of Río Condoto, between Quebrada Guarapo and Mandinga, 120–180 m, 22–28 Apr 1939 (fr), E. Killip 35673 (COL, US). Cundinamarca: Cordillera
Bogotá, 2,000 m, Sep 1855 (fr), J. Triana 4 (BM). **Materiales de recolección:**
E. André 1151, 7 Jan 1876 (stcr), E. André s.n. (K); Caño Tigre, entre Caño Agua Chatas and Caño Grande, 4.5 km SW of Villavicencio, 0°4°07' N, 73°39' W, 500–550 m, 24 Feb 1943 (pist. fl), F.R. Fosberg 70148 (COL, US); Llano de San Martín, (stam. fl, pist. fl mixed), H. Karst 49 s.n. (FL 2 sheets). **Nariño:** Mpio. Barbaocas, Corregimiento Ortiz y Zamora, Vereda El Barro, Reserva Natural Río Nambí, ca. 5 km W de Altaquer, faldas occidentales de la Cordillera Occidental, 01°18' N, 78°08' W, 1,350–1,400 m, 1 Sep 1997 (stam. fl), J. Pipoly, A. Cogollo, et al. 21093 (BRIT, FMB, JAUM, PSO), 21144, 21149, 1,450–1,500 m, 2 Sep 1997 (fr), J. Pipoly, A. Cogollo et al. 21483 1,250–1,350 m, 8 Dec 1997 (fr), J. Pipoly, A. Cogollo et al. 21598 (BRIT, JAUM, PSO). **Norte de Santander:** Ocaña, 1200 m, May 1846–52 (stam. fl), L. Schlim 688 (BR-5 sheets, F-2 sheets, G-BOIS-2 sheets, G-DEL, MA-2 sheets). **Santander:** 8 km SE of Barrancabermeja, Río Opón, 200 m, 28 Aug 1954 (stam. fl), R. Castañeda 4746 (COL), vicinity Barrancabermeja, between Ríos Sogamoso and Colorado, 100–500 m, S of Río Sogamoso, Camp Mesa, 8 Jan 1935 (stam. fl), O. Haught 1502 (A, COL, F, NY, US). **Valle del Cauca:** Cordillera Occidental, W slope, along Río Sanquinitin, left side, La Lagana, 1,250–1,400 m, 13 Dec 1943 (stam. fl), J. C. Crotalacis 15474 (VALLE); Bahía Málaga, Quebrada Algéria, new Rd. to military base, 07°02' N, 77°22' W, 50 m, A. Gentry et al. 53326 (COL, MO, US); Bank of Río Dagua, Río San Juan, below Querecal, to the right of river between km 52 and 53, 1,300–1,500 m, 19 Mar 1947 (fr), J. Crotalacis 23855 (COL, F-3 sheets); Calima Dam, 1600–1700 m, 17 Sep 1966 (stam. fl), S. Espinal 2109 (MO, VALLE). **Santander:** 45 km below Maldonado, along path to Tobar Donoso, 800 m, 1 Dec 1979 (fr), H. Madison & L. Besse 7201 (AAU, F, QCNE, SEL); Cantón Tucán, Reserva Indígena Awá, Parroquia Tobar Donoso, sector El Baboso, 00°53' N, 78°20' W, 1,600 m, 3 Oct 1991 (fl, fr), G. Típaez et al. 260 (BRIT, MO, QCNE), (fr), 311 (BRIT, MO, QCNE), Centro El Baboso, 00°53' N, 78°25' W, 1,800 m, 17–27 Aug 1992 (fr), G. Típaez et al. 1950 (BRIT, F, MO, QCNE). **Esmeraldas:** Cantón San Lorenzo, Reserva Indígena Awá, Cañón del Río Mira, 10 km W of Alto Tambo, Comunidad “La Unión,” 01°02' N, 78°26' W, 250 m, 16–26 Mar 1991 (fr), D. Rubio et al. 1262 (MO, QCNE). **Sucumbios:** Cantón Lago Agrio, Reserva Cuyabeno, Laguna Grande, Near NEOTROPIC Cabins, 00°00' S, 76°11' W, 230 m, 15 Nov 1991 (stam. fl), W. Palacios et al. 9269 (BRIT, MO, QCNE). **Zamora-Chinchipe:** Cantón Nangaratza, Valle del Río Nangaratza, Mazi, 04°18' S, 78°40' W, 1,200 m, 10 Dec 1990 (pist. fl), W. Palacios 6734 (BRIT, MO, QCNE), Behind military camp, 04°16' S, 78°42' W, 970 m, 20 Oct 1991 (stam. fl), W. Palacios et al. 8483 (BRIT, MO, QCNE). **PERÚ:** **Amazonas:** Camino de chicijam, entsa, 180–250 m, 2 May 1973 (stam. fl), R. Kayap 728 (MO); Valle del Río Santiago, 03°50' S, 77°40' W, Quebrada Caterpira, 2–3 km behind Caterpira, 200 m, 4 Jan 1980 (stam. fl), S. Tamqui 549 (MO). Loreto: Prov. Maynas, Guarnición Pijuaay, near Pebas, 130 m, 7 Sep 1988 (stam. fl), C. Díaz et al. 566 (MO). Ucayali: Prov. Padre Abad, Boquerón del Padre Abad, 400 m, 20 May 1969 (fr), J. Schanke 3068 (F-2 sheets, US, USM). **BRAZIL:** **Amazonas:** Mpio. Humayatá, on plateau between Río Livramento & Río Ipixuna, 7–18 Nov 1934 (stam. fl), B. Kruckoff 7290 (A, NY, S, U); São Paulo de Olivença, near Esperança, Dec 1935 (ster.), B. Kruckoff 7663 (K, NY), Behind São Paulo de Olivença, 16 Aug 1973 (fr), E. Lleras et al. P17315 (GB, INPA, MG, NY); km 500, Manaos-Humayatá Rd., 17 Sep 1980 (stam. fl), S. Lourie et al. 52 (INPA,


The “pseudocataphylls” referred to in the description are poorly developed and do not occur in a regular phyllotactic spiral as is found in subgenus Comomyrsine. Likewise, their morphology is essentially that of a leaf arrested at different stages of development, and as such, do not have a distinctive morphology.

Northern populations from Nicaragua and Costa Rica corresponding to the type of C. spectabilis (as Ardisia spectabilis) differ in their smaller flowers and anther connectives sometimes eglandular, a feature which is more a function of ecotype then anything else. Eglandular anthers and entire leaves may be found in very lowland wet forest populations in the Darién of Panama, and the Chocó of Colombia.

The type of Weigeltia multiflora A.C. Sm. represents populations whose inflorescences are less branched (although the duplicates of the type collection vary in that regard) and the largest flowers of the species. They, like many of the Panamanian populations, have entire leaves and are otherwise inseparable from the type of Weigeltia triandra Asplund.

The collections of Kayap from Amazonian Peru are referred to this species, despite their longer petioles.


Polyaxial dioecious or rarely, monoecious shrubs or small trees. Roots positively geotropic. Trunk distinguishable, growth dynamics following Rauh’s Architectural Model (in ours), rarely Corner’s Model (not in Ecuador or Peru) sensu Hallé et al. (1978). Bark grey to beige, thick, vertically fissured. Branchlets sessile furfuraceous lepidote or rarely, rufous tomentose, often glabrescent Cataphylls and pseudocataphylls absent. Leaves alternate, rarely subopposite, with minute sessile rufous furfuraceous lepidote scales abaxially. Inflorescence a pinnate or bipinnate panicle, rarely a simple raceme; peduncle 0.5–2 cm long. Flowers 4- rarely 5-merous; calyx valvate, crenate or rarely entire, glabrous or rarely glandular-ciliolate, punctations red or black, prominent or not; corolla rotate to subrotate, the lobes imbricate, glandular-granulose only at the junction with the corolla tube, the punctations red or black, conspicuous, or rarely, prominent; stamens and staminodes united to form an inconspicuous or conspicuous tube, the tube without lobes alternating
with the apically free filaments, the filaments one to three times longer than the anthers, terete, and recurved proximally, the anthers subglobose, or widely ovoid, versatile, apically acute to emarginate, basally widely cordate, dehiscent by wide longitudinal slits, the connectives mostly prominently red or black punctate; pistil conic, pyriform or obturinate, the ovary translucent glandular-lepidote or glabrous, the style capitate-lobate, the lobes entire; pistillode minutely conic, or at times, absent. Fruit globose or depressed-globose.

_Cybianthus_ subgenus _Weigelia_ contains approximately 46 species in South America and the Caribbean. Five species are known from Ecuador and Peru; they are restricted to the lowlands and premontane forests on the lower slopes of the Western Cordillera in Ecuador and the Eastern Cordillera in Ecuador and Peru.

KEY TO SPECIES OF _CYBIANTHUS_ SUBGENUS _WEIGELIA_

1. Inflorescence bipinnately paniculate; petioles canaliculate; staminate flowers with stamens shorter than corolla.
2. Branchlets terete; leaf blades apically long attenuate-subulate, basally long-attenuate.
   3. Branchlets 2.5–4 mm diam., minutely rufous-lepidote; leaves pseudoverticillate, the blades membranaceous, prominently black punctate-lineate below, margins subentire to obtusely serrate; petioles 0.5–1.5 cm long; calyx membranaceous, 1–1.3 mm long, the lobes obtuse, prominently punctate, glandular-ciliate along the margin. ............... 23. _C. poepigii_
   4. Branchlets angulate, 8–10 mm diam., conspicuously rubiginous punctate-lineate; leaf blades coraceous, conspicuously rubiginous punctate-lineate below; petioles 2.5–3 cm long; staminate calyx membranaceous, 1.4–1.6 mm long, the lobes apically acute; staminate corolla membranaceous, 2.3–2.5 mm long; stamens 1.8–2 mm long. ............... 25. _C. vasquezii_
3. Branchlets 5.5–6 mm diam., minutely ferrugineous tomentellous; leaves alternate, the blades chartaceous, minutely and prominently puncticulose below, margins entire; petioles 2–3.5 cm long; calyx chartaceous, 0.7–1 mm long, the lobes acuminate, epunctate, glabrous along the margin. .......................................................... 24. _C. pseudolongifolius_
2. Branchlets angulate or winged; leaf blades apically acute or short-acuminate, basally acute or cuneate.
   4. Branchlets angulate, 8–10 mm diam., conspicuously rubiginous punctate-lineate; leaf blades coraceous, conspicuously rubiginous punctate-lineate below; petioles 2.5–3 cm long; staminate calyx membranaceous, 1.4–1.6 mm long, the lobes apically acute; staminate corolla membranaceous, 2.3–2.5 mm long; stamens 1.8–2 mm long. ............... 25. _C. vasquezii_

1. Inflorescence racemose; petioles marginate; staminate flowers with stamens exerted or equalling corolla. .......................................................... 27. _C. nanayensis_


Shrub or small tree to 4(–7) m tall. Branchlets thin, terete, 2.5–3.5(–4) mm diam., minutely rufous-lepidote. Leaves in loose pseudoverticils; blades membranaceous, elliptic, oblanceolate, lanceolate or rarely obovate, (6–)6.8–18.5(–24) cm long, (2.2–)3.5–6.5(–8.5) cm wide, apically acuminate to subacuminate-attenuate, basally cuneate to acute, not decurrent on the petiole, midrib depressed above, prominently raised below, the secondary veins 7–12(–14) pairs, rufous lepidote above and below early glabrescent above, tardily glabrescent below, sparsely black punctate and densely black punctate-lineate below, the margin flat, subentire to obtusely serrate; petioles canaliculate, 0.5–1.5 mm long, minutely rufous-lepidote. Staminate and pistillate inflorescences monomorphic, bipinnately paniculate, somewhat pyramidal, sometimes malformed and appearing racemose, 8–15 cm long, 8–10 cm wide, the rachis densely glandular-papillate, the flowers racemose; inflorescence bracts unknown; floral bracts membranous, linear-lanceolate, 1–2.5 (–3.5) mm long, 0.3–0.8(–1.2) mm wide, apically attenuate, densely glandular-papillate, epunctate, the margin glandular-ciliate; pedicels cylindrical, (0.7–)1.6–1.9(–2.5) mm long, densely glandular-papillate. Staminate flowers 4-merous, yellow or yellowish-green; calyx membranaceous, cotyliiform, 0.8–1.3 mm long, the tube 0.2–0.3 mm long, glabrous, the lobes widely ovate to suborbicular, (0.6–)1 mm long, (0.5–)0.6–1 mm wide, apically obtuse, prominently punctate, the margin hyaline, irregular, erose-serrate apically, densely glandular-ciliate; corolla membranaceous, rotate, (1.7–)1.8–2.2(–2.6) mm long, the tube (0.3–)0.4–0.6 mm long, glabrous without, glandular-granulose within, the lobes suborbicular, (0.9–)1.2–1.6(–2) mm long, (0.8–)1.2–1.7(–2) mm wide, apically obtuse, prominently punctate, glabrous without, glandular-granulose medially at stamen base within, the margin hyaline, irregular, erose; stamens (1–)1.4–1.6 mm long, the tube inconspicuous, hyaline, (0.3–)0.4–0.6 mm long, densely glandular-granulose within, the apically free portions of the filaments (0.3–)0.4–0.5 mm long, the anthers ovate-triangular, 0.3–0.4 mm long, 0.2–0.3 mm wide, apically rounded, basally obtuse, the connective epunctate; pistillode conic, 0.3–0.4 mm long, densely rufous glandular-papillate. Pistillate flowers as in staminate, but calyx 1–1.3 mm long, the tube 0.2–0.3 mm long, the lobes delate to widely elliptic, 0.8–1 mm long and wide, the margin opaque; corolla 2–2.3 mm long, the tube, 0.6–0.7 mm long, the lobes 1.4–1.6 mm long, 0.6–0.7 mm wide,
glandular-granulose within above filament junction with tube, the margin often erose; staminodes resembling stamens but 1–1.3 mm long, the staminodial tube ca. 0.6 mm long, the apically free portions of the filaments to 0.3 mm long, the antherodes suborbicular, to 0.2 mm long and wide; pistil obnuptiform, 1.2–1.3 mm long, the ovary 0.8–0.9 mm long, 0.3–0.5 mm wide, densely translucent-lepidote, the style 0.3–0.4 mm long, the stigma bilobed, the lobes decurrent, ca. 0.4 mm long. Fruit depressed-globose, 3.5–4.5 mm long, 4.5–6 mm diam. when dried, red, then black at maturity, inconspicuously punctate, exocarp thin.

**Distribution.**—Known from the easternmost Darién of Panama south to Amazonian Peru and Brazil, 100–1,800 m.

**Ecology and conservation status.**—Cybianthus poepigii is a broad ranging polymorphic ochlospecies, occurring in primary premontane wet and pluvial forests, from the transition zone with lowland forests, to the transition zone to cloud forests. Recent fieldwork in the Cordillera Occidental of Colombia has shown it is a conspicuous element of primary pluvial premontane forests, with a density of approximately 20 individuals per hectare, clustered mostly along the margin of the windward side of the forest, and along streambanks above the high water level. While locally common, its restricted primary habitat verifies its threatened status.

**Etymology.**—The specific epithet honors Eduard F. Poeppig (1798-1868), professor at Leipzig, explorer and plant collector, who made numerous valuable contributions to our knowledge of the Peruvian Amazon Basin.

Representative specimens examined. **PANAMA.** Darién: Serranía del Darién, Panama/Colombia frontier, Cerro Tacaracuna, Cerro Mali, summit, 1,400 m, 17 Jan 1975 (stam. fl), A. Gentry & S. Mori 13665 (LL-TEX, MO-2 sheets), W ridge, Cerro Tacaracuna, 1,800–1,850 m, 31 Jan 1975 (fr), A. Gentry & S. Mori 14023 (COL, LL-TEX, MO-2 sheets); Serranía de Pirrče, Cerro Pirrče, above Canal Gold Mine between Ríos Cana and Escucha Ruido, 1,000–1,310 m, 27 Jul 1976 (stam. fl), T. Croat 37785 (LL-TEX, MO, NY, PMA), SW ridge leading to Alturas de Nique, Panama/Colombia border, 1,100–1,200 m, 30 Dec 1980 (stam. fl), R. Hartman 12401, 12461 (MO). **COLOMBIA.** Antioquia: Mpio. De Anorí, Corregimiento Providencia, Río Anorí Valley, between Dos Bocas and Anorí, 400–900 m, 24–31 May 1973 (fr), D. Nejerto et al. 4090 (A, COL, F, HUA, MO); Mpio. Sonson, Río Verde region, Hacienda “La Soledad,” 1,430–1,800 m, 21 Jan 1947 (stam. fl), G. Gutierrez 1186 (F, MEDEL, MO, UC); Mpio. San Carlos, Corregimiento Alto de Samaná, Vereda Mirafloros, 820–900 m, 15 Jun 1989 (stam. fl), R. Fonnegra et al. 3076 (BRIT, HUA). Mpio. Urrao, Parque Nacional Natural Las Orquídeas, Vereda Calles, Permanent Inventory, right bank, Río Calles, 06° 32' N, 76° 19' W, 1,450 m, 27 Nov 1993 (ster.), J. Pipoly et al. 17183 (BRIT, JAUM, MO), 1,150–1,500 m, 29 Nov 1993 (ster. seedling), J. Pipoly et al. 17360 (BRIT, JAUM, MO). Chocó: Mpio. San José del Palmar, vereda “El Tabo,” 1,510 m, 18 Jan 1983 (pist. fl), P. Franco et al. 1469 (COL). Vaupés: Río Pacoa (tributary of Río Apaporís), 00° 20' N, 71° 20' W, 300 m, 7–12 Feb 1952 (pist. fl), R. Schultes & I. Cabrera 15423 (COL, GH, US). **ECUADOR.** Morona-Santiago: Macuana, 50 km N of Macas, 21 Mar 1973 (pist. fl), H. Lago 3633 (GB); Río Cayes and Boboiza-Gualaquiza Rd., 03° 25' S, 78° 35' W, 800 m, 1 Nov 1986 (stam. fl), W. Palacios 1466 (MO, US). **Napo:** Between Tena and Napo. 1 Jan
Cybianthus poeppigii was mistakenly placed by Agostini (1980) in subgenus Cybianthus, but the versatile, dorsifixed anthers clearly place it in subgenus Weigeltia. I had reported earlier (Pipoly 1983a) that Cybianthus albiflorus, its synonym, was closely related to C. lawrencei Moldenke. However, the bipinnate inflorescences with racemose flowers, stamens shorter than the corolla and usually long petiolo indicate that Cybianthus poeppigii is more closely related to C. longifolius Miq., a vicariant species of the southwestern Amazon Basin of Brazil and adjacent Bolivia. The glandular granules of the staminal and staminaloid tubes represent a unique (autapomorphic) character state within the genus.

The holotype of Cybianthus poeppigii is staminate, as are those of its taxonomic synonyms. The type of Weigeltia albiflora (Cybianthus albiflorus) represents populations with entire, irregularly margined leaves, but is otherwise qualitatively identical with that of C. poeppigii. Likewise, the type of Cybianthus gentry Lundell represents isolated montane populations of the Darién/Chocó regions, and exhibits more notable lineate-punctations, much smaller leaves, and abbreviated inflorescences. According to annotations by Killip at US, description of another taxon was at one time contemplated, based on the fact that the populations of this species from near Tena, Ecuador, have roughly serrate leaf margins.

24. Cybianthus pseudolongifolius Pipoly, sp. nov. (Fig. 18). Type: PERU.
Pasco: Prov. Oxapampa, Palcazu Valley, Cabeza de Mono, 5–6 km W of Isocasín 10° 12' S, 75° 14' W, 325 m, 13–19 Apr 1983 (fr), D. Smith 3808 (holotype: MO; isotypes: US, USM).

Quod folia magna chartacea, inflorescentias bipinnatipaniculatas, pedicellis cylindricis, lobos calycinis ovariis, ca. 1/3 connatis, petioli canaliculatos C. longifolius arcte accedens, sed ab ea ramulis teretibus (non angulatis), 5–5–6 (non 3.5–4) mm diametris, laminis anguste oblongoelatis (non ellipticis vel lanceolatis) desuper sordidis (non nitidis) ad apices longi-
Fig. 18. Cybianthus pseudolongifolius Pipoly. A. Habit, showing bipinnate panicles. B. Peduncle and axillant leaf, showing canaliculate petiole. C. Detail of prominently puncticulose abaxial leaf surface. D. Pedicel, calyx and fruit, showing hyaline and erose calyx lobes. A & C, drawn from isotype; B & D, drawn from holotype. Figure drawn by Linda Ellis.
attenuatis et subulatis (nec acutis vel acuminatis) ad bases longi-attenuatis (nec acutis), inflorescentiis 8–13 (non 15–20) cm longis, pedicellis 2.8–3 (nec 0.6–1) mm longis necnon fructibus depresso-globosis (nec globosis) arque minute cosatis (nec laevibus) perfoliato discenda.

Treelet to 3 m tall. Branchlets terete, 5.5–6 mm diam., densely and minutely ferrugineous tomentellous. Leaves alternate; blades chartaceous, narrowly oblanceolate, (22–)26.5–33 (–36.5) cm long, (5–)6.5–8.5 cm wide, apically long attenuate, subulate, basally long-attenuate, decurrent on the petiole, sordid and glabrous above, pallid, minutely and prominently pellucid puncticulose and minutely ferrugineous puberulent below, midrib slightly raised above, prominently raised below, the secondary veins 13–18 pairs, the margin entire, glabrous, flat; petioles canalicate, (2–)2.5–3 (–3.5) cm long, glabrous above, minutely ferrugineous puberulent below. Stamine inflorescence: unknown. Pistillate inflorescence: a lax bipinnate panicle, 8–13 cm long, 1.5–4 cm wide, densely ferrugineous puberulent, glabrescent; secondary inflorescence bracts unknown; floral bracts unknown; pedicels cylindrical, 2.8–3 mm long, densely ferrugineous puberulent; Pistillate flowers unknown; fruitsing calyx chartaceous, cotyliform, 0.7–1 mm long, the tube 0.3–0.4 mm long, the lobes ovate, 0.5–0.7 mm long, 0.5–0.6 mm wide, apically acuminate, densely and prominently red punctate, the margin hyaline, erose, epunctate, glabrous. Fruit depressed-globose, 3–4 mm long, 5–6 mm diam., inconspicuously pellucid punctate, minutely longitudinally costate.

Distribution.—Known only from the type.

Ecology and conservation status.—Cybianthus pseudolongifolius appears to be restricted to the lowland primary forest of the eastern Andean slopes. The Oxapampa Province of Pasco is home to numerous Peruvian endemics, and it would not be surprising if the species was of extremely limited distribution or endemic. With only one specimen known, no determination can be made of its true conservation status.

Etymology.—The specific epithet refers to its general likeness to Cybianthus longifolius Miq., a lowland black water river species from Amazonian Brazil and Venezuela.

Cybianthus pseudolongifolius is most closely related to C. longifolius, but differs by its terete branchlets, 5.5–6 mm in diameter, narrowly oblanceolate leaf blades that are sordid above, long-attenuate and subulate apically and long-attenuate basally, longer inflorescences, much longer pedicels and depressed-globose, minutely costate fruits. The Oxapampa region of Pasco contains a number of endemic species and disjunct taxa and as such, is one of the most important underexplored areas in Peru.

25. Cybianthus vasquezi Pipoly, sp. nov. (Fig. 19). Type: PERU. LORETO: Prov. Alto Amazonas, Capahuari Norte, 02° 45' S, 76° 25' W, 220 m, 7 Jun 1981 (stam. fl), R. Vásquez & N. Jaramillo 1993 (holotype: MO; isotypes: AMAZ, BRIT, F, NY, US, USM).
Fig. 19. *Cybianthus vasquezii* Pipoly. A. Habit, showing angulate, punctate-lineate branchlet. B. Inflorescence branch, showing racemose-glomerulate floral arrangement. C. Open corolla. D. Abaxial calyx lobe surface. E. Abaxial leaf surface, showing minute furfuraceous scales and prominent punctate-lineations. F. Branchlet apex. A–F, drawn by Linda Ellis, from holotype.
Propter ramulos crassos manifeste angulatos, folia coriacea subter pallida ad apices subacuminata ad bases acuta, petioli callicallaros, inflorescentias angustae bipinnatifidocallaros, ramulos infloroscentiis dense spicatos vel glomerulos lobos calycines grosse crenatos C. potteo valde affinis sed ab ramulis rubiginoso-punctato-lineatis (non epunctatis), folia pseudoverticillata (non alterna), laminis oblancoleatis (nee ellipticis), (9—10) 13—15.3 (nee 6.5—8) cm latis, petioliis 2.5—3 (nee 1.5—2) cm longis, inflorescentiis 12—25 (non 3—6) cm longis, corollae lobis ovatis (non ellipticis) ad apices acute rotundatis (nee emarginatis) ad bases abrupte constrictis (nee rectis), secus margines grosse crenatis (nee integerrimis) confeste separabilis.

Terrestrial dioecious tree to 8 m tall. Branchlets angulate, 8—10 mm diam., densely and minutely rubiginous furfuraceous-lepidote, conspicuously rubiginous punctate-lineate below. Leaves pseudoverticillate; blades coriaceous, oblancoleate, (21—)26—34.5 cm long, (6.5—)9—12.2 cm wide, apically acute to subacuminate, basally acute, decurrent on the petiole 4—7 mm, glabrous above, very minutely rubiginous furfuraceous-lepidote below, the midrib slightly raised above, prominently raised and rubiginous punctate-lineate below, the secondary veins 7—10 pairs, slightly impressed above, prominently raised below, the margin entire, flat; petioles callicallar, 2.5—3 cm long, swollen below to 0.5—0.7 cm diam. basaly, rubiginous furfuraceous-lepidote at first, early glabrescent, conspicuously rubiginous punctate-lineate. Staminate inflorescence: a bipinnate panicle (12—)14—17.5 (—25) cm long, 2—3 cm wide; peduncle (1—)2—3.5 cm long; secondary inflorescence bracts chartaceous, linear, 2—3 mm long, 0.3—0.6 mm wide, apically attenuate, densely glandular-papillate, the margin entire; branches racemose-glomerulate (0.5—)1—1.5 cm long; floral bracts membranaceous, linear, 1.6—1.8 mm long, 0.3—0.4 mm wide, apically attenuate, densely rubiginous puberulent; pedicels cylindrical, 0.3—0.5 mm long, glabrescent. Staminate flowers 4-merous, pink; calyx membranaceous, corylliform, 1.4—1.6 mm long, the rube ca. 0.2 mm long, the lobes ovate, 1.2—1.4 mm long, 1—1.1 mm wide, apically acute, sparsely and inconspicuously orange punctate, glabrous, the margin coarsely crenulate, glabrous; corolla membranaceous, subrotate, 2.3—2.5 mm long, the tube 0.2—0.3 mm long, densely glandular-granulose, the lobes ovate, 2—2.3 mm long, 1.7—1.8 mm wide, apically acutely rounded, abruptly constricted basaly, inconspicuously orange punctate without, sparsely gladular-granulose behind the base of the filaments, the margin hyaline, coarsely crenate, glabrous; stamens 1.8—2 mm long, the tube carnose, squarrose, 0.2—0.3 mm long, the filaments terete, 1.1—1.2 mm long, slightly curved proximally, the anthers ovate, 0.5—0.6 mm long, 0.6—0.7 mm wide, apically rounded, basaly cordate, the connectives inconspicuously orange punctate dorsally; pistilode obturinale, 0.5 mm long, 0.6 mm diam., the stigma truncare, minutely lobed. Pistillate inflorescence as in stamine but (3.5—)5.5—9.5 cm long, the branches glomerulate. Pistillate flowers as in stamine but red, except white on corolla lobe apices; calyx obconic, 1.3—1.7 mm long, the tube 0.6—0.8 mm long, the lobes very widely ovate to suborbicular, 0.7—
1.2 mm long, 0.8–1.2 mm wide, apically broadly rounded, corolla 2.3–2.7 mm long, the tube 0.6–0.8 mm long, the lobes suborbicular, 1.5–1.7 mm long, 1.5–1.8 mm wide, the margin irregular, hyaline, staminodial tube 1–1.3 mm long, the apically free portions of the filaments 0.4–0.5 mm long, the antherodes 0.3–0.4 mm long and wide; pistil obnapiform, 2.2–2.4 mm long, 1.3–1.5 mm diam, the ovary 1.3–1.5 mm long, the style thick, 1.1–1.3 mm long, the stigma capitate, 4-lobed, the lobes recurved, the placenta deeply cupuliform, the ovules 2–3, imbedded. Fruit unknown.

Distribution.—Known only from the Department of Loreto, in Alto Amazonas and Loreto Provinces, Peru, at 160–220 m elevation.

Ecology and conservation status.—Cybianthus vasquezii occurs in primary terra firme lowland forest, with scattered white sand areas. Label data do not allow determination of whether this species occurs on the laterite or on the sands. Because it is known only from two gatherings, its conservation status is unknown. However, its importance as a tonic in Mayna Jívaro culture may indicate it is locally common.

Etymology.—It gives me great pleasure to dedicate this species to a great friend and colleague, Ing. Rodolfo Vásquez Martínez, Assistant Curator and Director of the Flora of Peru Program of the Missouri Botanical Garden. Vásquez is an indefatigable collector, a forestry engineer, dendrologist, taxonomist and author of numerous publications on uses of Peruvian forest products, economic plants of the Peruvian Amazon, and Flore of the Biological Reserves of Iquitos. He is a taxonomic authority on Carapuca and Myristicaceae of the Amazon Basin.

Local names and uses.—Peru: “sésa,” “kurúp” (Mayna Jívaro). The sap is extracted and a juice is drunk to “improve hunting ability.”

Paratype: PERU. Loreto: Prov. Loreto, Pampa Hermosa and vicinity, Río Corrientes, 1 km S of junction with Río Macusari, 03° 15' S, 75° 50' W, 160 m, 15–20 Dec 1985 (pist. fl), W. Lewis et al. 10306 (BRIT, MO).

Cybianthus vasquezii is most closely related to C. potirei of the eastern Amazon Basin (French Guiana and Brazil (Amapá, Bahía), but is easily recognized by the conspicuously rubiginous punctate-lineate branchlets, larger pseudoverticillate, oblancoleate leaves, longer petioles and inflorescences, ovate, apically rounded corolla lobes that are abruptly constricted basally, and coarsely crenate along the margins.

26. Cybianthus cenepensis Pipoly, sp. nov. (Fig. 20). Type: PERU. AMAZONAS: Río Cenepa, vicinity Huampani, ca. 5 km E of Chávez Valdivia, 04° 30' S, 78° 30' W, 200–250 m, 12 Aug 1978 (stam. fl), A. Kujikat 265 (HOLOTYPE: MO; ISOTYPES: F, MO, NY, US, USM).

Ob folia characeae oblancoleata ad apices acuminata ad bases cuneata, petiolis canalicuatos, inflorescentias angusti bipinnatipaniculatas, ad C. buechtiensi valde affinis sed ab ca ramulis alaris (nec laevibus), petiolis 2–2.5 (non 1.5–1.8) cm longis, lobis calycinis late ovatis (nec
Fig. 20. Cybianthus cuneepensis Pipoly. A. Habit, showing winged branchlets. B. Staminate inflorescence branch, showing secondary inflorescence branch bracts. C. Staminate flower, showing stamens subequal to corolla lobes, conspicuous square staminal tube, and coarsely crenate corolla lobes. D. Pistillate flower, showing ellipsoid pistil. E. Pistillate inflorescence branch, showing dense spike appearing glomerulate. D. Branchlet apex, showing puberulent vestiture. A drawn from holotype. B–D, drawn from Aucuash 522. E–F, drawn from Kujikai 306. Figure drawn by Linda Ellis.
lineari-lanceolatis), grosse crenatis (nec integerrimis), lobis corollinis grosse crenatis (nec enteris) denique antheris ad apices acutis (nec rotundatis) ad bases cordatis (nec obtusis) perfacile distinguitur. 

Treetlet to 2 m tall. Branchlets prominently longitudinally ridged, the ridges forming small, rounded wings, (2.5–3–5–6 mm diam., sparsely rufous puberulent, glabrescent. Leaves alternate; blades chartaceous, oblanceolate, (13.7–)18.5–23(–26.2) cm long, (4–)6–10 cm wide, apically acuminate, basally cuneate, glabrous above, sparsely rufous puberulent below, glabrescent, inconspicuously pellucid punctate, the margin entire, flat; petioles canaliculate, 2–2.5 cm long, sparsely rufous puberulent, glabrescent. Staminate inflorescence a lax bipinnate panicle, 14–18 cm long, 1.7 cm wide, the rachis densely rufous papillate; secondary inflorescence bracts chartaceous, linear-lanceolate, 4–4.5 mm long, 1–1.2 mm wide, apically subulate, densely rufous tomentellotis, forming densely long, densely glandular-papillate, the margin crenulate, glabrous; pedicels cylindrical, 0.2–0.3 mm long, densely glandular-papillate. Staminate flowers 4-merous, chartaceous, brownish-purple, 1.6–1.8 mm long; calyx coryliform, 1–1.2 mm long, the tube 0.3–0.4 mm long, the lobes broadly ovate, 0.7–0.8 mm long, 0.6–0.7 mm wide, apically acute, prominently brown punctate, the margin hyaline, coarsely crenate, glabrous; corolla subrotiate, 1.2–1.3 mm long, the tube ca. 0.1 mm long, densely glandular-granulose within, the lobes widely ovate, 1–1.2 mm long, 0.8–1 mm wide, apically subacuminate, glabrous and inconspicuously orange punctate without, glabrous within except under the filaments, the margin hyaline, coarsely crenate, glabrous; stamens subequalling the corolla lobes, 1–1.1 mm long, the tube conspicuous, carnose, square, 0.1–0.2 mm long, densely glandular-granulose, the filaments 0.6–0.7 mm long, the anthers ovate, 0.3–0.4 mm long, 0.4–0.5 mm wide, apically acute, basally cordate, the connective inconspicuously orange punctate; pistillode obturbinate, 0.1–0.2 mm long, 0.2–0.3 mm diam., hollow, glabrous. Pistillate inflorescence as in staminate but 12–14 cm long, 0.8–1.0 cm wide; secondary inflorescence bracts 3.8–4.1 mm long, 0.8–1 mm wide; inflorescence branches 3.5–6 mm long; floral bracts 1–1.2 mm long, 0.1–0.2 mm wide; pedicels 0.2–0.3 mm long. Pistillate flowers as in staminate but white, 1.1–1.4 mm long; calyx 0.6–0.8 mm long, the tube 0.1–0.2 mm long, the lobes 0.5–0.6 mm long, 0.3–0.4 mm wide; corolla 0.7–0.8 mm long, the tube ca. 0.1 mm long, the lobes 0.6–0.7 mm long, 0.5–0.6 mm wide; staminodes much shorter than the corolla lobes, 0.3–0.4 mm long, the tube conspicuous, carnose, circular, ca. 0.1 mm long, the filaments ca. 0.1 mm long, the anthers 0.2–0.3 mm long, 0.1–0.2 mm wide; pistil ellipsoid, 0.5–0.6 mm long, 0.2–0.3 mm diam., the style 4-lobed, the lobes curved distally, pla-
centa subobose, bearing 4 partially immersed ovules. Fruit globose, 6–7 mm long and in diam., prominently red punctate.

**Distribution.**—Known only from the Río Cenepa Drainage Basin, Amazonas, Peru, 200–250 m elevation, and from one disjunct population from Napo, Ecuador, very close to the Colombian border.

**Ecology and conservation status.**—*Cybianthus cenepensis* inhabits várzea forests in the Amazon of Ecuador and Peru. Despite lack of collections, it is known that the Napo and the Cenepa Rivers are shallower than many with their same volume, thus giving them strong currents. Aside from the need for much more exploration at the edge of the Amazon Basin in Ecuador and Peru, perhaps the strong current of these rivers makes the dynamics of their adjacent várzea forests different from others in Amazonia. At this time, the conservation status of this species is unknown.

**Etymology.**—The specific epithet refers to the region of Peru from which the type was collected, the Río Cenepa Drainage Basin of the Alto Amazonas Province, Amazonas Department, Peru.

**Local names and uses.**—Peru: “sauka” (Huambisa).

**Paratypes.** ECUADOR. Napo: Cantón Orellana, Yasuní National Park, Maxus Rd. and pipeline construction project, km 15, 01° 31' S, 76° 32' W, 250 m, 30 Jun 1994 (bud), N. Pitman 461 (BRIT, MO, QCNE); Río Yasuní, periodically inundated forest ca. 80 km upriver from Nuevo Rocafrute, 225 m, 17 Sep 1977 (Fr), R. Foster 3708 (F, QCA). PERU. Amazonas: Quebrada Sasa, Río Cenepa, 250 m, 2 Jun 1973 (stam. fl), E. Ancash 522 (MO, USM); Río Cenepa, vicinity of Huampami, ca. 5 km E of Chávez Valdivia, ca. 4° 30' S, 78° 30' W, 200–250 m, 12 Aug 1978 (pist. fl), A Kajikat 306 (F, MO, USM); Quebrada Chigu, 4° 30' S, 78° 30' W, 11 Aug 1978 (bud), E. Ancash 1412 (MO, USM).

*Cybianthus cenepensis* is closely related to *C. buchtieni* Pax of the Mapiri region in Bolivia. However, *Cybianthus cenepensis* is easily recognized by its winged branchlets, petioles 2–2.5 cm long, widely ovate and coarsely crenate calyx lobes, coarsely crenate corolla lobes, and anthers with acute apices and cordate bases. The ellipsoid pistil is also unique within the subgenus.


Subshrub to shrub to 0.5(–1.5) m tall. Branchlets 0.2–0.5 cm thick, smooth, rufous-lepidote. Leaves in loose pseudoverticels; blades chartaceous to subcoriaceous, elliptic, lanceolate or oblanceolate, (7–)11–18(–25.5) cm long, (2.9–)3.5–7.5(–10) cm, apically acute to acuminate, basally acute to cuneate, midrib depressed above, prominently raised below, the secondary veins 7–16 pairs, glabrous above, sparsely and minutely rufous-lepidote below, puncticulate, the margin flat, entire; petioles marginate, (0.6–)0.9–1.5 cm long, glabrous. Inflorescences monomorphic, a simple raceme or rarely with a second, malformed basal branch, (1.5–)3–9.5(–14.5) cm long, the rachis densely glandular-papillate; floral bracts membranaceous, linear-lanceolate, 0.2–1.2 mm long, 0.1–0.2 mm wide, the apically long-attenuate, sparsely glandular-papillate, the margin glandular-ciliate, entire; pedicels cylindrical, (0.7–)1–1.5(–2) mm long, densely glandular-papillate. Staminate flowers: white to cream, 4-merous, chartaceous; calyx cotyliform, 1–1.3 mm long, the tube ca. 0.1 mm long, the lobes widely ovate to deltate, 0.9–1.2 mm long, 0.8–1.2 mm wide, apically acute to acuminate, medially thickened and prominently black punctate, glabrous, the margin hyaline, irregular, densely glandular-ciliolate; corolla rotate, 1.9–2.3 mm long, the tube 0.6–0.8 mm long, the lobes widely ovate to ovate, 1.3–1.6 mm long, 1.2–1.4 mm wide, apically acute to rounded, subentire or apically notched, medially thickened and prominently black punctate, glabrous without, glandular-granulose within at junction of tube and lobe, the margin hyaline, irregular, glabrous; stamens 2.2–2.5 mm long, exserted or rarely subequal to corolla, the staminal tube carnose, conspicuous, 0.5–0.7 mm long, subtruncate between the filaments, the apically free portions of the filaments terete, (1.2–)1.4–2 mm long, the anthers widely ovate, 0.32–0.36 mm long, apically rounded to obtuse, basally cordulate, the connective prominently punctate dorsally; pistillode vestigial, obclavate or tubiform, 0.7–0.8 mm long, sparsely translucent glandular-lepidote, hollow. Pistillate flowers as in staminate but beige to brown; calyx 2–2.1 mm long, the tube 0.1–0.2 mm long, the lobes 1.9–2 mm long, 1.9–2 mm wide; corolla cotyliform, 1.9–2 mm long, the tube 0.5–0.6 mm long, the lobes widely ovate, 1.2–1.4 mm long, 1.3–1.4 mm wide, apically acute to acuminate; staminodes resembling stamens, 1.2–1.3 mm long, the staminodial tube 0.5–0.6 mm long, the filaments 0.4–0.5 mm long, the antherodia subquadrate, ca. 0.2 mm long and wide, apically obtuse, basally truncate; pistil ellipsoid, 1.4–1.6 mm long, the ovary 1–1.2 mm long, 1.1–1.2 mm diam., densely translucent glandular-lepidote, the placenta cupuliform, ovules 2, partially immersed, the style truncate, 0.3–0.4 mm long, the stigma punctiform. Fruit depressed-globose, 4.5–5.5 mm long, 5.5–6.5(–7) mm diam., yellow when fresh, prominently black punctate.
Distribution.—Endemic to the tall moist forests on white sands of the Peruvian Amazon, primarily from the Iquitos area, 100–160 m.

Ecology and conservation status.—Cybianthus nanayensis is locally common, and thrives in gaps left by large treefalls in overmature forests, and along the margins of forest margins and paths, where it occurs in a rather dense herbaceous layer. However, it does not tolerate compacted soils. With decreasing quantities of habitat owing to logging pressures, the species should be considered threatened. As a gap species growing on nutrient deficient soils, and with very attractive fruits, Cybianthus nanayensis shows great promise as a potentially marketable horticultural plant.

Etymology.—The epithet takes its name from the river basin where it occurs, the Nanay River.

Representative specimens examined. PERU. Loreto: Prov. Loreto, Nauta, 04°32' S, 73°35' W, 160 m, 2 Jun 1984 (stam. fl), R. Vásquez & N. Jaramillo 5075 (AMAZ, MO, NY), (fr), R. Vásquez & N. Jaramillo 5086 (AMAZ, MO); Prov. Maynas, Allpahuayo, IIAP Experimental Station, 04° 10' S, 73° 30' W, 120 m, 20 Sep 1990 (fr), J. Pipoly et al. 12263 (AMAZ, MO, USM), 15 Aug 1990 (fr), R. Vásquez & N. Jaramillo 14204 (AMAZ, MO, US, USM), 10 Oct 1990 (stam. fl), R. Vásquez & N. Jaramillo 14465 (AMAZ, MO); Laguna Quistococha, 15 km SW of Iquitos, 8 Jul 1977 (stam. fl), J. Solomon 3466 (LL-TEX, MO); Mishiana, 30 km SW of Iquitos, Callicebus Biological Reserve, Río Nanay, 4 km S of Mishana, 19 Aug 1978 (stam. fl), R. Foster 4243 (AMAZ, F), 16 Aug 1980 (stam. fl), 4327 (F-2 sheets); Vicinity Mishana, between Río Nanay and Río Itaya, 130 m, 29 Nov 1977 (fr), A. Gentry et al. 21033 (F, MO); Between Iquitos and Sra. Marfá de Nanay, 180 m, 31 May 1978 (stam. fl), A. Gentry et al. 22367 (AMAZ, F, MO); 03° 50' S, 73° 30' W, 25 Feb 1981 (fr), A. Gentry et al. 31479 (AMAZ, MO), 31 Dec. 1982 (mixed- stam. fl, fr), A. Gentry & L. Emmons 38776 (MO-2 sheets), 5 Aug 1990 (fr), R. Vásquez et al. 14161 (AMAZ, MO, USM); Río Nanay, May–Jun 1929 (stam. fl), Ll. Williams 657 (F); Mishuyacu, near Iquitos, 100 m, 10 Oct–Nov 1929 (stam. fl), G. Klug 304 (F), May–Jun 1930 (stam. fl), G. Klug 1335 (F); 6 Oct. 1982 (stam. bud), R. Vásquez & N. Jaramillo 3261 (MO), 20 Jan 1985 (stam. fl), 6125 (MO); Puerto. Almendrás, 03° 48' S, 73° 25' W, 122 m, 4 Jan. 1986 (pist. fl), R. Vásquez & N. Jaramillo 7070 (AMAZ, MO), 30 May (stam. bud), 7593 (MO), 20 Oct. 1986 (fr), 8073 (AMAZ, MO); Roca Fuerte (Momón), Oct–Nov 1984 (stam. fl), R. Vásquez & N. Jaramillo 5241. Madre de Dios: Prov. Tambopata, Tambopata Reserve, Río Tambopata ar mouth of Río D’Orbigny, 250 m, 6 Mar 1981 (fr), A. Gentry & K. Young 32025 (AMAZ, MO, NY).

Agostini (1980) had not seen the type specimen of Weigeltia silvestris and included it in Cybianthus subgenus Comomyrsine, probably due to matching with a herbarium misidentification of a specimen of Cybianthus kayapii (Lundell) Pipoly as Weigeltia silvestris in NY. I previously recognized Cybianthus dubius and C. lorentesis as distinct taxa (Pipoly 1981) on the basis of quantitative characters, and had not seen the type of C. silvestris. The exserted stamens and obclavate or tubiform pistillode of the staminate flowers, and truncate style with punctiform stigma in the pistillate flowers are unique features within the subgenus.
Populations corresponding to the type of *Weigeltia silvestris* have slightly larger leaves, but are otherwise indistinguishable from the type of *Weigeltia nanayensis*. The type of *Conomorpha dubia* is notable only for differences attributable to the fact that it is a pistillate fruiting specimen. Fieldwork in Peru has shown that populations corresponding to the type of *Conomorpha lorentensis* grow in full sun, and consequently have narrower leaves with longer petioles than those of the type of *Weigeltia nanayensis*.


Erect or pendent, evergreen, terrestrial, epiphytic or epipetric dioecious, bisexual, dioecious or monoecious shrubs or small trees. **Bark** mostly smooth, gray or sometimes brown, cracking transversely on older parts. **Trunks** distinguishable, normally more or less terete, leptocaulous or rarely pachycaulous basally, growth dynamics corresponding to Rauh’s Model (Halle et al. 1978). **Branchlets** thin to moderately thick, terete or ridged, smooth to verruculose to verrucose, glabrous or rarely glandular-papillate apically, glandular-papillate at first in the leaf axils then glabrescent, without lenticels. **Cataphylls** and pseudocataphylls absent. **Leaves** alternate, supravolute, exstipulate, sessile, acrodromous, apically obtuse-mucronate, basally auriculate, subamplexicaul, minutely glandular-papillate along midrib above, glabrescent, glabrous below, hydropotes few or absent above, numerous below, the margins hyaline, membranaceous, prominently punctate and punctate-lineate, entire or minutely crenulate to denticulate; petioles absent. **Inflorescence** monomorphic, simple, axillary raceme, at times reduced to appear dichasial; inflorescence bract broadly ovate to deltate, acute, prominently punctate, the margins entire to erose, early caducous; rachis terete, straight or flexuous, minutely glandular-papillate, glabrescent; floral bracts solitary, at pedicel base, ovate to lanceolate, persistent; pedicels cylindrical to clavate, minutely glandular-papillate, glabrescent, accrescent in fruit. **Flowers** unisexual or bisexual, (4—)5—6(—7)—merous; perianth lobes imbricate or quincuncial or rarely and aberrantly dextrorsely contorted, prominently, conspicuously or inconspicuously punctate and punctate-lineate; calyx cotyliform, the lobes erect, at times reflexed in fruit, the margins irregular or regular, entire or minutely crenulate, glabrous or glandular-ciliate; corolla rotate, bearing a ring of glandular granules at the junction of tube and lobe, the lobes glabrous without, glabrous or rarely glandular-granulose and smooth or rugose within, the margins regular or irregular, entire or minutely crenulate; stamens and staminodes similar, connate to form a conspicuous, membranaceous or carnose tube adnate to the corolla tube, elobate or with minute lobes alternating with the anthers, the anthers and antherodes basifixed, sessile
or on minute apically free filaments, quadrate or ovate, apically emarginate or rounded, basally truncate, dehiscent by apical birimose pores, usually dorsally and rarely ventrally punctate; pistil and pistillode similar, obnapiiform, ellipsoid or obovate, the ovary terete, lobed or costate, sparsely to densely translucent-lepidote, the placenta obovate, (1–)2–3(–4) ovulate, the ovules half-immersed in the basal placenta, uniseriate or biseriate, the style short, truncate, the stigma punctiform. Fruit drupaceous, depressed globose, obovate, or ellipsoid, the exocarp sometimes fleshy, the mesocarp and endocarp stony, prominently punctate-lineate, white, lavender or purple-black at maturity, one seeded, the testa corrugate, the embryo cylindrical, transverse.

A subgenus of 7 species, in the Lesser Antilles, in Mesoamerica from northern Costa Rica through Panama, in the Andes from Venezuela to southern Peru, east through the Guayana Highland and to the Serranía de Turumiquíre, Anzoátegui, Venezuela. In Ecuador, two species occur. In Peru, 3 species have been recorded, of which one, Cybianthus lineatus (Benth.) Pipoly, formerly thought to be a Guayana Highland endemic (Pipoly 1987) is reported for the first time here.

KEY TO THE SPECIES OF CYBIANTHUS SUBGENUS GRAMMADENIA

1. Branchlets verruculose- to verrucose-papillate or red glandular-papillate; leaves coriaceous, symmetrical; inflorescence erect, flexuous; perianth coriaceous; epipetric or terrestrial shrubs or trees of lagunas in páramos and elfin forests or in “jalca” or “pajonal” alpine savannas.

2. Epipetric shrub or tree to 6 m tall; trunk leptocaulous; branchlets verruculose- to verrucose-papillate, prominently ridged, rugose when dried; leaves oblong, elliptic or lanceolate, (1.1–)1.4–2(–2.5) cm wide; fruit ovoid, then ellipsoid at maturity; plants of páramos or elfin forests.

28. C. marginatus

2. Terrestrial shrub to 1.5 m tall; trunk pachycaulous; branchlets red glandular-papillate, terete, smooth when dried; leaves oblong-lanceolate, (0.4–)0.6–1(–1.2) cm wide; fruit obovoid throughout development; plants of jalca or pajonal alpine savannas.

29. C. lineatus

1. Branchlets smooth, glabrous; leaves chartaceous, asymmetrical; inflorescence lax, straight; perianth chartaceous; epiphytic shrub or tree in cloud forests below subpáramos or facultative epiphytes in montane and elfin forests.

30. C. magnus

3. Leaves not bearing hydropoten above, conspicuously black punctate and punctate-lineate below; inflorescence rachis black punctate-lineate; perianth white-green, prominently black punctate and punctate-lineate; anthers ovate, rounded apically; branchlets 4–7 mm diam.; fruit purple-black at maturity.

30a. C. magnus subsp. magnus

3. Leaves bearing hydropoten above, at least proximally, inconspicuously pellucid to orange punctate; inflorescence rachis orange punctate-lineate; perianth maroon to purple, rarely white (then pistillate), prominently orange-punctate; anthers quadrate, emarginate apically; branchlets 2.5–3.5(–4.0) mm diam.; fruit white, then lavender at maturity.

30b. C. magnus subsp. asymmetricus


Epiphytic shrub or small tree to 6 m, the trunk leptocaulous. Branchlets prominently ridged, 3–4(–5) mm diam., verruculose- to verrucose-papillate, rugose when dried, glabrous. Leaves coriaceous, symmetrical, oblong, elliptic or lanceolate, (3–)3.5–6(–6.5) cm long, (1.1–)1.4–2(–2.5) cm wide, apically acute to obtuse, mucronulate, basally acute, auriculate, nitid above, palloid below, prominently punctate and punctate-lineate, the margin entire, revolute. Inflorescence erect, the rachis flexuous, slender, (1–)1.3–2(–3.2) cm long, densely black punctate-lineate; floral bracts widely ovate to deltate, (0.8–)1.2–1.5(–1.8) mm long, 0.8–1.4(–1.8) mm wide, apically acute, the margin entire; pedicels (1–)1.5–2 mm long. Flowers coriaceous, 5(–7)-merous; calyx 1.1–2.1 mm long, the tube ca. 0.1 mm long, the lobes deltate, (1–)1.5–2 mm long, (1.2–)1.3–1.5(–2) mm long, apically acute, prominently and densely punctate and punctate-lineate, the margins minutely crenulate, glabrous to minutely ciliolate at first apically; corolla (2–)2.2–3 mm long, the lobes widely ovate, (1–)1.2–2 mm long, (1.2–)1.5–2(–2.5) mm wide, obtuse to rounded, glabrous without, glandular-granulose within basally, densely and prominently punctate medially, the margin entire; staminal tube carnose, 0.6–0.8(–1) mm long, the anthers sessile, alternate with fleshy lobes to 0.2 mm long, quadrate, 0.4–0.7 mm long and wide, apically rounded, basally truncate, the connective prominently punctate dorsally; pistil obnapiform, (0.9–)1.2–1.5 mm long and (0.8–)1.2–1.6 mm diam., the ovary (0.4–)0.6–1 mm long, glabrous to sparingly translucen glandular-lepidote, ovules 2(–4), uni- or biserrate, the style 0.3–0.5 mm long, epuncate. Fruit somewhat ovoid, then ellipsoid at maturity, 4.5–5(–6) mm long, (2.5–)3–4 mm diam., white, then purple-black at maturity, the punctations red-black, prominent.

**Distribution.**—Cybianthus marginatus is the most common species of the
subgenus, occurring throughout the Andes from Venezuela to Peru, 2,000–3,400 m.

Ecology and conservation status.—This species occurs in large populations on rocks above lagunas in páramos in northern Ecuador and along watercourses in paramoid elfin forests, and “ceja” formations in the remainder of Ecuador and Peru. As long as there are remnant páramo formations, or elfin forests, there will be populations of *Cybianthus marginatus*. However, in some instances, soil compaction due to overgrazing by sheep can render the soil uninhabitable for this species.

Etymology.—The specific epithet refers to the scarious leaf margin, made conspicuous by the coriaceous texture. In addition, this aspect is made more conspicuous by the prominent submarginal vein of many populations.

Representative specimens examined. **ECUADOR.** Azuay: “Oriente” border, Páramo del Castillo, crest of E cordillera on trail between Sevilla de Oro and Méndez, 2,727–3,335 m, 18 Aug 1945 (fl, fr), W. Camp E-4809 (NY, VEN); Rio Collay, Huagarancha S of El Pan, 2,650–3,290 m, 6 Jul 1943 (fl), J. Steyermark 53354 (NY). *Eriachis*: Peak of Cerro Gollondrinatas, 00° 51’ 12” N, 78° 08’ 21” W, 3070 m, 24 Jul 1994 (fr), B. Boyle et al. 3373 (BRIT, MO, QCNE); Cantón Montufar, Loma El Corazón, Bretaña, SE of Mariscal Sucre, Río Minas, 00° 35’ N, 77° 42’ W, 3,150 m, 22–23 Dec 1992 (fl, fr), W. Palacios & G. Tipped 10569 (BRIT, MO, QCNE). **Imbabura**: Cordillera Oriental, Camp Arelán, E of Volcán Cayambe, 2,803 m, 21 Jul 1944 (fl, fr), W. Drees E-351 (MSC); Ridge just S of Río Clavadero, along trail to Río San Pedro, E of Cayambe, 2,893 m, 27 Jul 1943 (fl, fr), I. Wiggins 10484 (DS, US). **Loja**: Saraguro-Loja, Km 12.4, turnoff toward Fierro Urco, Km 2.5–2.7, 03° 41’ 05” S, 79° 17’ 20” W, 3,150–3,300 m, 7 Dec 1994 (fl), P. Jorgensen et al. 1278 (BRIT, LOJA, MO, QCA, QCNE); Páramos de Saraguro, 10 km S of Saraguro, 3,050 m, 2 Jan 1979 (fl), J. Lathey et al. 6647 (NY, QCA). **Zamora-Chinchipe**: border, crest of Cordillera Oriental, 2,840 m, 28 Jan 1984 (fl), J. Lathey & E. Cotton 11295 (NY, QCA); W slopes of Cordillera del Cúndor and NW slopes of Nudo de Sabamilas, around Tambo Cachiaycu, ca. 2 km SE of Yagana, 2,000–3,000 m, 19 Oct 1943 (fl, fr), J. Steyermark 54800 (NY, U); S of El Playón de San Francisco, slopes of Cerro Mirador, 3,300–3,600 m, 29 Dec 1980 (fl, fr), L. Holm-Nielsen et al. 29949 (AAU); J. Jarmillo et al. 3929 (AAU, QCA). **PERU.** **Amazonas**: Prov. Lukas, Drto. Camporredondo, Anexo Tullanaya, Cerro Wicosungccca, 06° 05’ 35” S, 78° 19’ 56” W, 3,075 m, 7 Dec 1996 (pist. fl), J. & L. Campos 3121 (BRIT, MO, USM). **Cajamarca**: Jaén, SW of Querocortillo, 3,150 m, Aug 1915 (bisex. fl, fr), A. Weberbauer 7168 (F, GH). **Cusco**: La Convención, 2,800 m, 9 Jul 1968 (bisex. fl, fr), T. Dudley 10910 (NA), 10 Jul 1968 (bisex. fl, fr), T. Dudley 10922 (F, NA), T. Dudley 109318 (F, NA). **Huánuco**: Prov. Huánuco, 45 km on rd. from Huánuco to Tingo María, trail on S side of Carpish Tunnel, 09° 42’ S, 76° 05’ W, 2,400 m, 3 Mar 1985 (bisex. fl), C. Todzia & B. Stein 2740 (F, USM).

As was stated previously (Pipoly 1987), *Cybianthus marginatus* is most closely related to *C. lineatus* (Benth.) Pipoly, previously known only from the contiguous Guayana Floristic Province, because of its (synapomorphic) flexous inflorescences and biseriate ovules. However, *Cybianthus marginatus* is easily distinguished from *C. lineatus* by its glabrous, ridged, verrucose-papillate branchlers, oblong, elliptic or ovate leaves, obnapiform pistil and
ellipsoidal fruits. The verrucose-papillate branchlets, leaf and fruit shape are unique (autapomorphic) features within the subgenus.

Cybianthus marginatus is the most variable species of the subgenus, containing one-third of the names attributed to Grammadenia as taxonomic synonyms. Variation in leaf size and punctuation and quantitative floral variation have led to much overdescription. A full discussion of synonymy and variation was provided by Pipoly (1987). Cybianthus marginatus is most closely related to C. lineatus by virtue of its flexuous inflorescences and biseriate ovules. However, Cybianthus marginatus is easily distinguished from C. lineatus by the glabrous, ridged, verrucose-papillate branchlets, oblong, elliptic or ovate leaves, obnapiform pistil and ellipsoid fruits.


Terrestrial shrub to 1.5 m tall, the trunk pachycalous. Branchlets terete, (2.5–)3–4(–6) mm diam., densely red glandular-papillate apically. Leaves coriaceous, symmetrical, oblong-cylindrical, (1.2–)1.6–3(–3.9) cm long, (0.4–)0.6–1(–1.2) cm wide, apically acute, basally subauriculate, the margin flat. Inflorescence flexuous, at times reduced to a simple dichasium, 0.6–1.0(–2.5) cm long, sparingly glandular-papillate; floral bracts widely ovate, 0.8–1.1 mm long, 1.1–1.4 mm wide, apically acute, the margin entire, glabrous. Flowers chartaceous, 5–6(–7)-merous; calyx 1.1–1.6 mm long, the tube ca. 0.1 mm long, the lobes wide-triangular to deltate, (0.8–)1–1.5 mm long, (0.7–)1–1.2(–1.4) mm wide, apically acute, conspicuously black punctate and punctate-linear, the margins entire, glandular-ciliolate; corolla (1.8–)2–2.5(–3) mm long, the lobes widely ovate, (1–)1.3–1.6(–2) mm long, (1–)1.3–1.7(–2) mm wide, obtuse to emarginate, inconspicuously punctate medially, the margins irregular, entire; staminal tube carnose, conspicuous, (0.6–)0.8–1 mm long, the anthers sessile, alternate with prominent fleshy lobes, quadrate, 0.4–0.6 mm long and wide, apically rounded, prominently black punctate dorsally; pistil ellipsoid, (0.9–)1–1.2(–1.4) mm long, (0.8–)1–1.3 mm diam., the ovary 0.8–1 mm long, glabrous to translucent glandular-lepidote apically, ovules 2–3, when more than 2, biseriate, the style (0.1–)0.2(–0.3) mm long, glabrous. Fruit obovoid, (3–)4–5 mm long, (2–)2.5–3 mm diam., purple, than black at maturity, the punctations green, prominent.

Distribution.—Formerly thought to be endemic to the Guayana Highland, in open savannas on tepui summits throughout Pantepui (Mayr & Phelps 1967), at 1,400–2,850 m elevation, but now known elsewhere only from the collection cited below.

Ecology and conservation status.—Cybianthus lineatus grows in fully exposed,
dry montane “shrub savannas” (Huber 1995) in shallow sand over sandstone throughout Pantepui. Its occurrence in Pajonal (“jalca”) vegetation in Peru gives reason to expect it in other places, especially in the Cordillera del Cóndor along the Ecuadorean/Peruvian border. Unfortunately, recent civil unrest has prohibited collection in that area. In the majority of the range for the species, *Cybianthus lineatus* is not threatened.

*Etymology.*—The specific epithet refers to the numerous and prominent punctate-lineations of the abaxial leaf surface.

Specimen examined. PERU. Pasco: Oxapampa Prov., Cerro Pajonal, 29 km from Oxapampa, 2,680 m, D. Smith & Foster 2509 (f, MO, USM).

*Cybianthus lineatus* is most closely related to *C. marginatus* (Benth.) Pipoly, by virtue of its flexuous inflorescence and biseriate ovules (Pipoly 1987). However, *Cybianthus lineatus* may be easily recognized by its pachycaulous trunk, densely red glandular-papillate branchlet apices, ellipsoid pistil and obovoid fruits. It is the only species in the subgenus with parenchyma instead of aerenchyma in the cortex, the only one with bifacial palisade layers in the leaf, and the only one with a pachycaulous trunk. None of these morphological peculiarities are unexpected given its drier, wind-swept habitat.


Facultative epiphytic *shrub or tree* to 7 m tall. *Branchlets* terete, smooth, glabrous. *Leaves* chartaceous, asymmetrical, narrowly ob lanceolate, ob lanceolate or narrowly obovate, (4.5–)5.2–15 cm long, (1.0–)2.1–5.2 cm wide, apically acute to abruptly acuminate, tapering abruptly or gradually to base, bearing hydropotes above or not, conspicuously black punctate and punctate-lineate or inconspicuously pellucid to orange punctate below, the margins entire, flat, or subrevolute. *Inflorescence* lax, straight, (1.5–)2–8(–11.5) cm long, slender, densely glandular-granulose and papillate, prominently black punctate-lineate or conspicuously orange to brown punctate-lineate; floral bracts ovate, widely ovate or deltate, (0.7–)1.1–2.2 mm long, (0.6–)1.3–2 mm wide, apically acute to acuminate, prominently black or orange punctate and punctate-lineate, the margins erose and glandular-ciliate; pedicels 1.0–2.2(–5.5) mm long in flower, the smaller ones accrescent to 4(–6) mm long in fruit. *Flowers* chartaceous, 5(–6)-merous, whitish-green or pink to maroon; calyx lobes widely ovate to deltate, (0.8–)1–1.5(–2) mm long, (0.8–)1–2.1 mm wide, apically acute to acuminate, prominently black punctate and punctate-lineate or orange to brown punctate, the margins erose to fimbriate and densely glandular-ciliate; corolla (1.7–)2–2.6(–3) mm long, the staminate and bisexual maroon, the pistillate white, the lobes widely ovate, 1.1–1.6(–2.2) mm long, (0.9–)1.1–2.6 mm wide, apically obtuse to emarginate, rugose medialy within, densely and prominently black punctate and
punctate-lineate or orange to brown punctate, the margins irregular, entire; staminal tube membranaceous, (0.4–0.7–1(–1.2) mm long, lobate, the lobes 0.1–0.2 mm long, the anthers sessile, alternate with the lobes, ovate to quadrate, (0.3–)0.4–0.6 mm long, 0.4–0.6(–7) mm wide, apically rounded or emarginate, the connectives punctate ventrally, prominently black or orange punctate dorsally; pistil obnapiform, 1–1.2 mm long, 0.9–1.5 mm diam., the ovary 0.6–0.9(–1.3) mm long, densely translucent glandular-lepidote, the ovules 2–4(–5), uniseriate, the style 0.3–0.5(–0.7) mm long, glabrous. Fruit obovoid, 2.5–3.5 mm long, 2–3 mm diam. when dried, pink, then purple-black or white, then lavender at maturity, prominently black punctate-lineate or orange punctate and punctate-lineate when dried.

**Distribution.**—*Cybianthus magnus* occurs in the Andes of Venezuela southward to Peru as an epiphyte in the cloud forest zone below subpáramo thickets and as a facultative epiphyte in montane and elfin “ceja” forests, from 1,100–3,500 m. It is also known from the Serranía de Turumiquire, in the states of Monagas, Sucre and Anzoátegui, Venezuela, at 2,000–2,400 m.

**Etymology.**—The specific epithet refers both to the large, branchlets, often appearing succulent, as well as the large leaf size found in some populations.

As shown by Pipoly (1987) *Cybianthus magnus* is most closely related to *C. parasiticus* (Sw.) Pipoly from the Lesser Antilles by its chartaceous corolla rugose medially within, asymmetrical leaves, and obovoid fruits, but is easily separated from it by its erose and fimbriate calyx lobes, lobate staminal tube and sessile anthers. *Cybianthus magnus* superficially resembles *C. marginatus* (Benth.) Pipoly, but may be easily separated by its subsucculent smooth stems, and obovoid fruits.

Both subspecies are known from Ecuador and Peru, with one region of apparent sympatry on the eastern slopes of the Cordillera Oriental in Ecuador and adjacent northern Peru. However, they appear to be separated by habitat. In Ecuador and Peru, subspecies *magnus* appears to be restricted to closed cloud forests, while subspecies *asymmetricus* is found in open montane forest and elfin (“ceja”) forest. The salient features of each are summarized below.


Facultative epiphytic *shrub* or *tree* to 7 m tall, 7–15(–30) cm diam., the
canopy often bowl-shaped. Branchlets (4.0–)5.0–7.0 mm diam. Leaves not bearing hydropotes above, conspicuously black punctate and punctate-lineate below. Inflorescence rachis prominently black punctate and punctate-lineate. Flowers with perianth whitish-green, prominently black punctate and punctate-lineate; anthers ovate, rounded apically, the connectives prominently black punctate dorsally. Fruit purple-black at maturity, prominently black punctate-lineate when dried.

**Distribution.**—Subspecies magnus occurs from the Serranía de Turumiquire (states of Anzoátegui, Monagas, Sucre), and in the Andes, from Venezuela southward through Colombia to and Ecuador to Peru.

**Ecology and conservation status.**—Subspecies magnus occurs as an epiphyte in closed cloud forests, especially those below subpáramo thickets. It is a relatively rare, but widely distributed subspecies, and is increasingly endangered owing to habitat destruction.

**Etymology.**—The epithet refers to the leaf size and stem succulence, a novelty within the subgenus.


Faculative epiphytic shrub to 2 m tall, 7 m diam., the canopy open, conical. Branchlets 2.5–3.5(–4.0) mm diam. Leaves bearing hydropotes above at least proximally, inconspicuously pellucid to orange punctate below. Inflorescence rachis conspicuously orange to brown punctate-lineate. Flowers with calyx greenish-pink, the staminate and bisexual with corolla maroon, the pistillate with corolla white and prominently orange punctate and punctate-lineate lobes; anthers quadrate, apically emarginate, the connectives prominently orange punctate dorsally. Fruit white, then lavender at maturity, prominently orange punctate and punctate-lineate when dried.

**Distribution.**—Cybianthus magnus subsp. asymmetricus occurs as an obligate epiphyte, growing on detritus in open montane forests and elfin forests, from the Darién of Panama to Cusco, Peru, from 1,000–2,000(–2,700) m.
Ecology and conservation status.—Subspecies *asymmetricus* grows as an obligate epiphyte, growing on rocks with deep organic detritus and large, moss-covered trees. With increasing levels of disturbance, it is being threatened.

Etymology.—The epithet refers to the asymmetric shape of the leaf blades.

Specimens examined. ECUADOR. Carchi: Cantón Tulcán, Parroquia Tobar Donoso, Reserva Indígena Awá, Centro El Baboso, 00° 53' N, 78° 25' W, 1,800 m, 17–27 Aug 1992 (fr), G. Tipaz et al. 1741 (BRIT, MO, QCNE); Parroquia el Chicál, Centro San Marcos, 01° 06' N, 78° 14' W, 900-1,100 m, 20-30 Apr 1993 (fl), P. Méndez et al. 341 (BRIT, MO); Cerro Golondrinas, valley bottom ca. 1.5 km NNE of summit, 00° 51' 52" N, 78° 08' 10" W, 2,750 m, 25 Jul 1994 (stam. fl), B. Boyle et al. 3450 (BRIT, QCNE, MO). PERU. Amazonas: Prov. Bagua, Imaza, Nuevo Samaria (anexo de UVT), 18 Mar 1995 C. Díaz et al. 7585 (BRIT, HUT, MO, USM). Cusco: La Convención, Cordillera Vilcabamba, ca. 1/2 way between Camps 2 1/2 and 3, 1,980 m, 1 Jul 1968 (bisex. fl, fr), T. Dudley 10668 (F, NA), 1,800 m, 24 Jul 1968 (bisex. fl, fr), T. Dudley 11324 (NA). Huánuco: Prov. Pachitea, region of Pucallpa, W part of Sirá Mountains and adjacent lowland, ca 24 km SE to 26 km ESE of Puerto Inca, next to Campamento Pato Rojo, 09° 27' S, 74° 46' W, and along crest after Campamento Peligroso, 600 m, 14 Apr 1988 (fr), B. Wallnöfer 18-14488 (BRIT, MO, W, WU). Pasco: Oxapampa, Cordillera Yanachaga, Cerro Pajonal, chacos, 12 km SE of Oxapampa, 2,700–2,800 m, 7 Oct 1983 (bisex. fl), R. Foster 9013 (MO, NY, USM).

*Cybianthus magnus* subsp. *asymmetricus* is notable for its stems with angular collenchyma in the pith, well-developed aerenchyma in the inner cortex, and tangential collenchyma in the outer cortex. It is separated from subspecies *magnus* by its inconspicuous or orange punctate leaves, orange punctate-lineate inflorescence rachis and perianth, quadrate, emarginate anthers and open montane and elfin forest habitat.

*Grammadenia macrocarpa* Lundell is notable only for its large, bright orange fruits and smaller flowers. I examined one fruit from each of the isotypes of *G. macrocarpa* and found an insect larva in each one, accounting for the size and peculiar morphology.


*Peckia* Vell., Fl. Flum. 1:51. 1825., nom. rej.

Terrestrial dioecious shrubs or small trees. Roots positively geotropic. Bark mostly smooth, gray or sometimes brown, cracking longitudinally on older parts. Trunks distinguishable, normally more or less terete, leptocaulous, growth dynamics corresponding to Rauh's Model (Hallé et al. 1978). Branchlets thin to moderately thick, terete, trigonal, or ridged, rufous stellate or dendroid tomentose or rarely, with rufous, subsessile covering lepidote scales. Cataphylls and pseudocataphylls absent. Leaves alternate, or pseudoverticillate, supravolute, exstipulate, petiolate; blades epunctate or variously black or red punctate, the punctations at times prominent. Inflorescence a simple, lateral (axillary) raceme; peduncle 1–5 mm long, the rachis straight, minutely
rufous glandular-papillate, glandular-granulose or lepidote, glabrescent or persistent; floral bracts solitary, at pedicel basally, ovate to lanceolate, persistent; pedicels cylindrical to clavate, or obconic, minutely glandular-papillate, glandular-granulose or lepidote, accrescent in fruit. Flowers unisexual or bisexual, 4-merous; perianth lobes imbricate or rarely valvate, prominently, conspicuously or inconspicuously punctate and/or punctate-lineate; calyx cotyliform, the lobes erect, at times reflexed in fruit, the margins irregular or regular, entire or minutely crenulate, glandular-ciliate; corolla rotate, to subrotate, the tube short, glabrous or glandular-granulose, at times papillate, the lobes glabrous without, glandular-granulose and/or glandular-papillate throughout within, the margins regular or irregular, entire or minutely crenulate, glabrous, glandular-granulose or papillate along the margins; stamens and staminodes similar, developmentally adnate to the corolla tube to form an inconspicuous tube, the stamens thus appearing epipetalous, apical free portion of the filaments present or absent, when present up to 3 times longer than the anthers, the anthers basifixed, appearing sessile or on minute apically free filaments, quadrate or ovate, apically emarginate, rounded, acute, apiculate or truncate, basally truncate or subcordate, dehiscent by apical pores, the pores at times confluent, the connective epipunctate or conspicuously or prominently punctate, at times glandular-papillate; pistil and pistillode similar, conic, ellipsoidal, or rarely, obturinate, the ovary terete, lobed or costate, sparsely to densely translucent-lepidote, the placenta subglobose, (1–)2–3(–4) ovulate, the ovules half-immersed in the basal placenta, uniseriate or biseriate, the style long-attenuate, the stigma punctiform, lobed or capitulate-lobed. Fruit drupaceous, depressed globose, the exocarp sometimes fleshy, the mesocarp and endocarp stony, prominently punctate-lineate, white, red or purple-black at maturity, one seeded, the testa corrugate, the embryo cylindrical, transverse.

A subgenus of 50 species in tropical South America, with the largest concentration of species in the Amazon Basin and adjacent Guianas, Planalto and coastal Brazil. Subgenus *Cybianthus* is by far the most complicated taxonomic group within the genus and is known from rather incomplete material. Collection of more material is hampered by the fact that the populations studied heretofore have revealed population densities lower than any other subgenus. So far, 13 species are known from Ecuador and Peru, but with additional collections, we may expect to find *Cybianthus lanceolatus* Pax, and/or *Cybianthus psychotriifolius* (Rusby) Mez, both from nearby Bolivia, in southern Peru.

**KEY TO SPECIES OF CYBIANTHUS SUBGENUS CYBIANTHUS**

1. Branchlets subterete to angulate.
2. Inflorescence spicate or subspicate; calyx lobes inconspicuously or prominently orange punctate; petioles pulvinate basally.
3. Leaf blades inconspicuously pellucid punctate below; calyx lobes chartaceous or carnose, rounded or acute apically.

4. Branchlets 4–6 mm diam.; leaf blades coriaceous, nitid above; petioles 2.2–3 cm long; inflorescence spicate, the pedicels obsolete to 0.4 mm long; calyx lobes chartaceous, deltate, the margin entire, undulate, glabrous. ......................................................... 31. C. incognitus

4. Branchlet 2–3.9 mm diam.; leaf blades membranaceous, dull above; petioles 1.7–2 cm long; inflorescence subspicate, the pedicels 0.6–0.9 mm long; calyx lobes carnose, ovate, the margin crenulate, glandular-ciliate. ......................................................... 32. C. minutiflorus

3. Leaf blades perpuncticulose below; calyx lobes membranaceous, subacuminate apically. ......................................................... 33. C. huampamiensis

2. Inflorescence racemose; calyx lobes densely and prominently black punctate or epunculate; petioles tapered, not pulvinate basally.

5. Leaves alternate; calyx lobes acute apically, the margins hyaline; another apically rounded, obtuse or acute apically, the pores not confluent.

6. Pedicels 1.9–2.2 mm long; flowers erect; calyx carnose, 0.8–1.1 mm long, the lobes ovate, abruptly constricted basally, densely and prominently black punctate, the margin irregularly serrate, punctate-lineate, glabrous. ......................................................... 34. C. granulosus

6. Pedicels 2.5–3.5 mm long; flowers nodding; calyx membranaceous, 1.5–1.9 mm long, the lobes deltate to triangular, not constricted basally, epunculate, the margin entire, epunculate, minutely glandular-ciliolate. ......................................................... 35. C. flavovires

5. Leaves pseudoverticillate; calyx lobes rounded apically, the margins opaque; anthers truncate apically, the pores confluent. ......................................................... 36. C. venezuelanus

1. Branchlets terete.

7. Branchlets thick, (6–)7–10 mm in diameter.

8. Leaf blades subacuminate apically; calyx membranaceous or chartaceous, the lobes acute or acuminute.

9. Leaf blades nitid and perpuncticulose above, 12–13.5 cm wide, the secondary veins prominently raised above and below, basally truncate, auriculate; petioles 0.5–1.4 cm long; pedicels 0.3–0.5 mm long. ......................................................... 37. C. grandezii

9. Leaf blades sordid and epunculate above, 2.1–5 cm wide, the secondary veins deeply impressed above, prominently raised below, basally cuneate; petioles 2.1–5 cm long; pedicels 0.8–1.4 mm long. ......................................................... 38. C. jensonii

8. Leaf blades abruptly acuminate apically; calyx coriaceous, the lobes rounded. ......................................................... 39. C. fosteri

7. Branchlets thin, 1.5–3.5 mm in diameter.

10. Leaf blades apically subacuminate to acuminute; calyx lobes acuminate or attenuate, the margin erose, short glandular-ciliate.

11. Leaf blades chartaceous to coriaceous, somewhat to very nitid above and below, the midrib raised above, decurrent to base of petiole; petioles short-pulvinate basally.

12. Leaf blades elliptic, (4–)5.5–7(–10.8) cm wide, apically long-acuminate, basally cuneate, the tertiary veins prominently raised, inconspicuously pellucid-punctate below; petioles canaliculate; pedicels cylindrical in fruit. ......................................................... 40. C. resinosus
Fig. 22. *Cybianthus incognitus* Pipoly. A. Habit, showing trigonal branchlet. B. Abaxial leaf surface, showing minute scales. C. Portion of infructescence, showing deltate calyx lobes with entire margins. D. Branchlet apex, showing dendroid and stellate tomentum. E. Portion of staminate spike, showing conspicuous staminal tube, and obcordate anthers with subapical non-confluent pores. A, B, D, drawn from Gentry et al. 22911. C, drawn from Barbour 2367. E, drawn from holotype, by Linda Ellis.
12. Leaf blades very narrowly oblanceolate or oblong, 2–4(–5) cm wide, apically and basally long-attenuate, the tertiary veins inconspicuous, conspicuously black or red punctate and punctate lineate below; petioles marginate; pedicels obconic in fruit. ................................................................. 41. C. fuscus

11. Leaf blades chartaceous, dull green above and below, the midrib impressed above, not decurrent on the petiole; petioles gradually tapering to base, without pulvinus. ................................. 42. C. cyclopetalus

10. Leaf blades apically acute; calyx lobes obtuse, the margin crenulate, long ciliolate. .......................................................... 43. C. penduliflorus

31. Cybianthus incognitus Pipoly, sp. nov. (Fig. 22). Type: PERU. AMAZONAS: Rio Santiago Valley, 03° 50' S, 77° 40' W, Quebrada Caterpiza, 2–3 km from Caterpiza settlement, primary forest, 200 m, tree 9 m tall, 12 Dec 1979 (stam. fl), S. Tinqui 289 (holotype: MO; isotypes: USM, NY).

Ob foliá coriacea oblanco-lata desuper nitida subter pallida anthera filamenta 3–plo breviores C. prieto valde arce affinis sed ab ea petiolis canaliculatis (nec marginatis), ramulis adpressae dendroideo- et stellato- (nec erectae dendroidae-) tomentellis, pedicellis 0–0.4 (non 0.8–1.4) mm longis, lobis calycinis inconspicue pellucidó- (non manifeste atro-) punctatis, lobisw corollinis ovatis (nec suborbicularis) pistillodio globoso (nec conico) denique fructu laevi statim recognitur.

Tree to 9 m tall, at times flowering precociously (P. Barbour 2405). Branchlets subterete to trigonal, 4–6 mm diam., appressed rufous dendroid and stelate tomentose. Leaves pseudoverticillate; blades coriaceous, oblanco-late, (16–)20–25(–31) cm long, (5–)6.5–8.5(–10) cm wide, apically acuminate, basally cuneate, decurrent on the petiole, nitid above, pallid below, the midrib slightly impressed above, prominently raised below, the secondary veins 9–12(–15) pairs, slightly raised above, prominently raised below, nitid above, pallid and minutely rubiginous lepidote below, the pellucid punctations inconspicuous, the margin entire, irregular, flat; petioles canaliculate 2.2–3 cm long, pulvinate, sparsely pubescent at first, glabrescent. Staminate inflorescence: an erect, dense spike, (6–)8–9.5 cm long, the rachis green, sparsely dendroid pubescent, glabrescent; floral bracts lanceolate, 0.5–1 mm long, apically attenuate, sparsely pubescent, early caducous; pedicels obsolete to stoutly cylindrical, 0–0.4 mm long, glabrate. Staminate flowers 4-merous, yellow, chartaceous; calyx coryliform, 0.6–0.9 mm long, the tube 0.2 mm long, the lobes deltate, 0.4–0.7 mm long and wide, apically acute, inconspicuously pellucid punctate, the margins scarious, entire, epunctate, undulate, glabrous; corolla subrotate, 1.4–1.6 mm long, the tube 0.2–0.3 mm long, the lobes ovate, 1.2–1.4 mm long, 0.4–0.6 mm wide, apically acute, glabrous without, densely glandular-granulose within, inconspicuously pellucid punctate, the margin opaque, densely glandular-granulose, entire; stamens 1–1.2 mm long, the tube ca. 0.2 mm long, the filaments terete, 0.5–0.6 mm long, slightly reflexed proximally, the anthers obcordate, 0.3–0.4 mm long, apically apiculate, basally cordate, dehiscent by small, subapical, ovate,
non-confluent pores, the pores extending less than 1/2 anther length, the connective epunctate, densely and minutely rubiginous glandular-granulose dorsally; pistilode broadly subglobose, ca. 0.2 mm long, 0.4 mm diam., densely yellow glandular-papillate. *Pistillate inflorescence* as in staminate but 9–12 cm long; floral bracts lanceolate, 0.2–0.5 mm long, glabrate; pedicels obsolete to 0.4 mm long, glabrate. *Pistillate flowers* as in staminate, but calyx 0.6–0.9 mm long, the tube 0.2 mm long, the lobes 0.4–0.7 mm long and wide, the margins opaque, entire; corolla, staminodes and pistil unknown. *Fruit* dark purple at maturity, globose, 0.4–0.5 mm long, 0.4–0.6 mm diam., smooth, inconspicuously pellucid punctate.

**Distribution.**—Upper Río Santiago Valley and adjacent Serranía de Bagua, Amazonas, 200–2,000 m, and Maynas Province, Loreto, Peru, along the Río Napo, at 120 m elevation.

**Ecology and conservation status.**—*Cybianthus incognitus* is mostly a ridgetop species in the cloud forests of Amazonas Department, occurring infrequently near the forest margin. The Upper Río Santiago Valley and adjacent Serranía de Bagua are known for their endemic species (Pipoly 1992b). However, one surprising collection was noted at 120 m elevation, from Caserío de Urcumiraho, in Maynas Province of Loreto Department, where vegetation normally associated with much higher altitudes occurs on the tops of undulating hills. Much more fieldwork will be required to better understand forest dynamics at the western limits of the Peruvian Amazon with the foothills of the Andes.

**Etymology.**—The specific epithet refers to the fact that the plant was misidentified even to family for nearly twenty years, and was finally identified only when a flowering specimen was matched with the other fruiting specimens. The densely spicate infructescences with numerous fruits were heretofore unknown in the genus.

**Paratypes.** **PERU.** Amazonas: Prov. Bagua, 12 km E of La Peca, cloud forest, 1700 m, 20 Jun 1978 (fr), P. Barbour 2403 (AMAZ, F, MO, USM), 29 Jun 1978 (fr), P. Barbour 2567 (AMAZ, BRIT, F, MO, NY, US); Ca. 12–18 km E of La Peca in Serranía de Bagua, cloud forest, 1,800–1,950 m, 14 Jun 1978 (fr), A. Gentry et al. 22859 (F, MO, USM), A. Gentry et al. 22911 (F, MO, USM). Loreto: Río Napo near entrance to Isla Inayuga, 20 Sep 1972 (fr), T. Croat 20528 (AMAZ, MO, USM); Caserío de Urcumiraho, Río Napo, 2 hours along trail from village to forest, 120 m, 8 Oct 1979 (stam. fl), C. Díaz & N. Jaramillo 1474 (AMAZ, BRIT, MO, USM).

*Cybianthus incognitus* is appears to be most closely related to *Cybianthus priarii* A. DC. of the Guianas, Venezuela and Brazil, because of the ob lanceolate, highly nitid coriaceous leaf blades and the filaments three times longer than the anthers. However, *Cybianthus incognitus* is separated from *C. priarii* by its canaliculate petioles, dendroid and stellate tomentose branchlets, sessile to subsessile flowers (spicate inflorescences), inconspicuously pellu-
cid-punctate calyx lobes, ovate corolla lobes, globose pistillode and smooth fruits. *Cybianthus incognitus* is unique within the subgenus by virtue of its densely spicate inflorescences, dendroid and stellate tomentum of the branchlets and inconspicuously punctate calyx lobes.

32. *Cybianthus minutiflorus* Mez, Repert. Spec. Nov. Regni Veg. 3:102. 1906. **Type: PERU. LORETO; near Rioja, W of Moyobamba, 800–900 m, 8 Sep 1904 (pist. fl, fr), A. Weberbauer 4699 (holotype: B -destr.; fragment, F; lectotype, here designated: F). Because the fragment at F contains floral and leaf material, and leave no doubt as to the identity of the species, in the absence of other duplicates, it is most appropriate to select this "clastotype" (a fragment taken with permission) as the lectotype.

*Tree* to 3 m tall. **Branchlets** angulate, 4.5–6 mm diam., densely rufous stellate-tomentose, glabrescent. **Leaves** alternate; blades membranaceous, widely (rarely narrowly) oblanceolate, (14–)19–28(–40) cm long, (4–)9–12(–15) cm wide, apically acuminate, the acumen 1–1.5 cm long, basally cuneate, midrib slightly raised above, prominently raised and densely rufous tomentulose below, the secondary veins (9–)12–21 pairs, slightly raised above, prominently raised and sparsely rufous tomentulose below, smooth and glabrous above at maturity, sparsely rufous puberulent below, conspicuously pellucid punctate, the margin entire, flat; petioles canaliculate, 1.7–2 cm long, somewhat pulvinate, glabrous above, rufous tomentulose below, glabrescent. **Staminate inflorescence** a simple, erect raceme, 4.5–9 cm long, the rachis densely rufous stellate-tomentose; floral bracts linear-lanceolate, 1–1.2 mm long, 0.2–0.3 mm wide, apically attenuate, densely tomentose above and below, the margin entire; pedicels cylindrical, 0.6–0.9 mm long, densely tomentose, persistent. **Staminate flowers** pale yellow; calyx carnose, cotyliform, 0.6–0.8 mm long, the tube ca. 0.1 mm long, the lobes widely triangular, 0.5–0.7 mm long, 0.7–0.9 mm wide, apically acute, densely and prominently orange punctate, sparsely rufous puberulent, the margin irregular, opaque, somewhat crenulate, minutely glandular-ciliolate; corolla carnose, subrotate, 1.2–1.4 mm long, the tube 0.3–0.4 mm long, the lobes widely triangular, 0.9–1.1 mm long, 1.1–1.2 mm wide, apically obtuse, densely and prominently orange punctate medially without, densely glandular-granulose medially and above anther within, the margin opaque, glandular-granulose, entire; stamens apparently sessile at corolla tube apically, the anthers widely obcordate, 0.4–0.5 mm long, 0.7–0.9 mm wide, apically acute, basally cordate, the thecae moderately yellow glandular-granulose, the connective prominently red punctate; pistillode conic, 0.3–0.4 mm long, 0.1–0.2 mm diam., the stigma glandular-papillate. **Pistillate inflorescence** as in staminate but (4–)8–13 cm long; floral bracts 0.6–1 mm long, 0.1–0.2 mm wide, apically attenuate, densely tomentose above and below, the margin entire; pedicels 0.6–0.8 mm long, accrescent in fruit to 1.8 mm long. **Pistillate flowers** as in
staminate but green; calyx 0.8–1 mm long, the tube ca. 0.1 mm long, the lobes 0.7–0.9 mm long, 0.9–1 mm wide; corolla 1–1.2 mm long, the tube 0.2–0.3 mm long, the lobes 0.8–1.0 mm long, 1–1.1 mm wide; staminodes as in stamens but antherodes obcordate, 0.2–0.3 mm long, 0.2–0.3 mm wide; pistil cylindrical, 0.6–1 mm long, 0.2–0.3 mm diam., the ovary angular, 0.3–0.4 mm long, the style 0.3–0.6 mm long, the stigma subcapitate, 4-lobed, the placenta cotyliform, ovules 2, naked. Fruit depressed-globose, 2.5–3.5 mm long, 4.5–5.5 mm diam., inconspicuously pellucid punctate, the exocarp thin. Bisexual inflorescence in staminate bud 2–3(−5) cm long, the rachis moderately tomentose; floral bracts, 0.6–0.9 mm long, 0.1–0.2 mm wide; pedicels 0.6–0.7 mm long. Bisexual flowers green; calyx 0.7–8 mm long, the tube ca. 0.1 mm long, the lobes 0.6–0.7 mm long and wide; corolla 1.3–1.4 mm long, the tube 0.2–0.3 mm long, the lobes 1.1–1.2 mm long, 1–1.1 mm wide; stamens identical to pistillate staminodes, but thecae full of pollen; pistil almost indistinguishable from pistillate flower except the stigma subcapitate, 3–4-lobed, ovule 1, naked. Fruit (from bisexual flower) unknown.

Distribution.—Endemic to the eastern slopes of the Andes and adjacent Amazonian Hylaea of Peru and adjacent Bolivia, 100–1200 m.

Ecology and conservation status.—Cybianthus minitiflorus occurs in primary tall wet forest and premontane forest, on well drained white sands, known as varillal in Peru. These pockets of sandstone often alternate with rolling lateritic hills in the foothills of the eastern Andean slopes and adjacent Amazonia. The lowland forests where Cybianthus minitiflorus is occurs are also notable for their numerous lianas. Cybianthus minitiflorus is a rare species and should be considered threatened.

Etymology.—The specific epithet refers to the extremely small flowers, some of the smallest in the subgenus.

Local names and uses.—Peru: “takú kaspi” (Mayna Jívaro); leaves are boiled in water and the decoction drunk to treat stomach ache.


Cybianthus minutiflorus is most closely related to C. granulosus Pipoly by its densely rufous furfuraceous-lepidote branchlets, erect, carnose, densely and prominently black punctate perianth, and sessile anthers. However, the flat petals, subacuminate leaf apices, short pedicels, opaque, crenulate and epunctate margins of the calyx lobes, and emarginate anthers easily distinguish Cybianthus minutiflorus.

33. Cybianthus huampamiensis Pipoly, sp. nov. (Fig. 23). Type: PERU. AMAZONAS: Quebrada chigkan enesa, Río Cenepa, 300 m, 9 Jun 1973 (stam. fl), E. Anaiba 588 (holotype: MO; isotypes: NY, USM).

Propter folia elliptica lanceolata vel oblanceolata, longipetiolata equilaterale vel inequilaterale secus margines irregularas, rachides inflorentesiares graciles, flores erectae deminosutoque, necon frutos minores, ad aspectu primo intuito C. resinoso arcte similans sed ab ea laminis membranaceis (non tenuiter coriaceis), utrinque sordidis (nee nitisidis) subter manifestoque atro-perpuncticulosis (nee epunctatis), petiolis (1.5–)2–2.5 (non 0.5–1.4) cm longis, lobis calycinis translucentibus (non opacis) acuminatis (nee rotundatis), lobis corollinis extus glandularis granulosis (non glabris) acutis vel rotundatis (nee obtusis vel emarginatis) denique fructibus luteis (non atris) permanente distinguitur.

Tree to 3(–6) m tall. Branchlets subterete to angulate, (3.5–)4–5 mm diam., densely rufous tomentose, glabrescent. Leaves pseudoverticillate; blades membranaceous, elliptic lanceolate or rarely, oblanceolate, (12–)16–25(–31) cm long, (5.2–)7–9(–12) cm wide, apically long-acuminate, basally acute, not decurrent on the petiole, dull green above, pallid below, midrib impressed above, prominently raised below, the secondary veins 12–18 pairs, prominently raised below, glabrous above rufous puberulent below along the veins, prominently and densely perpuncticulose below, the margin entire, irregular, flat; petiole slightly canaliculate distally or flat, 2–2.5 mm long, thick and pulvinate, densely rufous puberulent at first, glabrescent. Staminate inflorescence a lax, simple, subscape raceme, (5–)10–(18) cm long, sparsely rufous puberulent; floral bracts linear-lanceolate, 1–1.3 mm long, apically attenuate, densely rufous puberulent abaxially, the margin erose, persistent; pedicels cylindrical 0.8–0.9 mm long, densely rufous pubescent, glabrescent. Staminate flowers yellowish to orange; calyx membranaceous, cotyliform, translucent, 1.2–1.4 mm long, the tube ca. 0.2 mm long, the
lobes ovate, 1–1.2 mm long, 0.6–0.8 mm wide, apically subacuminate, densely and prominently orange punctate, glabrous, the margin hyaline, prominently erose-dentate, sparsely glandular-ciliate; corolla chartaceous, subrotate, 2.0–2.4 mm long, the tube 0.4–0.5 mm long, the lobes ovate, 1.6–1.9 mm long, 1.2–1.4 mm wide, apically acute to rounded, sparsely glandular-granulose without and densely so throughout within, densely and prominently orange punctate, flat, the margin scariosus, erose-denticulate and glandular-granulose; anthers apparently sessile at junction of corolla tube and lobe, very widely ovate, 0.4–0.5 mm long, 0.6–0.8 mm wide, apically obtuse to rounded, dehiscent by apical confluent pores extending ca. 2/3 length of anther, the connective epunctate, densely rubiginous glandular-papillate dorsally; pistillode conic, ca. 0.2–0.3 mm long and diam., hollow, glandular-papillate. *Pistillate inflorescence* as in staminate but (5–)7–9(–14) cm long, densely rufous puberulent at first, glabrescent; pedicel 0.4–0.5 mm long. *Pistillate flowers* as in staminate but yellowish to orange; calyx 1–1.2 mm long, the tube ca. 0.2 mm long, the lobes 0.8–1 mm long, 0.4–0.5 mm wide; corolla 1.8–2.2 mm long, the tube 0.3–0.4 mm long, the lobes 1.5–1.7 mm long, 1.1–1.4 mm wide; staminodes as in stamens but antherodes 0.3–0.4 mm long, 0.5–0.6 mm wide, apically rounded to acute; pistil conic, ca. 1.3 mm long, the ovary 0.5–0.6 mm long 0.6–0.8 mm diam., translucent glandular-lipodeite, the style short, to 0.2 mm long, the stigma 4-lobate, the lobes distally curved, glandular-papillate. *Fruit* yellow, subglobose, 4–6 mm long, 5–8 mm diam. inconspicuously pellucid punctate.

**Distribution.**—Endemic to the Río Marañón, Río Cenepa and Río Santiago drainage basins in the northwest corner of the Department of Amazonas, Peru, 200–550(–1,850) m.

Ecology and conservation status.—*Cybianthus huampamiensis* occurs in the foothills of the premontane and lowland wet forest of the most underexplored area of the Peruvian Hylaea/Andean interface. Given that the region is a border area, and therefore, a priority for development, this species should be considered.

**Etymology.**—The epithet describes the place where many of the collections were made, the Haumpami area of the Río Cenepa Drainage Basin.

**Paratypes.** **PERU.** **Amazonas**: Prov. Bagua; ca. 12–18 trail km E of La Peca, Serranía de Bagua, 1,800–1,950 m, 14 Jun 1978 (fr), A. Gentry *et al.* 22859 (F, MO, USM); Río Cenepa, Quebrada tujushik entsa, 330 m, 18 Apr 1973 (fr), *E. Ancuash* 274 (MO, USM); along Río Cenepa, 350 m, 3 May 1973 (fr), *E. Ancuash* 303 (MO, USM); Río Cenepa, Quebrada Idayua entsa, 400 m, 16 May 1973 (fr), *E. Ancuash* 392 (BRIT, F, LL-TEX, MO, US, USM); Río Cenepa, Quebrada Wampusik entsa, 5 Aug 1974 (stam. fl), *E. Ancuash* 731 (MO-2 sheets, USM); Río Cenepa, Quebrada Cikan Inci, 250–330 m, 1 Jan 1973 (stam. fl), *B. Berlin* 779 (MO, USM); 10 km N of Quebrada Huaampami, 200–250 m, 24 Jul 1974 (stam. fl), *B. Berlin* 1760 (MO, USM); Quebrada Chigkui Shinuki Cenepa, 250 m, 11 Apr 1973 (fr), *R. Kayap* 618 (MO, USM), 23 May 1973 (stam. fl), *R. Kayap* 783 (MO, NY, USM);
Fig. 24. *Cybianthus granulosus* Pipoly. A. Habit. B. Branchlet apex. C. Abaxial leaf surface, showing minutely rufous lepidote indumentum. D. Staminate flower. E. Staminate corolla. F. Staminate calyx. A–C, drawn from holotype. D–F, drawn from V. Haoshikat 1221. Figure drawn by Linda Ellis.
Cybianthus huampamiensis may at once be distinguished from all other species of the subgenus by its translucent calyx, externally glandular-granulose corolla and yellow fruit. This species is one of many endemic taxa known from this most underexplored area at the junction of the eastern Andean slopes with the Amazon Basin in northern Peru.

34. Cybianthus granulosus Pipoly, sp. nov. (Fig. 24). Type: PERU. AMAZONAS: Río Santiago Valley, 05° 50' S, 77° 40' W, Quebrada Caterpiza, 2–3 km from Caterpiza settlement, primary forest, 200 m, treelot 2 m tall, fls. brownish-green, 28 Nov 1979 (stam. fl), S. Tunquí 161 (HOLOTYPE: MO; ISOTYPE: NY).

Quoad folia altera chartacea ad apices acuminata ad bases cuneataque, ramulos dense rufo-furfuraceo-lepidotos, flores erectos, carnosos, dense manifestoque atro maculatos, antheras sessiles, ad C. minutifloro valde affinis sed ab ea petiolis canaliculatis (non planis) laminis abrupte largo-(non sub-)acuminatis, pedicellis 1.5–2.5 ( nec 0.5–1) mm longis, lobis calycinis secus margines hyalinis (non opacis) serratis ( nec crenulatis) punctato-linearis ( nec epunctaris) lobis coroninis secus marginis erosis ( nec integerrimis) antheris acutis ( nec emarginatis) facile cognoscitur.

Treelot to 3 m tall. Branchlets angulate, 2–4 mm diam., densely rufous furfuraceous lepidote. Leaves alternate; blades chartaceous, elliptic to narrowly oblanceolate, (9–)11–15(–18) cm long, (3–)4–5(–6) cm wide, apically abruptly acuminate, basally cuneate, densely rufous lepidote (appearing granulose) above and below at first, glabrate above, somewhat persistent below, midrib impressed above, prominently raised below, the secondary veins 8–12 pairs, impressed above, prominently raised below, inconspicuously pellucid punctate, the margin entire; petioles canaliculate, 1.5–1.8 cm long, glabrescent above, densely lepidote below. Staminate inflorescence a simple raceme, (4–) 6–9(–10) cm long, the rachis and pedicels densely rufous furfuraceous lepidote; floral bracts carnose, linear lanceolate, 0.8–1.2 mm long, apically long-attenuate, the margin entire, densely lepidote; pedicels cylindrical, 1.9–2.2 mm long. Staminate flowers erect, 4-merous, carnose, subrotate, brownish-green;
calyx 0.8–1.1 mm long, the tube 0.1–0.2 mm long, the lobes ovate, 0.7–0.9 mm long, 0.8–0.8 mm wide, apically acute, abruptly constricted basally, densely and prominently black punctate, moderately rufous lepidote, glabrescent, the margin hyaline, conspicuously black punctate-lineate, irregularly serrate, glabrous; corolla subrotate, 1.6–1.8 mm long, the tube 0.3–0.4 mm long, square, glabrous, the lobes suborbicular, 1.3–1.4 mm long and wide, emarginate apically, abruptly constricted basally, densely and prominently black punctate, sparsely rufous lepidote without, glabrescent, densely glandular-granulose throughout within, the margin erose; anthers sessile at apex of corolla tube, thus appearing epipetalous, the tube 0.3–0.4 mm long, glabrous, the anthers widely quadrate, 0.3–0.4 mm long, 0.6–0.7 mm wide, apically acute, basally truncate, dehiscent by large subapical, ovate pores, the pores not confluent, extending ca. 3/4 anther length, the connectives densely and prominently red or black punctate; pistillode conic, 0.2–0.3 mm long, sparsely glandular-lepidote. **Pistillate inflorescence unknown.** *Fruit unknown.*

**Distribution.**—Endemic to the upper Río Santiago Valley, in the Department of Amazonas, Peru, 180–200 m.

**Ecology and conservation status.**—*Cybianthus granulosus* inhabits wet premontane forests above the Río Santiago valley, which together with the Río Cenepe, comprise a region now known to be host to a number of endemic species. Given that it is most likely endemic, and not at all well-known, its conservation status cannot be determined at this time.

**Etymology.**—The specific epithet refers to the densely rufous lepidote tomentum, which appears granulose when examined superficially.

**Paratypes.** **PERU.** **Amazonas:** Prov. Bagua, Drto. Imaza, Comunidad Aguaruna Putuim, Anexo Yamayakat, Zonas Altas de Putuim, “Campou,” 700 m, 18 Jan 1996 (fr), C. Díaz et al. 7649A (BRIT, HUT, MO, USM); Río Santiago, 3 km from Caterpiza, 180 m, 12 Nov 1979 (stam. fl), V. Huashikat 1221 (MO, USM); Valle del Río Santiago, 65 km N of Pinglo, Quebrada Caterpiza, 2–3 km from Caterpiza, 200 m, 19 Sep 1977 (bud), V. Huashikat 677 (MO, USM), 28 Nov 1979 (stam. fl), V. Huashikat 1-422 (MO, USM).

*Cybianthus granulosus* is most closely related to *C. minutiflorus* Mez by virtue of its alternate, chartaceous leaf blades with acuminate apices and cuneate bases, densely rufous furfuraceous-lepidote branchles, flowers with carnosine texture, densely and prominently black punctate, and sessile anthers. However, *Cybianthus granulosus* is easily separated from *C. minutiflorus* by the abruptly long-acuminate leaf apices, canaliculate petioles, the hyaline, serrate, and punctate-lineate calyx margins, the erose corolla margins, acute anthers, and pedicels 1.5–2.5 mm long.

**35. Cybianthus flavovirens** Pipoly, sp. nov. (Fig. 25). **Type: PERU.** **SAN MARTÍN:** Prov. Mariscal Cáceres, Drto. Tocaché Nuevo, Palo Blanco near Fundo de Manuel
Fig. 25. *Cybianthus flavovirens* Pipoly. A. Habit, showing angulate branchlets and gradually tapering petioles. B. Abaxial leaf surface, showing sparse, rufous stellate tomentum. C. Section of inflorescence, showing nodding flowers, widely deltate calyx lobes and corolla with lobes constricted basally, prominent veins, and pusticulate surface. D. Branchlet, showing rufous stellate tomentum. A–D, drawn from holotype, by Linda Ellis.
Proper ramulos angulatos, petiolo gradate angustatos, inflorcentiam racemosam, flores
mutantes, antheras sessilia, C. reuzeliana valde arcte affinis, sed ab ea lobis calycinis membranaceis
(non carnosis) acutis (nec rotundatis) secus marginis hyalinis (nec opacis), antheris obtusis vel
subacutis (nec truncatis), porisque separatis (nec confluentibus), denique lobis corollinis
membranaceis (non carnosis) pustularis (nec planis) truncatis vel emarginarisque (nec acutisque)
praeclare distat.

Tree to 4 m tall. Branchlets lightly angulate, 2.5–3.5 mm diam., densely
rufous stellate-tomentose. Leaves alternate; blades chartaceous, elliptic, (12.5–)
19–30 (–32) cm long, (4–)6–10 cm wide, apically subacuminate to acuminate,
the acumen 0.5–2 cm long, basally attenuate, decurrent on the distal
end of the petiole, midrib somewhat elevated but canaliculate above, not
decurrent on petiole, prominently raised and densely rufous tomentose be-
low, the secondary veins 10–16 pairs, dull green above, pallid green below,
pellucid punctate above and below, sparsely rufous stellate-puberulent below,
the margin entire, opaque, regular, flat; petioles semiterete (1.6–)2–
2.5 cm, flat above, tapered, slightly thickened basally, not pubulate, gla-
brous above, sparsely rufous pubescent below, glabrescent. Stamine inflor-
cescence a lax raceme (7.5–)13–19 (–40) cm long, the rachis and pedicels moderately
rufous tomentellous, glabrescent; floral bracts linear-lanceolate, 1.1–1.5 mm
long, 0.1–0.2 mm wide, apically attenuate, densely rufous tomentellous
below, glabrescent, the margin entire; pedicels cylindrical, 2.5–3.5 mm long
at anthesis, erect in bud, nodding in anthesis. Stamine flowers 4-merous,
membranaceous, nodding, bright yellow-green; calyx cotyliform, 1.5–1.9
mm long, the tube 0.6–0.8 mm long, the lobes widely deltate to triangu-
lar, 1.1–1.3 mm long and wide, apically acute, epunculate, medially thick-
ened, sparsely rufous puberulent, glabrescent, the margin hyaline, epunculate,
entire, minutely glandular-ciliolate; corolla subrotate, 2.8–3 mm long, the
tube 0.5–0.8 mm long, glabrous without, densely glandular-granulose within,
the lobes suborbicular to oblate, 1.5–2.2 mm long, 2.2–2.6 mm wide, apically
truncate to slightly emarginate, contracted basally, translucent, the three
veins conspicuous, glabrous without, prominently pustulate and sparsely
glandular-granulose above but densely so toward base within, the margin
opaque, sparsely glandular-granulose, entire; stamens apparently sessile at
junction of corolla lobes and tube, the anthers sessile, very widely ovate-
obcordate, 0.4–0.6 mm long, 0.5–0.8 mm wide, apically obtuse to sub-
acute, basally cordate, the pores widely ovate, extending 1/2–3/4 anther
length, separate (not confluent), the connective epunculate, minutely red glandular-
papillate; pistillode costate, subglobose, 0.8–1 mm long, 0.6–0.7 mm wide,
hollow, the stigma capitate, densely yellow glandular-papilalte. Pistillate
inflorcscentiam unknown. Fruit unknown.
**Distribution.**—Endemic to the junction of the westernmost Amazon Basin (Hylaea) with the foothills of the Peruvian Andes, from 100–800 m elevation.

**Ecology and conservation status.**—*Cybianthus flavovirens* occurs in lowland moist forests on *terra firme*. These forests are drier than sites with the same general physiognomy farther to the north in Amazonas and Loreto. The few sporadic collections may be the result of underexploration rather than rarity, but owing to increasing pressure to cut forests for farming, this species should be considered threatened.

**Etymology.**—The epithet refers to the bright yellow-green corolla, a unique feature in the subgenus.


*Cybianthus flavovirens* is a member of a complex of taxa related to *C. venezuelanus* Mez, as evidenced by the angulate branches, gradually tapered petioles, nodding flowers, and sessile anthers. However, *C. flavovirens* is easily recognized by its membranaceous perianth, acute calyx lobes with opaque margins, pusticulate, bright yellow-green corolla lobes with truncate or emarginate apices, and obtuse or subacute anthers with separate pores. This species has been confused with *Cybianthus cyclopetalus*. However, *Cybianthus flavovirens* may easily be separated from that species by its angulate branchlets, racemose inflorescences, large, yellow flowers, and delate to triangular calyx lobes.


**Tree** to 5 m tall. **Branchlets** angulate, (2.5–)3.5–5 mm diam., densely rus- fous tomentose. **Leaves** pseudoverrucillate; blades chartaceous, oblong to elliptic, (10–)17–27–(34) cm long, (3–)6–9(–11) cm wide, apically acute to acuminate, basally acute, slightly decurrent on the petiole, midrib slightly
raised above, prominently raised below, the secondary veins 10–13 pairs, rufous puberulent and smooth above, glabrescent, sparsely rufous puberulent below, concentrated along the midrib and secondary veins, inconspicuously pellucid punctate, the margin flat, entire; petioles slightly canaliculate, (15–) 20–25(–30) mm long, tapered, densely and minutely stellate rufous stellate puberulent. **Staminate inflorescence**: an erect, simple raceme, (7.5–)10.5–18(–23) cm long, sparsely rufous stellate puberulent; peduncle 1–3 cm long; floral bracts coriaceous, lanceolate, 0.5–0.7 mm long, 0.2–0.3 mm wide, apically subulate, densely rufous stellate puberulent, the margin entire; pedicels cylindrical, 2.1–2.7 mm long, sparsely rufous stellate puberulent, glabrescent. **Staminate flowers**: 4-merous, carnose, nodding, green; calyx cotyliform, 0.9–1.1 mm long, the tube ca. 0.1 mm long, the lobes widely ovate, 0.8–1 mm long, 0.9–1 mm wide, apically rounded, densely rufous stellate puberulent, sparsely and prominently black punctate, the margin opaque, coarsely serrulate, densely glandular-ciliolate; corolla carnose, subrotate, 1.6–1.8 mm long, the tube quadrate, 0.5–0.6 mm long, glabrous, the lobes widely triangular, 1.1–1.3 mm long, 1.5–1.7 mm wide, reflexed in anthesis, apically acute, dorsally recurved, prominently and densely black punctate and glabrous without, densely glandular granulose throughout within, the margin slightly revolute, densely glandular-granulose; staminal tube inconspicuous, hyaline, membranous, 0.5–0.6 mm long, adnate to corolla tube, anthers apparently sessile, quadrate, 0.3–0.4 mm long, 0.5–0.6 mm wide, apically truncate, basally truncate, leaning proximally at anthesis, the connective prominently punctate dorsally, rufous glandular-papille apically; pistilloide obsolete or conical, 0.4–0.5 mm long, 0.1–0.2 mm wide, hollow, glabrous. **Pistillate inflorescence**: as in staminate but (4.5–)8.5–10(–13) cm long; peduncle 1–2.5 cm long; floral bracts 0.5–0.7 mm long, 0.2–0.3 mm wide; pedicels 0.9–1.2 mm long. **Pistillate flowers**: as in staminate but calyx 0.8–1.2 mm long, the tube ca. 0.2 mm long, the lobes 0.6–0.8 mm long, 0.9–1.1 mm wide; corolla 1.2–1.4 mm long, the tube 0.4–0.5 mm long, the lobes 0.7–0.9 mm long, 1.1–1.2 mm wide; staminodial as in staminal tube, 0.4–0.5 mm long, adnate to corolla tube, the antherodes 0.2–0.3 mm long, 0.4–0.5 mm wide; pistil obturinate, 0.5–0.6 mm long, 0.3–0.4 mm wide, glabrous, the ovules 2–3, partially imbedded in the placenta. **Fruit**: globose, 5–7(–9) mm diam., black at maturity, the exocarp thick, juicy.

**Distribution.**—In moist forests rimming the Amazon Basin, from Guyana through Venezuela to the Andes of Colombia southward to Bolivia, 100–1,000(–2,000) m. It is also known from the Chocó Floristic Province of Colombia, and may be expected in that corresponding region of Ecuador. The Bolivian specimens cited below represent new distribution records.

**Ecology and conservation status.**—Cybianthus venezuelanus is common in lowland and premontane moist forests, and occasionally in premontane pluvial for-
ests. It is locally common and appears to do well in light gaps and forest margins, thus, it should not be considered threatened.

*Etymology.*—The epithet refers to the the country from which the type was collected, Venezuela.


The perianth of the lectotype of *Cybianthus venezuelanus*, with dense and prominent black punctations, the truncate sessile anthers, large oblong-colate chartaceous leaves, and short pedicels match the collections cited here. *Cybianthus venezuelanus*, as treated here, is a polymorphic ochlospecies with many regional variants. The type of *Cybianthus brownii* Gleason varies only in its shorter pedicels and longer corolla lobes. Likewise, the type of *Cybianthus egensis* Mez, in bud, has correspondingly shorter pedicels and corollas. *Cybianthus venezuelanus* is easily recognized by the angulate branchlets, pseudoverticillate leaves, rounded calyx lobes with opaque margins, and truncate anthers with confluent pores. Its distribution, which rims the Amazon Basin, is unusual in the Myrsinaceae but is common in other families, such as the Piperaceae (R. Callejas, pers. comm.).

37. *Cybianthus grandezi* Pipoly, sp. nov. (Fig. 26). **Type:** PERU. **Loreto:** Prov. Maynas, Quebrada Yanayacu, entering from Aucayo, 25 Aug 1990 (stam. fl), C. Grández, S. Vásquez & M. Flores 1824 (holotype: MO; isotypes: AMAZ, US).

Quoad folia magna chartacea nervos secundarios tertiariosque laminares praecrite utrinque conspicua ad bases gradatim descrescentiaque necno petioli pulvinatos *C. jensoni* valde affinis sed ab ea laminis ad bases obtrusi auriculatisque (non cuneatis) manifeste desuper perpunctulosis (loc epunculatis) desuper nitidus (loc sordidis) nervii secundarii 18–24 (non 24–30) -jugis, 12–13.5 (non 6.5–9) cm latis, petiolis 0.5–1.4 (non 2.1–5) cm longis, pedicellis 0.3–0.5 (non 0.8–1.4) mm longis, bracteis florinis pedicellis 3 (non 6–7)-plo longiores statim cognoscitur.

*Shrub* to 2 m tall. *Branchlets* terete, ca. 10 mm diam., rufous-lepidote.
Leaves alternate; blades chartaceous, oblanceolate, 34–36 cm long, 12–13.2 cm wide, apically subacuminate, basally truncate and appearing auriculate, nitid above, pallid below, glabrous, and prominently black perpuncticulose above, sparsely and minutely rufous-lepidote below, the midrib raised and canaliculate above, prominently raised, black punctate-lineate and densely rufous-lepidote below, the secondary veins 18–24 pairs, loop-connected submarginally, the margin entire; petioles canaliculate, (0.5–)1–1.4 mm long, 0.4–0.6 mm diam., pulvinate, densely lepidote. Staminate inflorescence unknown. Pistillate inflorescence an erect, straight simple raceme, (8.5–)11–14 cm long; peduncle 1–3 cm long; the rachis green, densely red glandular-papillate, black punctate-lineate; floral bracts membranaceous, linear-lanceolate, 1.8–2 mm long, densely rufous lepidote; pedicels obconic, 0.5–1 mm long, densely glandular-papillate. Pistillate flowers chartaceous, creamish-white; calyx cotyliform, 1.8–2 mm long, the tube ca. 0.5 mm long, the lobes widely ovate, 1.3–1.5 mm long, 1.1–1.2 mm wide, apically acute, densely and prominently black punctate, prominently translucent pustulate, the margin hyaline, irregular, erose-serrulate, epunctate, glabrous; corolla subrotate, 2.2–2.4 mm long, the tube ca. 0.5 mm long, the lobes very widely ovate 1.7–1.9 mm long and wide, apically rounded, densely and prominently black punctate and translucent pustulate without, glandular-granulose throughout and prominently black punctate within, the margin hyaline, epunctate, minutely erose-crenulate, glabrous; staminodes 1.1–1.2 mm long, staminal tube conspicuous, carnose, 0.4–0.5 mm long, elobate, densely glandular-papillate, the filaments terete, proximally curved, 0.2–0.3 mm long, the sterile anthers ovate, 0.5–0.6 mm long, and wide, the apically apiculate, dehiscent by terminal confluent pores ca. 3/4 length, the connective prominently black punctate; pistil obturbinate, 1.5–1.6 mm long, 0.5–0.6 mm diam., densely and prominently black punctate, translucent glandular-lepidote, the ovary 0.5–0.6 mm long, the style 0.8–0.9 mm long, the stigma bilobed, the lobes to 0.1 mm long, distally curved, the placenta subglobose, with 2–4 ovules partially embedded. Fruit globose, 8–10 mm long and in diam., the exocarp thick, juicy, purple-black at maturity.

Distribution.—Known only from Maynas Province, Dept. of Loreto, Peru, at up to 125 m elevation; presumably endemic.

Ecology and conservation status.—Cybianthus grandezi is restricted to primary lowland most upland terra firme forest over red lateritic clays. Label data indicate it is rare, and given the valuable timber present in that forest type, this species should be considered threatened.

Etymology.—It is indeed a pleasure to dedicate this species to Biól. César Grandez, professor of biology at the Universidad Nacional de la Amazonía Peruana (UNAP), Iquitos, and authority on the systematics of Peruvian Flacourtiaceae. César is an ardent field worker, an excellent teacher and herbarium curator.

Cybianthus grandezi is closely related to C. jensonii Pipoly, but is easily recognized by its subsessile leaves with truncate bases. The perpuncticulose and nitid adaxial leaf surface, and secondary veins raised prominently above and below are also distinctive.

38. **Cybianthus jensonii** Pipoly, sp. nov. (Fig. 27). **Type: PERU. Loreto; Prov. Alto Amazonas: Andos, Río Pastaza near Ecuadorean border, 02° 48’ S, 76° 28’ W, 210 m, 14 Aug 1980 (fr), A. Gentry, R. Vásquez & N. Jaramillo 29700 (Holotype: MO; Isotypes: AMAZ, NY, USM).

Quoad folia magna chartacea nervos laminares secundarios tertiariosque praecipitae utrinque conspicua ad bases gradatim aqdescrecentia petiolosoque pulvinatos C. grandezi valde affinis sed ab ea laminis ad bases cuneatis (nee obtusis auriculatisque) epunctatis (non manifesit desuper perpuncticulosis) desuper bordis (non nitidis) nerviis secundariis 24–30 (non 18–24) jugis, 6.5–9 (nee 12–13.5) cm latis, petiolis 2.1–5 (non 0.5–1.4) cm longis, pedicellis 0.8–1.4 (non 0.3–0.5) mm longis bracteis florinis pedicellis 6–7 (non 3)–plo longiores statim cognoscitur.

**Treelet to 4 m tall. Branchlets terete, 7–9 mm diam., lenticellate, the bark vertically ridged, densely rufous tomentose. Leaves alternate; blades membranaceous, oblanceolate, 33–49 cm long, 6.5–9 cm wide, apically subacuminate, basally long-attenuate, dull green above and below, the veins 24–30 pairs, bullate above, prominently raised below, the tertiary areoles prominently raised below; glabrate above, moderately puberulent furfuraceous lepidote and sparsely pellucid punctate below, the margin entire, decurrent, gradually tapering to the petiole; petioles marginate, 2.1–5 cm long, to 0.5 cm thick, glabrous, abruptly pulvinate, the pulvinus 1.3–2 cm above petiole base. Staminate inflorescence: a simple, lax, axillary raceme 6.5–8 cm in bud; the rachis, bracts and pedicels densely rufous tomentose; floral bracts membranaceous, linear-lanceolate, 3–4 mm long, 0.3–0.4 mm wide, apically subulate, the margin entire; pedicels cylindrical, 0.8–1.4 mm long, glabrescent. Staminate flowers 4-merous; calyx membranaceous, cotyliform, 1.4–1.6 mm long, the tube 0.2–0.4 mm long, the lobes widely ovate, 1–1.3 mm long, 1.2–1.5 mm wide, apically acuminate, densely and prominently black punctate, sparsely rufous pubescent, the margin hyaline, flat, erose, epunctate; corolla (in bud) subrotate, membranaceous, to 1.2–1.5 mm long, the lobes ovate, apically obtuse, densely and prominently black punctate, glabrous without, sparsely glandular-granulose within, the margin hyaline, flat, erose, epunctate, glabrous; stamens appearing epipetalous, the anthers sessile at the junction of corolla tube and lobe, deltoid, ca. 0.7 mm long and wide, dehiscent by subapical pores, the connectives red punctate medially; pistilode, conic, hollow, ca. 0.5 mm long and 0.2 mm diam. Pistillate inflorescence as in staminate but 3–6(–7.2) cm long; floral bracts 1–1.6 mm long, 0.2–0.4 mm wide, apically long-attenuate; fruiting pedicels incrassate, 0.7–0.9 mm long, to 1.5 mm...
Fig. 27. *Cybianthus jensonii* Pipoly. A. Habit, showing long-attenuate leaf bases. B. Abaxial leaf surface with prominently defined areoles. C. Portion of staminate inflorescence in bud. D. Open staminate bud. E. Pedicel, calyx and fruit. A–D, drawn from Gentry et al. 55708. E, drawn from Croat 19485. Figure drawn by Linda Ellis.
diam. **Pistillate flowers** as in staminate, calyx 1.4–1.6 mm long, the tube 0.2–0.4 mm long, the lobes 1–1.3 mm long, 1.2–1.5 mm wide; corolla, staminodes and pistil unknown. **Fruit** depressed-globose, orange, 5–6 mm long, 6–7 mm diam., smooth, prominently pellucid punctate.

**Distribution.**—Endemic to lateritic slopes above riparian areas in the Department of Loreto, Provinces of Alto Amazonas and Maynas, in the northern Amazon Basin of Peru, 130–210 m.

**Ecology and conservation status.**—This species occurs in primary lowland tropical várzea forest margin. It is surely a rare species, given the recent massive collection effort at the sites during the *Florula of the Biological Reserves of Iquitos* project (Vásquez 1997), during which the species was not relocated at the Explorama Inn (Indiana) site. Given its rarity, this species should be considered threatened.

**Etymology.**—I dedicate this species to Peter Jenson, President of Explorama Tours, conservationist and principal promoter of ecotourism in the Peruvian Amazon. Much of our knowledge regarding the biology of tropical ecosystems in the Peruvian Amazon would not have been discovered were it not for Peter and his associates’ enthusiastic support, generosity and hospitality at the company’s biological reserves (Explorama Inn, Explorama Lodge, and Explornapo Camp) which now serve as long-term ecological study sites. Explorama Tours’ properties, with their combination of research, public education and collaboration with local communities and tourism, serves as the most successful model for tropical ecotourism known.

**Paratypes.** *PERU. Loreto:* Prov. Maynas, Explorama Inn, 2 km W of Indiana on Rio Amazonas, 03° 30' S, 73° 02' W, 130 m, 12 Feb 1987 (stam. bud), A. Gentry et al. 55708 (AMAZ, MO); Varadero de Mazán from Rio Amazonas to Rio Napo, 22 Aug 1972 (fr), T. Croat 19485 (AMAZ, MO, NY, USM).

*Cybianthus jensonii* is most closely related to *C. grandezii* Pipoly, but easily recognized by its long-attenuate leaf bases, epunctate, pallid abaxial leaf surfaces, the secondary veins 24–30 pairs, narrower leaves with much longer petioles, subobsolete pedicels 0.8–1.4 mm long, and longer floral bracts.

39. **Cybianthus fosteri** Pipoly, sp. nov. (Fig. 28). **Type:** *PERU. MADRE DE DIOS:* Prov. Manú, Atalaya, vicinity Hacienda Amazonia, 2–3 km W of village, across Rio Alto Madre, 12° 55' S, 71° 12' W, forested ridge, 600–900 m, 7 Dec 1983 (stam. fl), R. Foster & T. Wachter 7254 (HOLOTYPE: MO; ISOTYPES: F, NY, USM).

*Ob folia pseudoverticillata magna chartacea longipetiolata abrupte acuminataque, inflorescinta longiracemosa, flores mutantes, coriaceosque, antheras sessiles manifeste necnon dorso punctatas, C. venezuelano valde affinis sed ea ramulis teretes (non angulatissi), foliis pseudoverticillatis (non alternatis), laminis densisque manifeste atro-punctatis et omnino prominentes (non parceque plane subter atro lineato-punctatis) petioliis anuliculatis (non marginatis ad bases abrupte crassis (sic gracilis) lobis corollinis interius pustulatis (non planis), antheris ad apices rotundatis (non truncatis) portis separatatis (non confluentialibus) praeclare distat.
Fig. 28. *Cybianthus fosteri* Pipoly. A. Habit, showing terete branchlets and pseudoverticillate phyllotaxy. B. Portion of staminate inflorescence, showing pustulate corolla and apically rounded anthers with separate (not bitemose) pores. C. Abaxial leaf surface detail, showing punctations and sparse puberulence. D. Branchlet apex, showing tomentum. A–D, drawn from holotype, by LindaEllis.
Tree to 5 m tall. Branchlets terete, (6–)7–9 mm diam., densely ferrugineous tomentose. Leaves pseudoverticillate; blades chartaceous, oblanceolate, (26–)28–34 cm long, 5.5–9(–10) cm wide, apically abruptly acuminate, basally long attenuate, midrib somewhat elevated above, prominently raised below, the secondary veins 11–18 pairs, dull green above, pallid below, prominently black punctate above and below, sparsely rufous puberulent below, the margin entire, regular, flat; petioles canaliculate, 1.6–2 cm, pulvinate, ferrugineous tomentose, glabrescent. Staminate inflorescence a lax raceme 8–12 cm long, moderately rufous lepidote, glabrescent; floral bracts lanceolate, 2–3 mm long, 0.8–1.1 mm wide, apically acute, densely rufous lepidote; pedicels cylindric, 3.5–5 mm long at anthesis erect in bud, nodding in anthesis, densely rufous lepidote. Staminate flowers 4-merous, coriaceous, nodding, pale green; calyx cotyliform, 1.2–1.3 mm long, the tube 0.5–0.6 mm long, the lobes widely ovate, 0.7–0.8 mm long, 1.1–1.2 mm wide, apically rounded, densely and prominently black punctate, sparsely rufous lepidote, glabrescent, the margin stramineous, opaque, epunicate, erose-fimbriate, glabrous; corolla subrotate, 2–2.5 mm long, the tube 0.5–0.6 mm long, glabrous, the lobes widely ovate, 2–2.1 mm long, 1.4–1.6 mm wide, apically acute, densely and prominently black punctate, sparsely rufous lepidote without, glabrescent, prominently pustulate and densely glandular-granulose throughout within, the margin stramineous, erose, glandular-granulose; stamens apparently sessile at junction of corolla lobes and tube, the anthers sessile, very widely ovate, 0.5–0.6 mm long, 0.8–0.9 mm wide, apically rounded, basally truncate, the pores widely ovate, extending 1/2–3/4 anther length, separate (not confluent), the connective prominently red punctate; pistillode subglobose, 0.7–0.8 mm long, 0.3–0.4 mm wide, hollow, densely glandular-lepidote. Pistillate inflorescence as in staminate but erect, 3–5 cm long; floral bracts 2–3 mm long, 0.8–1.1 mm wide; pedicels 2.5–4 mm long in fruit. Pistillate flowers as in staminate but calyx 0.8–1 mm long, the tube 0.2–0.3 mm long, the lobes 0.5–0.7 mm long, 0.9–1.1 mm wide; corolla, staminodes and pistil unknown. Fruit globose, 6–8 mm long and diam., red at maturity.

Distribution.—Known only from the type locality, presumably endemic.

Ecology and conservation status.—Cybianthus fosteri is endemic to one area of the Manú Biosphere Reserve and National Park, one of the largest in South America. It is a ridgetop species in lowland topical moist forest. Given the extension of the Reserve and the species narrow range, it should not be considered threatened at this time.

Etymology.—This species is dedicated to Robin Foster, of the Smithsonian Tropical Research Institute and a research associate of the Field Museum of Natural History. Robin has served as one of the co-founders of the Rapid Assessment Protocol, and is an expert on the reproductive biology of Tachigali (including Sclerodobium) of the Fabaceae.

Cybianthus fosteri is closely related to Cybianthus venezuelanus, but is easily recognized by its terete branchlets, pseudoverticillate leaves prominently and densely black punctate above and below, canaliculate petals, pustulate corolla lobes, and rounded anthers with separate (not birimose) pores. The pustulate corolla lobes are unique within the genus.


Tree to 15 m tall. Branchlets 2.5–3.5 mm diam., densely ferrugineous dendroid-tomentose at first, glabrescent. Leaves pseudoverticillate; blades thinly coriaceous, elliptic, (11–)15–21(–26) cm long, (4–)5.5–7(–10.8) cm wide, apically long-acuminate, the acumen 0.8–1.5(–2) cm long, basally cuneate, decurrent on the petiole, midrib prominently elevated above and below, decurrent to petiole base, the secondary veins (9–)11–16(–18) pairs, nitid and glabrous above and below, inconspicuously pellucid-punctate (not visible when dried), the margin entire, irregular, flat, entire; petals canaliculate, 1–2(–3) cm long, tapered, densely ferrugineous dendroid-tomentose, glabrescent. Stamineate inflorescence a lax, simple raceme, 11–15 cm long, sparsely rufous stellate puberulent; peduncle 0.9–1(–1.8) cm long; floral bracts chartaceous, linear, 1–1.2 mm long, 0.2–0.3 mm wide, apically subulate, densely rufous stellate puberulent above and below, the margin entire, early caducous; pedicels cylindrical, 2.1–1.7 mm long, sparsely puberulent, glabrescent. Stamineate flowers 4-merous, membranaceous, nodding, greyish-brown; calyx cotyliform, 0.9–1 mm long, the tube 0.1–0.2 mm long, the lobes widely ovate, 0.6–0.8 mm long, 0.9–1.2 mm wide, apically acuminate, sparsely rufous stellate puberulent, densely and prominently black punctate, the margin hyaline, erose, short glandular-ciliate; corolla subrotate, translucent, 1.6–1.8 mm long, the tube cylindrical, 0.3–0.5 mm long, the lobes very widely ovate, 1.2–1.5 mm long, 1.5–1.8 mm wide, flat, apically obtuse, densely and prominently black punctate and glabrous without, densely glandular-granulose and pusticate within, the margin irregular, glandular-granulose, entire; stamens 0.7–0.9 mm long, the tube inconspicuous, membranaceous, 0.3–0.5 mm long, sessile, the anthers quadrate, 0.2–0.3 mm long, 0.5–0.6 mm wide, apically truncate, translucent, glabrous, the connective prominently red punctate dorsally; pistillode cylindrical, 0.3–0.5 mm long, 0.2–0.3 mm diam., hollow, densely punctate, glabrous, the stigma 3-lobed. Pistillate inflorescence as in stamineate but (1–)1.5–5 cm long; peduncle (0.3–)0.5–1(–1.5) cm long; floral bracts 0.6–1 mm long, 0.1–0.2 mm wide; pedicels slightly
obconical, 0.7–1.1 mm long, erect in fruit. *Pistillate flowers* as in staminate but 1–1.2 mm long, the tube 0.2–0.3 mm long, the lobes 0.8–0.9 mm long, 1–1.2 mm wide; corolla 1.3–1.5 mm long, the tube 0.3–0.5 mm long, the lobes 0.8–1 mm long, 1.1–1.5 mm wide; staminodes as in stamens but 0.4–0.6 mm long, the tube 0.3–0.5 mm long, the antherodes ca. 0.1 mm long, 0.2–0.3 mm wide; pistil obturate, 0.4–0.6 mm long, and in diameter, the style very short, the stigma 3-lobed, the placenta cotyliform, bearing 2 apically exposed ovules. *Fruit* globose, 5–7 mm diam. at maturity, exocarp black, juicy, edible at maturity. *Bisexual inflorescence* as in pistillate but a lax, simple raceme, or rarely a poorly formed panicle, 5–8(–10) cm long; peduncle 0.5–1 cm long; floral bracts 1–1.2 mm long, 0.2–0.3 mm wide; pedicels 1.2–1.5 mm long. *Bisexual flowers* as in pistillate, but stamens as in staminate, 0.5–0.8 mm long, the tube 0.2–0.3 mm long, the anthers ca. 0.3–0.5 mm long, 0.4–0.5 mm wide; pistil as in pistillate, conical, 0.4–0.6 mm long, and in diam. *Bisexual fruit* globose, 4–6 mm diam. at maturity, exocarp reddish-black, thin.

**Distribution.**—Once thought to be endemic to the Iquitos area of Loreto, Peru, *Cybianthus resinosus* is now known (reported for the first time here), from the Chocó of Colombia, Amazonian Ecuador, Venezuela, with one disjunct population in French Guiana (*Oldeman 3272*) growing at 100–200(–1,300) m elevation.

**Ecology and conservation status.**—*Cybianthus resinosus* is restricted to primary non-inundated forests on white sand (varillal). While it is locally abundant, it should be considered threatened due to increasing habitat loss. The Ecuadorian and Venezuelan populations are unusual because they occur in premontane pluvial forest and wet forest on lower tepui talus slopes (on sandstone) respectively, each containing numerous lowland elements. It may be expected in the Río Cenepa-Río Santiago Drainage Basins, of Amazonas, Peru, an area known to show the same environments with numerous pockets of sandstone.

**Etymology.**—The specific epithet refers to the highly nictid adaxial leaf surface, giving it a lacquered, resinous appearance.

Specimens examined. **COLOMBIA.** Valle del Cauca: Bajo Calima Concession, ca. 25 km NW of Buenaventura, 9 km NW of San Isidro intersection on “Canalete,” near gate, 5–45° slopes, 03° 59′ N, 77° 08′ W, 50 m, 13 Jul 1988 (ster.), D. Faber-Langendoen & J. Hurtado 1757 (CUVC, MO). VENEZUELA. Territorio Federal Amazonas: Dept. Atalaia, base of cliff and forest below slope of Cerro Huachamacari, 03° 39′ N, 65° 43′ W, 1,000–1,300 m, 5 Mar 1985 (stam. fl.), R. Lienzer 18390 (BRIT, MO, VEN). ECUADOR. Napo: Cantón El Chaco, Río Granadillo, Campamento de I NECEL, “Codo Alto,” 00° 08′ S, 77° 28′ W, 1,300 m, 13–15 Sep 1990 (fr), W. Palacios 5589 (MO, QCNE). PERU. Huánuco: Prov. Pachitea, region of Pucallpa, W part of Sirí Mountains and adjacent lowland, ca. 24 km SE to 26 km ESE of Puerto Inca, from Campamento Sirí, 09° 28′ S, 74° 47′ W, SE to valley of Río Negro, 750 m, 29 May 1988 (fr), B. Wallmayer 14-29588 (BRIT, MO, W, WU). Loreto: Prov. Maynas, Iquitos, May 1925 (stam. fl), G. Tessmann 5145 (NY); Casería
Mishana, 30 km SW of Iquitos, Callicebus Biological Reserve, 4 km S of Mishana, 19 Aug 1980 (stam. fl), R. Foster 4404 (2-2 sheets, NY); Mishana, 16 Aug. 1978 (pist. fl, fr), J. Ramírez 17 (AMAZ, MO); Mishana, Río Nanay, 03° 50' S, 73° 30' W, 140 m, 16 Aug 1978 (fr), J. Ramírez 152 (AMAZ, MO); Mishana, along Río Nanay, 03° 55' S, 73° 35' W, 150 m, 20 Jan 1985 (fr), R. Vásquez & N. Jaramillo 6126 (AMAZ, MO, NY); Allpahuayo, Estación IIAP, 04° 10' S, 73° 30' W, 150 m, 5 Jun 1985 (bud), R. Vásquez et al. 6551 (AMAZ, BRIT, MO, NY), 29 May 1990 (fr) R. Vásquez et al. 13764 (AMAZ, MO, USM), 16 Aug 1990 (pist. fl, fr), R. Vásquez & N. Jaramillo 14224 (AMAZ, BRIT, F, MO, NY, TEX, US, USM), 4 Dec 1990 (fr), R. Vásquez & N. Jaramillo 15237 (AMAZ, BRIT, F, MO, USM), 150–180 m, 29 May 1991 (ster.), R. Vásquez & N. Jaramillo 16681 (AMAZ, BRIT, MO, USM), 150 m, 25 Mar 1992 (ster.), R. Vásquez et al. 17996 (AMAZ, BRIT, MO, USM); Allpahuayo, ca. 26 km along Iquitos-Nauta Rd., 130 m, 25 Aug 1988 (fr), H. van der Werff 10273 (AMAZ, MO); Mishuyacu, near Iquitos, 100 m, Sep 24–28 1929 (fr), E. Killip & A. Smith 29873 (F, US), May–Jun 1930 (bisp. fl), G. Klug 1384 (F, NY, US); Quistococha, 200 m, 27 May 1978 (pist. fl, fr), A. Gentry & N. Jaramillo 22314 (AMAZ, MO); Altura de Piña Negra, SW of Iquitos, ca. 3–4 km past Quistococha, 200 m, 19 Nov 1975 (fr); Caserio de Urcumiraño, Río Napo, path from settlement to tall forest, 120 m, 8 Oct 1979 (fr), C. Díaz & N. Jaramillo 1486 (MO, NY); Peña Blanca, on Río Itaya, 110 m, 19 Sep 1929 (fr), E. Killip & A. Smith 29672 (F, US); Between Yurimaguas and Balsapuerto (lower Río Huallaga basin), 135–150 m, 26–31 Aug 1929 (fr) E. Killip & A. Smith 28110 (F, NY, US); Prov. Requena, Dtro. Sapuena, Jenaro Herrera, Río Ucayali, 04° 55' S, 73° 40' W, 160 m, 16 Aug 1994 (stam. fl), R. Ortiz et al. 101 (AMAZ, BRIT, MO); without locality, except "in Peruvia subandina, without date (fr), E. Poeppig s.n. (L).

Cybianthus resinus is most closely related to C. penduliflorus Mart., but is easily separated from it by the inconspicuously punctate leaves, longer pedicles, flat corolla lobes and calyx lobes with acuminate apices and erose, short-ciliate margins. The adaxial prominently raised midrib decurrent to the petiole base is unique within the subgenus. The fruit of Cybianthus resinus is also smaller, black and has a thick exocarp, and it inhabits terra firme forests on white sand whereas C. penduliflorus is an igapó species.

41. Cybianthus fuscus Mart., Flora 259. 1841. Type: BRAZIL. MATO GROSSO:
"Prope rivum Cochim in Cujaba," May (pist. fl), P. da Silva Mário s.n. (holotype: M)

Shrub or small tree to 3 m tall. Branchlets terete, 2–3 mm diam., densely dendroid and stellate rufous glandular-tomentose, tardily glabrescent. Leaves pseudoverticillate; blades chartaceous to coriaceous, very narrowly oblanclolate or very narrowly oblong, (13–)16–25(–30) cm long, 2–4(–6) cm wide, apically long acuminate-attenuate, the attenuated portion 1–2 cm long, terminating in a minute rounded tip, basally long acuminate-attenuate, the attenuated portion 1.5–2 cm long, giving the petioles appearance of being longer, fully decurrent on petiole to pulvinus; midrib prominently elevated above, decurrent to petiole base, the secondary veins 12–25 pairs, somewhat to deeply impressed, the leaf appearing subbullate to bullate above, prominently raised and loop-connected below, somewhat nitid and glabrous above, pallid, rufous papillate and conspicuously black punctate and punctate-linear below, the margin entire, flat, glabrous; petioles somewhat marginate,
5–10(–12) mm long, with a basal pulvinus. *Staminate inflorescence*; a lax raceme (2.5–)5–8(–19) cm long; peduncle 0.8–1.5 cm long; floral bracts chartaceous, linear, 1.2–1.5 mm long, 0.3 mm wide, apically subulate, densely and prominently rufous papillate; pedicels 3.5–5 mm long, densely papillate. *Staminate flowers* chartaceous, 4-merous; calyx coryliform, 0.8–1(–1.8) mm long, the tube ca. 0.2 mm long, the lobes very broadly ovate or linear-lanceolate, 0.5–0.8(–1.6) mm long, 0.6–0.8 mm wide, apically acute to acuminate to attenuate, mediately thickened, densely and prominently red and black punctate medially, with a few scattered rufous papillae, the margin scarious, highly erose, densely glandular-ciliate; corolla subrotate, 2–2.3 mm long, the tube 0.6–0.8 mm long, the lobes suborbicular, unequally divided, 1.4–1.6 mm long, 1.3–1.7 mm wide, apically broadly rounded, densely and prominently orange punctate without, densely glandular-granulose throughout within, the margin often revolute at maturity, irregular, entire, glandular-granulose; stamens ca. 1 mm long, the filaments developmentally fused to the corolla tube for their entire length (the stamens appearing epipetalous), 0.6–0.8 mm long, the anthers very widely ovate, 0.4–0.5 mm long and wide, the apically acute, basally cordate, apically dehiscent by terminal pores, confluent at anthesis, ventrally sparsely rufous papillate basally, dorsally densely rufous papillate and sparsely but prominently orange punctate; pistillode absent or highly reduced, ca. 0.5 mm long. *Pistillate inflorescence* as in staminate but 3–10(–14) cm long; peduncle 6–10 mm long; pedicels 1.5–4 mm long. *Pistillate flowers* as in staminate but 0.7–0.9 mm long, the tube ca. 0.1 mm long, the lobes oblate, 0.6–0.8 mm long, 1–1.2 mm wide; corolla as in staminate but 1.4–1.8 mm long, the tube ca. 0.5 mm long, the lobes ovate to suborbicular, 1.1–1.7 mm long, 1.0–1.2 mm wide, the staminodes resembling stamens but with antherodes 0.3–0.4 mm long and wide; pistil ellipsoid, 1–1.2 mm long, 0.6–0.8 mm diam., the stigma capitate, 3–4-lobed, densely translucent glandular-lepidote, ovules 2–3, immersed in the placenta. Fruit globose, 5–7 mm long and diam. at maturity, densely and prominently punctate, with a few persistent translucent lepidote scales.

**Distribution.**—As here recognized, *Cybianthus fuscus* occurs from the Guianas, to Venezuela, Colombia, Ecuador, Peru, Bolivia, and their corresponding frontiers with Brazil. *Cybianthus fuscus* rims the Amazon Basin, from 100–200 m elevation. As stated earlier, this is an infrequent distribution, as in *Cybianthus venezuelanus*.

**Ecology and conservation status.**—*Cybianthus fuscus* occurs in primary forest on *terra firme*, especially on steep slopes, near water courses. It is a locally infrequent element of the understory but does not appear to be threatened at this time.

**Etymology.**—The epithet refers to the color of the tomentum of the branchlets, pedicels and calyx.
Representative specimens examined. ECUADOR. Napo: Small area of non-inundated forest, ca. 60 km upriver from Nuevo Rocafuerte, 15 Sep 1977 (fr), R. Foster 3618 (F, USM). PERU. Loreto: Prov. Alto Amazonas, Capahuari Sur (Petroleum Camp), 02° 51' S, 76° 20' W, 200 m, 25 Mar 1982 (fr), R. Vásquez et al. 3065 (AMAZ, MO, US); Prov. Maynas, Río Yavari, Petropolis, 3 km from Río Amazones, 8 Sep 1976 (fr), J. Revilla 1302 (AMAZ, BRIT, MO); 15 km from roadside along Rd. between UNAP Agricultural Experiment area and Escuela Forestal Vivero, 9 Feb 1968 (pist. fl), D. Simpson & F. Schanke 647 (F, USM); Puerto Almendras, 03° 45' S, 73° 25' W, 122 m, 7 Dec 1982 (pist. fl), R. Vásquez & N. Jaramillo 3511 (AMAZ, MO, NY).

Cybianthus fuscus is a widely defined, infrequent, but widely distributed species, and is most variable with regard to leaf size and inflorescence stature. Populations in Ecuador and Peru are almost identical to specimens known from the Guianas, Bolivia, and Brazil in the northeast portion of Amazonas state, near the border of Territorio do Roraima. Populations matching the type have leaves much smaller than the Ecuadorean and Peruvian populations do, and are more like those of the SE Amazon Basin. While Cuiabá is located at the northern extreme of the Pantanal Region, it is not entirely clear where the exact type locality was. If the type locality in what was Cuiabá Province, was north of the Chapada dos Parecis, then it would be at the headwaters of the Río Juruena or Río Teles Pires, both of which dump into the Río Tapajos, then to the Río Amazones. If the locality was west of Cuiabá, toward the Bolivian border, streams there form part of the headwaters of the Río Mamasaé, a branch of the Río Madeiras, which empties into the Amazonas near Manaos. In either case, the type locality would be at the very edge of the Amazon Basin sensu stricto and it would not be surprising to see the species in other parts ot the Basin. Therefore, while populations from the type locality are slightly smaller in stature, the leaves are more chartaceous, and the inflorescences shorter, there is good evidence to show that they are part of a large polymorphic ochlospecies complex, of which the populations in Ecuador and Peru represent a commonly encountered morphotype. The same pattern of variation seen in this species is seen in many Piperaceae (R. Callejas, pers. comm.).

Cybianthus fuscus is to be closely related to C. caneifolius Mart. (including C. indecorus Mez), a vicariant species from SE Brazil. The unique indument, pedicels obconic in fruit, and striking leaves with very long and attenuate apices and bases allow for easy recognition of Cybianthus fuscus.


Shrub to 1.5 m tall. Branchlets terete, 1.5–2.5 mm diam., densely rufous stellate tomentulose, the tomentum appressed. Leaves loosely pseudoverticillate; blades chartaceous, elliptic to oblanceolate, (9.5–)12.5–16 (–20.5) cm long,
3.5–5(–7) cm wide, apically subacuminate to acuminate, basally cuneate, decurrent throughout petiole length, midrib depressed above, prominently raised below, decurrent to base of petiole, the secondary veins 10–15 pairs, dull and glabrous above, dull and sparsely rufous puberulent below, concentrated along the midrib and the secondary veins, prominently perpuncticulose and black punctate-lineate, the margin slightly revolute upon drying, irregular, entire; petioles marginate and canaliculate, (1–)1.5–2(–3) cm long, tapered, sparsely stellate rufous puberulent, glabrescent. Stamine inflorescence an erect, simple raceme, (4–)9–13 cm long, sparsely rufous stellate puberulent; peduncle (0.6–)0.8–1(–1.3) cm long; floral bracts coriaceous, linear-lanceolate, 1.3–1.5 mm long, 0.2–0.3 mm wide, apically attenuate to a rounded tip, glabrous above, densely and minutely rufous stellate tomentulose below, the margin glabrous, entire; pedicels cylindrical, 3.7–5 mm long, sparsely rufous stellate tomentulose, glabrescent. Stamine flowers 4-merous, coriaceous, nodding, green; calyx 0.9–1.1 mm long, the tube 0.2–0.3 mm long, the lobes linear-lanceolate, 0.7–0.8 mm long; 0.2–0.3 mm wide basally, apically long-attenuate, densely and prominently red and black punctate, sparsely rufous stellate puberulent, glabrescent, the margin irregular, erose, minutely ciliolate; corolla subrotate, 1.5–1.8 mm long, the tube 0.6–0.7 mm long, the lobes very widely ovate, 0.9–1.1 mm long, 1.3–1.7 mm wide, apically emarginate, densely and prominently red and black punctate, glabrous without, densely glandular-granulose throughout within, the margin irregular, entire, flat, densely glandular-granulose; staminal tube inconspicuous, adnate to corolla throughout, 0.6–0.7 mm long, the filaments short, thick, 0.1–0.2 mm long, glabrous, the anthers widely ovate, 0.5–0.6 mm long, 0.4–0.5 mm wide, apically and basally truncate, the connective punctate, glabrous; pistilode subglobose, 0.3–0.4 mm long, 0.3–0.4 mm diam., hollow, densely translucent glandular-lepidote, the stigma obsolete. Pistillate inflorescence as in stamine but 4–6.5 cm long; peduncle 1–1.5 cm long; floral bracts 0.9–1.1 mm long, 0.1–0.2 mm wide; pedicels 1.5–2.5 mm long. Pistillate flowers as in stamine but calyx 0.8–1 mm long, the tube 0.1–0.2 mm long, the lobes, 0.7–0.8 mm long, 0.1–0.2 mm wide basally; corolla, staminodes and pistil unknown. Fruit globose, 0.3–0.5 mm long and wide, green, exocarp thin, red punctate.

Distribution. — Cybianthus cyclopetalus is restricted to the western Amazon Basin of Brazil and southeastern Peru, to 290 m elevation.

Ecology and conservation status. — This species is restricted to várzea or “tahuampa” habitats, subject to inundation. Rapid development along the rivers in the Amazon Basin changes its flow and may effect these populations. Therefore, it should be considered threatened.

Etymology. — The specific epithet refers to the very widely ovate petals of the species.
Representative specimens examined. PERU. Madre de Dios: Prov. Tambopata, Tambopata Wildlife Reserve, 30 km S of Puerto Maldonado, 12° 15' S, 69° 17' W, 260 m, 9 Nov 1984 (stam. fl), H. Young et al. 146 (MO, US); Tambopata Reserve, at mouth of Rio Orébigny, 12° 50' S, 69° 17' W, 250 m, 6 Mar 1981 (fr), A. Gentry & K. Young 32028 (MO, USM); Along trail from large lagoon at end of Swamp Trail, Explorer's Inn, near confluence of Rio Tambopata and Rio La Torre, Reserva Tambopata, 12° 50' S, 69° 20' W, 39 km SW of Puerto Maldonado, 14 Oct 1985 (stam. fl), S. Smith et al. 738 (US), (stam. fl), D. Bell 101 (US); Explorer's Inn, Permanent Plots, Tambopata Reserve, 12° 50' S, 69° 17' W, 290 m, 18 Sep 1994 (stam. fl), R. Vásquez et al. 19132 (AMAZ, BRIT, CUZ, MO).

Cybianthus cyclopetalus is most closely related to C. resinus Mez, but can immediately be separated from it by the thinner branchlets, dull, chartaceous leaves, and the unique linear-lanceolate calyx lobes with long attenuate apices.


Shrub or small tree to 4 m tall. Branchlets terete, 2.5–3.5 mm diam., stellate rufous tomentose, glabrescent. Leaves alternate; blades chartaceous, elliptic to oblong-lanceolate, (8–)10.5–19(–28.4) cm long, apically acute, basally broadly acute, slightly decurrent on the petiole; midrib raised above and below, the secondary veins (10–)12–15(–23) pairs, nitid above, pallid below, glabrous, densely black punctate, the margin flat, entire or bearing a few rough serrulations; petioles semiterete, (0.5–)0.8–1.2(–1.5) cm long, tapered, glabrous. Staminate inflorescence a lax, simple raceme (8–)10–14(–20) cm long, densely rufous puberulent; peduncle (0.5–)1–1.2(–1.5) cm long; floral bracts membraneaceous, linear-lanceolate, 1–1.2 mm long, 0.1–0.2 mm wide, apically attenuate, densely rufous puberulent, the margin entire; pedicels cylindrical, 1–2(–2.5) mm long, densely rufous puberulent, glabrescent. Staminate flowers 4-merous, erect, membraneaceous green; calyx cotyliform, 0.8–1.1 mm long, the tube 0.1–0.3 mm long, the lobes ovate, 0.4–0.6 mm long, 0.6–0.9 mm wide, apically obtuse, densely and prominently black punctate, the margin crenulate, long glandular-ciliate; corolla subrotate, 1.2–1.5 mm long, the tube 0.3–0.4 mm long, the lobes very widely ovate, 0.9–1.2 mm long, 1.2–1.5 mm wide, apically obtuse to rounded, densely and prominently black punctate, glabrous without, densely glandular-granulose throughout within, the margin involute, densely glandular-granulose, entire; stamens 0.7–0.9 mm long, the tube completely adnate to corolla tube, 0.3–0.4 mm long, the anthers ovate, 0.4–0.5 mm long, 0.3–0.4 mm wide, apically acute to obtuse, basally cordate, the connective prominently black.
punctate dorsally; pistillode obsolete. *Pistillate inflorescence* as in staminate
but (2.5—4—8—11) cm long; peduncle (0.3—0.5—1 cm long; floral bracts
1—1.2 mm long, 0.2—0.3 mm wide; pedicels 0.2—0.5 mm long. *Pistillate
flowers* as in staminate but calyx 1.2—1.5 mm long, the tube 0.3—0.4 mm
long, the lobes widely ovate, 0.9—1.2 mm long, 1.2—1.5 mm wide, apically
rounded, corolla and staminodes unknown; pistil conical, 1.2—1.3 mm long,
0.9—1.1 mm wide, the stigma 4-lobed, the placenta cotyliform, ovules 4,
naked. *Fruit* 6—10 mm long and in diam., the exocarp thin, densely black
punctate. *Bisexual inflorescence* as in staminate but 6—15 cm long; peduncle
0.8—1.2 cm long; floral bracts 1—1.2 mm long, 0.1—0.2 mm wide; pedicels
1—1.2 mm long. *Bisexual flowers* as in staminate but calyx 0.7—1 mm long,
the tube 0.1—0.2 mm long, the lobes 0.6—0.9 mm long, 0.5—0.8 mm wide;
corolla 1.2—1.5 mm long, the tube 0.3—0.4 mm long, the lobes very widely
ovate, 0.9—1.2 mm long, 1.2—1.5 mm wide, the margin involute, densely
glandular-granulose, entire; stamens 0.7—0.9 mm long, the tube completely
adnate to corolla tube, 0.3—0.4 mm long, the anthers ovate, 0.3—0.4 mm
long, 0.3—0.4 mm wide, apically acute to obtuse, basally cordate, the con-
nective prominently black punctate dorsally; pistil conical, 0.9—1.1 mm
long, 0.7—0.9 mm diam., the style 4-lobed, the placenta cotyliform, ovules
3, naked. *Bisexual fruit* globose, 4—6 mm long and in diam., the exocarp
thin, pellucid punctate.

Distribution.— *Cybianthus penduliflorus* is known from Brazil, Peru and Bolivia,
100—200 m. The species is not known from Ecuador, but may be expected
anywhere the habitat is appropriate within the Ecuadorean Amazon.

Ecology and conservation status.— *Cybianthus penduliflorus* is endemic to igapó
habitats, and withstands flooding. As a small shrub, it grows on riverbanks
and on hummocks, behind *Triplaris* (Polygonaceae) and other shoreline plants.
At this time, it is not considered threatened.

Etymology.— The specific epithet refers to the lax habit of the inflorescence,
pendent in the field.

Representative specimens examined. PERU. Loreto: Prov. Maynas, Quistococha, 100
m, 1 Feb 1979 (fr), F. Ayala 1623 (AMAZ, MO), Quistococha, 00° 45' S, 73° 15' W, 122
m, 27 Aug 1987 (stam. fl), R. Vásquez & N. Jaramillo 9461 (AMAZ, MO, USM); Lower
Río Momón, tributary of Río Nanay, near Iquitos, 8 Dec 1979 (bud), A. Jones & C. Davidson
9717 (AMAZ, CAS, MO), Near Momocillo, 16 Nov 1976 (stam. fl), J. Revi&aelig;a 1826 (AMAZ,
F, MO); Dtto. Iquitos, caserío near Nita Rumi, on Río Nanay, 23 Feb 1976 (fr), J. Revi&aelig;a
187 (AMAZ, F, MO, USM); Vicinity of Iquitos, 10 Sep—12 Oct 1976 (bud), J. Revi&aelig;a
1442 (AMAZ, BRIT, MO, USM); Morona Cocha, near Iquitos, 100 m, 14 Dec 1962 (fr),
J. Schunke 6268 (AMAZ, F, MO, UCLA, US, USM); Puerto Almendras, 03° 48' S, 73° 25'
W, 122 m, 17 Aug 1983 (bud), R. Vásquez & N. Jaramillo 4285 (AMAZ, MO, NY, USM);
Naira, Quebrada Saragosa, 04° 29' S, 73° 35' W, 150 m, 10 Jan 1988 (fr), R. Vásquez & N.
Jaramillo 10339 (AMAZ, MO, US, USM); Iquitos and vicinity, 11 Oct 1929 (bud), L.L.
Williams 3676 (F). BOLIVIA. Santa Cruz: Velasco Prov., Campamento El Refugio, along
Río Paragüa, SE of the house, 14° 46' 09" S, 61° 02' 11" W, 240 m, 11 Oct 1994 (fl bud),
R. Guillén & G. Salvatierca 2290 (BRIT, MO, USZ); Campamento La Toledo, 1,000 m E of the house, 14° 42' S, 61° 09' W, 160 m, 21 Oct 1994 (stam. fl), R. Guillén & R. Choré 2439 (BRIT, MO, USZ), 1 km W of camp, on canoe route to Campamento Toledo, 14° 45' 51" S, 61° 02' 22" W, 30 Jan 1995 (fr), R. Guillén et al. 3114 (BRIT, MO, USZ).

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1. Cybianthus pastensis
2. C. gigantophyllus
3. C. occidentalis
4. C. spichigeri
5. C. lepidotus
6. C. laetus
7. C. peruvianus
8. C. commeruvianus
9. C. guyanensis subsp. pseudoicacoreus
10. C. timanae
11. C. cuartecasaii
12. C. nestorii
13. C. spicatus
14. C. fulvopulverulentus subsp. magnolifolius
15. C. verticilloides
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NEW FLOWERING PLANTS FROM SOUTHERN NEW IRELAND, PAPUA NEW GUINEA

W. TAKEUCHI

Botanical Research Institute of Texas
c/o Papua New Guinea Forest Research Institute
P. O. Box 314, Lae, 411, PAPUA NEW GUINEA

JOHN J. PIPOLY III

Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060 U.S.A.
jpipoly@brit.org; clusia@latinmail.com

ABSTRACT

Botanical exploration of the Hans Meyer Range in southern New Ireland revealed the existence of two previously unknown taxa in the families Rubiaceae and Corsiaceae. The novelties, *Psychotria osiana* Takeuchi & Pipoly, (Rubiaceae) and *Corsia purpurata* var. *wiaakabui* Takeuchi & Pipoly (Corsiaceae) are described and illustrated. Taxonomic and ecological notes are also provided for the new taxa.

INTRODUCTION

Papua New Guinea (PNG) is one of only four countries on earth projected as retaining most of its original forest cover by the end of this century (Suzuki 1993). Unfortunately, it is also among the least known floristic areas within the Malesian region (Conn 1994; Johns 1995). In the recent multiagency Conservation Needs Assessment (CNA), 17 localities of primary conservation significance were identified for Papuasian forest environments (Beehler 1993). Southern New Ireland was one of the enumerated sites considered vital to biodiversity preservation and in critical need of current information. As a direct consequence of the CNA evaluation, a biological assessment expedition was organized by Conservation International and the Papua New Guinea Department of Environment and Conservation (DEC) in January–February 1994. A multidisciplinary compilation of results from that survey has been prepared as a Rapid Assessment Protocol (RAP) Working Paper.
by Conservation International (Beehler, in press). Orchid specimens from the Hans Meyer trip were previously reviewed in a separate specialist account (Howcroft 1994). Two new taxa discerned during general examination of the expedition’s botanical gatherings are described here.

**Rubiaceae**

**Psychotria osiana** Takeuchi & Pipoly, sp. nov. (Fig. 1). **Type:** PAPUA NEW GUINEA. **NEW IRELAND:** Hans Meyer Range, pond next to ‘Lake Camp,’ 04° 27.205’ S, 152° 56.489’ E, 1,175 m, 29 Jan 1994 (fl, fr), W. Takeuchi & J. Wiakabu 9650 (HOLOTYPE: LAE; ISOTYPES: A, BRIT, K, L).

Quoad stipula elongata calyptrataque, stipula ab laminis juvenibus rumpentes, *P. helamoides valde arce affinis, sed ab ea inflorescentiis trichotomis reducisque (non monotomis elongatissque), floribus verticillatis (non alternatis) praeditis, laminis secus costis furfuraceo-lepidotis (non glabris) denique petalis desuper papillosis (non glabris) statim cognoscitur.

Shrub or small tree to 7 m height, 8 cm dbh. **Stem** straight, isodiometric, basal swell absent; outer bark brown, smooth, slash and sapwood stramineous to pale yellow. **Branchlets** terete, 2–3 mm diam., pale brown, slightly compressed at the summit, laxly pilose at apical nodes otherwise glabrescent. **Stipules** sheathing, calyptrate, caducous, translucent whitish-green, glabrous, to 5.5 cm long and 6 mm wide. **Leaves** opposite, usually conflated; blades coriaceous, elliptic, 10–13 cm long, 3–4 cm wide, apically acuminate, basally attenuate, the margin entire, adaxially nitid and glabrous, abaxially light green and furfuraceous-tomentose along the midrib, the midrib prominent on both sides, more elevated beneath; the secondary veins 10–13 oblique lateral pairs, excurrently arcuate and usually closing submarginally, the tertiary reticulum lax, irregular, bifacially raised; petioles adaxially plane, 10–20 mm long, glabrous. **Inflorescence** a sessile, terminal, pinnate panicle, rupturing through the stipule, trichotomous (with three principal branches at base), the branches with flowers racemose, the primary rachis to 2 cm long, greenish, somewhat angulate, laxly pilose at nodes, internodes subglabrous or puberulent; floral bracts inconspicuous, not persisting; pedicels 1–3 mm long. **Flowers** opposed or in verticils, 5-merous, entirely glabrous, apparently isomorphic; calyx broadly cupuliform, .5 mm long, 1–2 mm wide, limb denticulate; corolla tubular, 3 mm long and obtusely cylindrical in bud, the lobes chartaceous, corniculate, elliptic to ovate, 1.5 mm long, 1 mm wide, spreading or reflexing at anthesis, adaxially papillos; stamens erect, epipetalous; filaments 1.5 mm long, adnate to the corolline sinuses or slightly below; the anthers basifixed, oblongoid, 0.7 mm long, 0.2 mm wide, apically and basally emarginate; ovary umbonate, channelled, bilocular, the style bifid, slightly exerted, the stigmatic lobes spreading and tuberculate. **Drupelet** subglobose, 5–8 mm diam., epicarp glabrous; pyrenes 2, not dorsally ridged, approximately planoconvex, flat on the commissural face, often with one pyrene aborted or reduced; endosperm ruminate.
Fig. 1. Psychotria osiana Takeuchi & Pipoly. A. Branchlet. B. Developing inflorescence emerging through stipule. C. Inflorescence, showing main rachis and part of the second rachis in back. Third axis deleted for clarity. D. Flower at anthesis; petals reflexing. E. Partially dissected flower. A–D drawn from holotype.
Distribution and ecology.—Known only from mossy montane forest in the Hans Meyer Range of southern New Ireland. Occurring as a seral element in gap phase regeneration among mature growth premontane forest stands, and along forest margins.

Etymology.—It is a great pleasure to dedicate this species to Dr. Osia Gideon, Deputy Director of the Papua New Guinea Forest Research Institute and a specialist in Papuan Rubiaceae and Zingiberaceae, for his relentless efforts to document the rich, largely autochthonous, flora of New Guinea.


Papuan Psychotria were first revised by Valeton (1927) and the nonclimbing representatives more recently treated by Sohmer (1988). Infrageneric relationships are still poorly understood due to the taxonomic difficulty of the genus and the absence of regionally-based studies. However a number of informal species groups have been recognized by Sohmer from macroscopic features such as stipule form and inflorescence structure.

Psychotria osiana is characterized by a contracted trichotomous inflorescence (i.e., with 3 rachises branched at the base), flowers opposed or verticelled along the main axes, leaf blades with abaxially furfuraceous-tomentose midribs, completely glabrous flowers, and petals adaxially papillose. The corolline papillae are apparent in fresh or rehydrated material, but less so in situ.

A total of 17 species of Papuan Psychotria have sheathing stipules of the sort present in Psychotria osiana. Developing inflorescences and young leaves emerge by rupturing through the stipule, which subsequently disintegrates or falls away intact. The combination of calyptrate (sheathing) stipules and a trichotomous inflorescence occurs in only two species: P. leleanoides Sohmer and P. lorentzii Valeton. Psychotria osiana is clearly related to P. leleanoides, (a species from New Britain and the Solomon Islands), but is distinguishable from it by the leaf indumentum and the entirely glabrous flowers with papillate corolla. Judging from elevational distributions, Psychotria osiana is the montane sister species to P. leleanoides, the latter being primarily a lowland taxon from elevations below 200 m (Sohmer 1988).

CORSIACEAE

Corsia purpurata L.O. Williams var. wiakabui, Takeuchi & Pipoly, var. nov. (Fig. 2). Type: PAPUA NEW GUINEA. NEW IRELAND: Hans Meyer Range, pond next to 'Lake Camp,' 04° 27.205' S, 152° 56.489' E, 1,175 m, 28 Jan 1994 (fl, fr), W. Takeuchi & J. Wiakabu 9611 (HOLOTYPE: LAE, in spirit).

Ad Corsia purpuratam var. purpuratam accedens sed ab ea labello acuminato nec ad basem extendens praeclarae distar.

Terrestial herb to 13 cm height, sciophytic, erect, all parts glabrous and
Fig. 2. Coris purpurata L.O. Williams var. wiaubu Takeuchi & Pipoly var. nov. A. Habit, dorsal view. B. Habit, lateral view. C. Frontal aspect, petals and lateral sepals. D. Median sepal. E. Petal. F. Basal calloity, from side. A–F drawn from holotype.
dull reddish-brown. Stems terete, weakly sulcate, the nodes distant. Leaves 4–5, spirally arranged, acrosopic, base sheathing; lamina linear-acuminate, conduplicate or with margins broadly revolute, chartaceous, 9–17 mm long, 4–6 mm wide, to 6-nerval, sometimes aciculate; venation visible as dark lines, not raised on either side. Flowers solitary, terminal on the unbranched stem, bisexual; median sepal flabellate, symmetrical, 16–19 mm long, 20–23 mm wide, nodding at anthesis, unguiculate, bluntly acuminate at the apex; the basal callosity linear, narrowly raised by 4 mm above the plane of the 'labellum,' summit corniculate, base abruptly truncate at the claw; median sepal 12-veined, the veins parallelostromous, diverging mainly from the proximal half of the sepal, once or several times furcate before the margin; petals and lateral sepals isomorphic, basiscopic and incurved, costate, lanceolate, 4 mm long, 3 mm wide, acumen 1.5 mm long; stamens 6, in 2 whorls opposite the perianth segments; filaments resembling the style, 0.6–0.7 mm long; the anther cells 2, oblongoid, 1.2 mm long; style simple, cylindrical, ca. 1 mm long. Fruit not seen.

*Distribution and ecology.*—Known only from the type locality in the Hans Meyer Range on New Ireland. *Corsia purpureata* var. *wiakabui* occurs infrequently in mature-growth, primary premontane forest, on its floor, covered by leaf duff. This new variety was encountered as a population flushing after recent rains and thereafter evanescent; all individuals were seen in comparable maturational states.

*Etymology.*—The new variety is dedicated to Joseph Wiakabu; botanist, explorer-collector, and colleague from the Papua New Guinea National Herbarium.

*Paratype:* PAPUA NEW GUINEA. NEW IRISLAND: Hans Meyer Range, slopes above river valley on the ascent from Mandih lake, 04° 26' S, 152° 59' E, 750 m, 10 Aug 1975, M.J.S. Sands et al. 2091 (K, LAE).

*Corsia* was revised by van Royen (1972) in a monograph based on 45 exsiccateae numbers, an average of less than 2 collections per species. The limited number of specimens available for study is due to population rarity, the inconspicuous habit of the plants, an ephemeral phenology, and the preference for sheltered microsites in forest where ambient light conditions favor concealment. Van Royen (ibid.) commented that encounters with *Corsia* are often of a fortuitous nature; occasioned by understory sun flecks falling on the plants in a certain way by chance. There is no doubt that the genus is rarely found by collectors. The intervening years since the initial revision has seen little increase in availability of specimens, nor is the situation likely to improve dramatically in the future. The difficulty of botanizing purposefully for *Corsia* discourages the sort of field-based studies necessary for understanding the morphological variation between populations.
According to van Royen's (1972) conspectus, *Corsia* is a saprophytic genus with 25 species distributed through New Guinea, the Bismarck Archipelago, the Solomon Islands, and Australia. Most of the species are narrowly defined endemics of montane forest habitats, and appear to be restricted to specific mountains. On the basis of the venation and basal callosity of the median sepal, the new taxon is related to *C. purpurata* var. *purpurata*, but is distinguishable by the flabellate 'labellum' with acuminate apex and the base truncate rather than extended.

The type locality for var. *waikabui* is floristically depauperate in comparison to similar habitats from mainland New Guinea, and is disproportionately composed of epiphytic or nonendemic species (Takeuchi and Wiakabu, in press). Depauperate levels of biological diversity in this montane environment was also reported by zoological specialists participating in the New Ireland survey (Beehler in press, passim). The expedition's collective findings are consistent with a supposition that the cloudy uplands of southern New Ireland are of geologically recent origin. In view of the multidisciplinary results from the recent survey, it is unlikely that future exploration of the Hans Meyer Range will yield significant numbers of additional novelties.

ACKNOWLEDGMENTS

The Rapid Assessment Protocol survey of New Ireland was funded by Conservation International and the Biodiversity Support Program. Expedition leader Dr. Bruce Beehler and the Papua New Guinea Department of Environment and Conservation performed key coordinating roles. The Liz Claiborne and Art Ortenberg Foundation and the John D. and Catherine T. MacArthur Foundation have provided ongoing financial support to W. Takeuchi for studies partially based at the Papua New Guinea National Herbarium, at the PNG Forest Research Institute, in Lae, in support of his principal work at the Crater Mountain Wildlife Management Area.

Neville Howcroft prepared the illustration of *Corsia purpurata* var. *waikabui* and Taik Iwagu the illustration of *Psychotria osiana*, which we gratefully acknowledge.

REFERENCES


THREE NEW SPECIES OF CRATAEGUS (ROSACEAE) FROM WESTERN NORTH AMERICA:
C. OKENNONII, C. OKANAGANENSIS AND C. PHIPPSII

J.B. PHIPPS
The University of Western Ontario
Department of Plant Sciences
London, Ontario, CANADA N6A 5B7

R.J. O’KENNON
Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060, U.S.A.

ABSTRACT

Three new species of Crataegus, C. okennonii J.B. Phipps (from series Douglasianae), C. okanaganensis J.B. Phipps & O’Kennon (from the newly described series Purpureofructi J.B. Phipps & O’Kennon), and C. phippsii O’Kennon (near series Molles) are described from western North America. All are striking, widespread taxa with a substantial number of records.

Key Words: Taxonomy, Crataegus, Rosaceae, new species

RESUMEN

Tres nuevas especies de Crataegus, C. okennonii J.B. Phipps (de la serie Douglasianae), C. okanaganensis J.B. Phipps & O’Kennon (de la nueva serie descrita Purpureofructi J.B. Phipps & O’Kennon), y C. phippsii O’Kennon (próximo a la serie Mollet) se describen del oeste de Norte América. Todos son taxa sorprendentes y de amplia difusión con un sustancial número de citas.

Recent fieldwork with R.J. O’Kennon of Fort Worth, Texas in the American states west of the Rocky Mountains and in British Columbia for the first author’s revision of the red-fruited Crataegi (Phipps 1998) of this region has serendipitously uncovered three new species of hawthorn. The first, Crataegus okennonii, a new purplish-fruited taxon of ser. Douglasianae (Rehd. ex Sarg.) Rehd., striking and obvious in the field, is also usually easily resolved in the herbarium. Crataegus okanaganensis, rarely collected before our studies, is also a striking new taxon with brilliant red (late August) to deep purple (late September) fruit. It is accorded a new series, Purpureofructi, together with the long-described and long-overlooked C. williamsii Eggl. The third new species, C. phippsii, though first collected as far back as 1908, remained otherwise unnoticed until our fieldwork. It is a very distinct purple-fruited species related to series Molles.

One of the reasons that these new *Crataegus* species west of the Rocky Mountains have been overlooked has been the failure of nearly all collectors to take note of fruit color (Phipps 1998). Each of the following species is quite distinct in this respect and we therefore take the opportunity to present color plates of the three species illustrating this point. Hawthorns are considered to have mostly black or red fruit. The discovery of these three extends the number of those which are burgundy to deep purple at some stage in their development. Another feature emerging from this work are new centers of diversity for western North American *Crataegus* appearing in the northern Okanagan of British Columbia and northwest Montana.

A further reason that these taxa have been overlooked is that in the Pacific Northwest region (to nw Montana) and British Columbia where they occur there has been a belief that generally, only one red-fruited native species, *C. columbiana* Howell,' one black-fruit native taxon, *C. douglasii* Lindl. (incl. *C. suksdorfii* (Sarg.) Kruschke) and one introduced red-fruited taxon (*C. monogyna* Jacq.) occurred. This belief has persisted (Phipps 1998) in spite of the widespread presence in this region of *C. macracantha* Lodd. ex Loud. In view of this lack of taxonomic inattention, including the disappearance from the floristic literature of the distinctive *C. williamsii*, it is perhaps not surprising that earlier botanists did not recognize potential new taxa in this region. Consequently, we take this opportunity of reviewing the main western North American species (west of the Rocky Mountains) in a numerical taxonomic analysis. This analysis uses one synthetic OTU per taxon, each described from typical material over 38 morphological characters (Table 1) of the kind commonly used in *Crataegus* taxonomy. The eleven native species generally recognized in the west are all present, together with *C. monogyna*, a useful outgroup, and five species from east of the Rocky Mountains (*C. mollis* (Torr. & A. Gray) Scheele, *C. submollis* Sarg., *C. brachyacantha* Sarg. & Engelm., *C. schnettei* Ashe and *C. punctata* Jacq.) to give structure and scale. Also the three new taxa described in this paper are included. A dendrogram was prepared by NT-SYS using the options taxonomic distance and unweighted pair-group arithmetic averaging. The results (Fig. 1) place *C. monogyna* and *C. punctata* outside all the other species. Among results of general interest, varieties (*C. chrysocarpa* Ashe var. *chrysocarpa* and *C. c. var. piperi* (Britton) Kruschke) cluster at about the 0.6 level while distinct species cluster at the 0.8 or greater level, e.g. *C. schnettei* and *C. wootoniana* Eggl. (series *Tenuifoliae*), *C. suksdorfii* and *C. douglasii* (series *Douglasianae*) and *C. erythropoda* Ashe and *C. rivularis* Nutt. (series *Cerrones*). Other pertinent results are discussed under the new taxa described in this paper.

**TAXON DESCRIPTIONS**

1. *Crataegus okennonii* J.B. Phipps, sp. nov. (Fig. 2). **TYPE.** CANADA.
Table 1. The 38 characters scored for the numerical taxonomic analysis.

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<th>Inflorescence</th>
</tr>
</thead>
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<tr>
<td>2. Bark type</td>
<td>23. Pedicel: pubescence</td>
</tr>
<tr>
<td>Thorns and Twigs</td>
<td>Flower</td>
</tr>
<tr>
<td>8. Thorns, color: gray</td>
<td>29. Style: number</td>
</tr>
<tr>
<td>9. Twigs, 1 yr old, color: browns</td>
<td>Fruit</td>
</tr>
<tr>
<td>10. Twigs, 1 yr old, color: gray</td>
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</tr>
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<td>Leaf</td>
<td>31. Fruit: color at full ripeness</td>
</tr>
<tr>
<td>11. Lamina: length</td>
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</tr>
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Frutices grandes vel arbores parvae, plerumque trunco uno, ad 10 m alti, spinosi; ramuli unius anni nitentes atro-castanei, ramuli veteriores brunneo-cinerei; spinac plerumque < 2.0 cm longae, crassae, plus minusve recurvatae, in juventute brunnae nitenter. Folia decidua; petioli plerumque 1–2 cm longi; laminae 4–6 cm longae, ellipticae vel late-ellipticae, interdum aliquanum anguste ovatae vel rhomboae, paribus 4 venarum secondariarum longiorum vel aliquando non-lobatae vel vix-lobatae vel vadositer 2–3(–4) lobatae per latus, marginibus serratis, ± coriaceae, in maturitate tenuiter appresso-pubescentes supra, subter ± glabre venis exceptis, colore autunnali prunino ad carmineum vel pallide carmineum. Inflorescentiae 12–20 florumae, bracteolis parvis caducis glandulo-marginatis, glabrae vel raro pubescentes. Flores 15–20 mm diam.; hypanthium glabrum extrinsecus; lobi calycis 3 mm longi, obscure glanduloso-marginati; petala ± circularia; stamina 10–12, antheris pallide roseis; carpelli et styla 3–4. Fructus amplexiforme-orbiculares, ca 10 mm diam., triste-purpurei vel nigri subinde in maturitate, in mense Augusto rubro-vinosi vel spadiceo-castanei, reliquis calycis parvis; pyrenae 3–4, vadositer sulcatae dorsaliter, lateribus cum foveis vel interdum planis.

Large bushes or small trees, usually single-trunked, up to 10 m tall, thorny; one year old twigs deep shining mahogany, older branches gray/brown; thorns usually < 2.0 cm long, stout, slightly recurved, shiny brown when young. Leaves deciduous; petioles usually 1–2 cm long; blades elliptic to broad-
New Crataegus species of western North America

UPGMA of taxonomic distance
19 taxa
38 characters

Fig. 1. Dendrogram of western North American Crataegus taxa showing relationships of species described in this paper. Newly described taxa in capitals. See text for more information.

elliptic, sometimes somewhat narrow ovate or rhombic, 4–6 cm long, with four pairs of longer secondary veins, barely lobed to shallowly 2–3(–4) lobed, the margins also serrate, somewhat coriaceous, at maturity finely appressed-pubescent above, below ± glabrous except on the veins; autumnal color plum to crimson or light crimson. Inflorescences 12–20 flowered, with small caducous gland-margined bracteoles, glabrous to rarely shortly pubescent. Flowers 15–20 mm diam.; the hypanthium externally glabrous; calyx lobes 3 mm long, obscurely gland-margined; petals ± circular; stamens 10–12, anthers pale pink; carpels and styles 3–4. Fruit ± ampulliform-orbicular, ca. 10 mm diam., dull-purple or occasionally black at full maturity, red-burgundy to chestnut or reddish-brown in August, calyx remnants small; nutlets 3–4, shallowly grooved dorsally, sides variably eroded or sometimes plane.

Distribution.—Crataegus okennonii is fairly common in southern interior British Columbia and the eastern half of northern Washington, ranging to Idaho and nw Montana (Fig. 3), usually along streams or other sources of water. It is a tall distinctive plant, usually with a straight trunk, easily recognized in the field both in flower and in fruit. This new species is most closely related to C. douglasii, sens. str., from which it differs in fruit shape.
Fig. 2. Line drawing of *C. okennonii* J.B. Phipps. Inflorescence, flowers and parts from *Phipps 6939 (UWO)*; infructescence, fruit and parts from *Phipps 6991, 6995 and O'Kennon (UWO)*. Scale bars = 1 cm.
Fig. 3. Distribution map of *C. okennonii* J.B. Phipps.

and color, flower size, color of mature leaves (often yellowish-green), habit, thorn length, leaf shape and autumnal color of foliage.

*Crataegus okennonii* is one of a small group of 'black-fruitied' (fruit ± black at full maturity) species comprising series *Douglasianae* (Rehd. ex Sarg.) Rehd. which I restrict to *C. douglasii* Lindl., its immediate relative *C. suksdorfi* and the new species described here. A greatly widened concept of *C. douglasii* which includes *C. saligna* Greene and *C. rivularis* is advocated by Welsh (1982) and Holmgren (1997) but in my opinion this cannot stand up due to many significant differences in leaf-shape, venation type, bark and thorn type. Moreover intermediates do not exist between *saligna-rivularis* and *douglasii-okennonii-suksdorfi*. Difficulties for the broad concept are also emphasized by the fact that *C. saligna* (called *C. douglasii* Lindl. var. *duchsnensis* Welsh by Holmgren) has 20 stamens and cream anthers, contrary to the Intermountain Flora. I am (JBP, 199X) therefore placing *C. saligna* and *C. rivularis* in a different grouping.

*Crataegus okennonii* is a clearly defined segregate of *C. douglasii* differing by a considerable number of correlated characters of which thorn length (the shortest in series *Douglasianae*) and flower size (largest in the series) are the most unambiguous. The following couplet separates *C. okennonii* from the restricted interpretation of typical *C. douglasii* as found in western Canada and the adjacent United States.
1. Usually tree-like with a straight trunk, 5–10 m tall; young twigs deep glossy purple-brown; thorns usually 1.5–2 cm long; flowers ca. 15–20 mm diam.; fruit crimson lake or chestnut-colored in late August, becoming deep plum-black at maturity, not bloomy, broadly ampulliform; autumnal foliage usually crimson, plum or pale shades of same; styles and nutlets usually 3.


C. okennonii

1. Usually bushy, though often large, not conspicuously single or straight-trunked, 3–8 m tall; thorns often longer, to 2.5(–3) cm long; young twigs mid to deep glossy brown, only occasionally as dark as C. okennonii; flowers often 12–15 mm in diam.; fruit variably colored in late August though never chestnut, shape ellipsoid or suborbicular; autumnal foliage color often bronzy, not consistently ± crimson or paler; styles and nutlets 3–5. ........................................... C. douglasii

The differences between C. okennonii and a somewhat restricted C. douglasii are not by any means large but recognition at the specific level is also supported by the numerical analysis (Fig. 1), the lack of intermediates among good quality specimens both in the field and herbarium and the consequent immediacy of recognition. A more elaborate comparison with C. douglasii in which detailed leaf shape comparisons will be used may be expected consequent on the publication of R. Dotterer and T.A. Dickinson’s detailed biosystematic studies of C. okennonii and C. douglasii.

It is possible that C. okennonii is the same as C. douglasii f. badia Sarg. (1907), a taxon in which the fruit is described as “chestnut”, certainly not a common color in ripening fruit of section Douglasii. However, some of the unripe fruit of C. okennonii seen by us certainly was the color of reddish-brown, highly polished, shoe leather. Piper, the original collector of forma badia, variously described the fruit as brown, dark shining brown, chestnut, etc. Forma badia is a taxon systematically disregarded in the floristic literature. Both color changes during the ripening of western North American Crataegus fruit and the final color of the autumnal foliage have been poorly understood (Phipps 1997) as taxonomic characters so we wish to record them here. Crataegus douglasii fruit is shown in Figures 4d and 4e. The latter, photographed in August, illustrates the black, pendant, ellipsoid fruit while the other is another British Columbia specimen showing plenty of bloom. Figures 4a–4c illustrate C. okennonii, plate 4a showing the late August “chestnut” color while Figure 4b is a later version of the same color. Figure 4c shows the final, near ripe color, in late September, close to that of C. douglasii. The foliage is frequently a distinctive bright pale crimson color in late September as is shown in Figure 4f. Variation in leaf form of C. okennonii tends to fall into two classes, both illustrated in Figure 2, there being a broader, somewhat rhombo-deltoid, distinctly lobed form (Fig. 4a) and a more elliptic or narrow-ovate, shallowly lobed shape (Fig. 4b). Crataegus okennonii also bears conspicuous, expanding, caducous, coral-red bud scales.

I (J.B.P.) am pleased to name this distinctive and handsome new species
after Robert (Bob) J. O’Kennon whose companionship and critical abilities as a field botanist helped to make this discovery possible. It is intriguing that so widely distributed a taxon, of which we are able to cite 36 specimens, has remained undetected for so long.

Additional specimens examined: CANADA. BRITISH COLUMBIA: Northern Okanagan, Spallumcheen Municipality, Powerhouse Rd., E side, near Stardel Drive, alt. ca. 1350 ft, 50°27’N, 119°09’W, bush, 1.5 m tall, ± erect; fruit deep plum/chestnut, ellipsoid-turbinate, 19 Aug 1995; J.B. Phipps 7164 (UBC, UWO); Okanagan Valley, Oyama, ca. 0.5 mi E of E end of spit, alt. ca. 1320 ft, 50°07’N, 119°21’W, hedgeline on clay soil, bush 5 m
tall, fruit plum-purple, turbinate, 17 Aug 1995, *J. B. Phipps* 7158 (UWO); Castlegar, Selkirk College grounds, towards bottom of slope beyond beehives, scruffy area, 49°19'N, 117°38'W, alt 950 ft, tree 6 m tall; stemans 5, anthers pale pink, buds force 3 Oct May, then 10 stamens seen, 06 May 1994, *J. B. Phipps* 6928 (BRT, CAN, DAO, TRT, UBC, UWO, US); Okanagan Valley, Westside Rd., ca. 9 mi W of jct. with 97 and ± due opposite Vernon, wooded edges on west of road, 50°15'N, 119°27'W, ca. 1200 ft, tree, 5 m tall, fruit smallish, bright red-burgundy, 19 Aug 1994, *Phipps, J. B. & O'Kennon, R. J.* 6990 (CAN, TRT, UBC, UWO); Northern Okanagan, Hwy 97, E side, between Westside Rd. and Silver Creek Rd., alt. 1800 ft, equals JBP 6969, beautiful 7 m tree, 50°23'N, 119°17'W, convex light yellow-green foliage, fruit light red, turning to burgundy, roundish, fatter at base, glossy, 19 Aug 1994, *Phipps, J. B. & O'Kennon, R. J.* 6995 (BRT, UWO); Salmon Arm, large hawthorn pasture just N of railroad and W of central business section, alt. ca. 1900 ft, 50°43'N, 119°16'W; bush, 4.5 m tall, fruit burgundy, locally frequent, (equals JBP 6959); 20 Aug 1994, *Phipps, J. B. & O'Kennon, R. J.* 7027 (CAN, TRT, UBC, UWO); Okanagan Valley, Westside Rd., ca. 9 mi W of jct. with 97 and ± due opposite Vernon on E side of road, fence line 50°15'N, 119°27'W, 7 m multitrunked tree, fruit burgundy, alt. ca. 1200 ft, 19 Aug 1994, *Phipps, J. B. & O'Kennon, R. J.* 6991 (BRT, CAN, TRT, UWO); Okanagan Valley, NNE of Vernon at jct. 97/97A, scrubby hillside E side of road, 26 Sep 1993, *J. B. Phipps and R. J. O'Kennon* 6821 (BRT, UWO). Pass Creek Rd., N of Castlegar, 1.3 mi along, mesic grassy slopes, alt. ca. 1800 ft, 49°19'N, 117°40'W, bush, 4 m tall, fruit reddish-burgundy (somewhat 'chestnut'—ROK), 23 Aug 1994, *Phipps, J. B. & O'Kennon, R. J.* 7056 (TRT, UWO); Castlegar, Selkirk College, path behind beehives towards river edge, open woodland-scrub, alt. 950 ft, 49°19'N, 117°38'W, tree, 20 ft tall, reddish-purple foliage, dark purple, ± round fruit, 20 stamens, 26 Sep 1993, *Phipps, J. B. & O'Kennon, R. J.* 6824 (UWO); Slocan Valley, S of Slocan, above swamp along small road off Hwy. 6 & just N of Perry Siding across river, 49°40'N, 117°30'W, hedges and brushy slopes, alt. 1775 ft, bush 6 m tall, fruit red-burgundy, 22 Aug 1994, *Phipps, J. B. & O'Kennon, R. J.* 7047 (UWO); NNW of Vernon on W side Rd about 2.5–3 km SW of intersection of 97 & 97A, alt. 450 ft, 50°20'N, 119°20'W, back of field on west side of road, bush 5 m tall, 24 Sep 1993, *Phipps, J. B. & O'Kennon, R. J.* 6785 (UWO); Okanagan Valley, Hwy. #97, ca. 2 mi S of Silver Creek Rd. exit, (200 m S of 'road narrows' sign), (100 m S of JBP 6968), 50°23'N, 119°17'W, alt 1800 ft, in cut-over forest, young tree 7 m tall, 11 May 1994, *J. B. Phipps* 6969 (BRT, TRT, UWO); Okanagan Valley, ca. 8 km NNE of center of Vernon, Pleasant Valley Rd., behind Vowle’s residence, hedge at S boundary of Burke’s PYO, 50°18'N, 119°14'W, alt. 380 m, dense, broad, mature hedge, dominant species, 3.7 m bush, 10 pink anthers, thorns long for species, 2 May 1994, *J. B. Phipps* 6879 (UWO); Salmon Arm, large hawthorn pasture, just N of railroad and W of central business center, 50°43'N, 119°16'W, alt. 1900 ft, bush, 5 m tall, 10 stamens, pink anthers, 10 May 1994, *J. B. Phipps* 6959 (TRT, UBC, UWO, V); Okanagan Valley, Newport Beach campsite on W side Rd., approx. due NW of Vernon, end of parking lot, S end of camp, 50°20'N, 119°22'W, below trees, alt. 1140 ft, tree 5 m tall, erect habit, burgundy fruit, short thorns, 19 Aug 1994, *Phipps, J. B. & O'Kennon, R. J.* 6988 (BRT, DAO, UBC, UWO, V); NNE of Vernon, S of jct. of 97 and 97A just N of Baker Hogg Rd., bottom of hill, 50°21'N, 119°15'W, alt. 350 m, 4 m bush, purplish fruit, 23 Sep 1993, *Phipps, J. B. & O'Kennon, R. J.* 6821 (UWO); Okanagan Valley, E side of 97, half mi N of intersection with 97; scrubby slopes with long cleared area, 50°21'N, 119°15'W, most abundant species here, bush 6 m tall, red fruit; 19 Aug 1994, *Phipps, J. B. & O'Kennon, R. J.* 6999 (UWO); Castlegar, grassy floodplain ENE of Selkirk College, dense hawthorn thickets on banks of old oxbow, alt. 950 m, 49°19'N, 117°38'W, tree, 9 m tall, foliage elliptical, slightly lobed, purple, fruit globose, dark purple, ± 20 stamens, 27 Sep 1993, *Phipps, J. B. & O'Kennon, R. J.* 6827 (CAN, ID, MONTU, TRT, UBC, UWO, US);
Northern Okanagan, ca. 1 mi S of Enderby, gravel driveway to NE starting at Indian Cemetery, alt. 1300 ft, 50°31'N, 119°08'W, bush, 4 m tall, fruit burgundy, only one here, 20 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7006 (UWO).

U.S.A. IDAHO. Idaho Co.: US 12, ca. 10 road mi E of Kooskia, bank at back of field, N side of road, with large hawthorns, 46°07'N, 115°50'W, alt. 1550 ft, tree, 9 m tall, fruit burgundy, 26 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7089 (UWO). MONTANA. Flathead Co.: Few mi E of Columbia Falls, at dead end of Mt.Creek Rd. (off Berne Rd.), on fenceline opposite Shoal 330 sign, 48°22'N, 114°08'W, alt. 3000 ft, bush, 2 m tall, 08 May 1994, J.B. Phipps 6953 (UWO). Lake Co.: Route 211, ca. 4 mi S of Ronan, nr. MP 44, at farm entrance, driveway through pasture, near scenic turnout, alt. 3030 ft, 47°28'N, 114°06'W, grove of hawthorns on bank S side of driveway, 20 ft apple-like tree, reddish foliage, black orbicular fruit, 28 Sep 1993, Phipps, J.B. & O’Kennon, R.J. 6841 (UWO); Rte. 93, ca. 4 mi S of Ronan, near Milepost 44, near scenic turnout, one of group on S side of farm drive, 47°28'N, 114°06'W, alt. 5050 ft, tree 5 m tall, quite large buds forced 'til 11 May, stamens 10, anthers pink, (equal JBP 6811), 08 May 1994, J.B. Phipps 6940 (BRIT, MONTU, TRT, UWO, US). Sanders Co.: Route 200, 30 mi W of 93 on N side of road above Flathead R., in group of hawthorns, alt. 2840 ft, 47°19'N, 114°43'W, tree, 11 m tall, ± orbicular, black fruit, 29 Sep 1993, Phipps, J.B. & O’Kennon, R.J. 6858 (BRIT, CAN, DAO, MO, UWO, V). Route 200, 50.6 km W of jct. with US 93, group of hawthorns above Flathead R., 47°19'N, 114°43'W, alt. 2840 ft, tree 9 m tall, stamens 10, anthers pale pink, (equal JBP & RO K 6955), 09 May 1994, J.B. Phipps 6955 (UWO); Route 200, 25 mi W of 93 on N side of road above Flathead R., in long hawthorn hedge, alt. 2845 ft, 47°19'N, 114°38'W, bush 6 m tall with spherical burgundy fruit, 29 Sep 1993, Phipps, J.B. & O’Kennon, R.J. 6857 (UWO); Route 200, exactly 42.6 km W of jct. with US 93, long hawthorn hedge, above Flathead River, 47°19'N, 114°38'W, alt. 2840 ft, (equal JBP & RO K 6857), 09 May 1994, J.B. Phipps 6953 (BRIT, MO, MONTU, UWO). WASHINGTON. Ferry Co.: Hwy. 21, ca. 3 km SW of Danville, alt. ca. 500 m, 48°59'N, 118°31'W, marshy roadside with trees and scrub, (tree, 7 m tall, fruit burgundy, (C. douglasii very common here), 23 Aug 1995, J.B. Phipps 7174 (UWO). Okanagan Co.: Chopecta Rd., 3 km directly NW of Palmer Lake, open thicket, low rocky slopes, edge of floodplain, alt. 340 m, 48°56'N, 119°41'W, tree, 5.5 m tall, fruit plum-red to burgundy, 28 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7105 (UBC, UWO, WS); Okanagan Valley, W side road about 7 km N of Tonasket, huge hawthorn stand along riverside, ca. 975 ft, 48°44'N, 119°25'W, bush, 6 m tall, crimson foliage, no fruit, 3 Sep 1993, Phipps, J.B. & O’Kennon, R.J. 6865 (UWO); Sinlahekin Valley, ca. 5 mi S of Loomis, in depression near roadside, alt. 450 m, 48°45'N, 119°37'W, bush, 4 m tall, black fruit, 28 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7109 (UWO); ca. 6 km NE of Omak, dense hedges in valley-bottom among farm lands, alt. 250 m, 48°27’N, 119°28’W, dense bush, 4 m tall, fruit red, changing from orange, 28 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7100 (UWO). Whitman Co.: US 195 along Spring Flat Creek few mi S of Colfax at MP 35.3, alt. ca. 775 m, 46°51’N, 117°21’W, tree, 6 m tall, fruit plum-red (some approaching chestnut), group of same, 28 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7099 (UWO); 66 Stayler Rd., 1 km NE of Chambers, alt. 775 m, dry roadside, young tree in front yard of Harold Bough, 46°39’N, 117°11’W, bush, 4 m tall, fruit shrivelled, 27 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7096 (UWO).

2. Crataegus okanaganensis J.B. Phipps & O’Kennon, sp. nov. (Fig. 5).

Type: CANADA. BRITISH COLUMBIA: Rough grass with hawthorns on Hwy. 97 near entrance to Kelowna airport, alt. 1800 ft, equals JBP 6907, bush, 4 m tall, fruit, slightly dull and deep red, ± ellipsoid, 17 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 6974 (Holotype: UWO, Isotypes: CAN, TRT, UBC, US).
Fig. 5. Line drawing of *C. okanaganensis* J.B. Phipps and O’Kennon. Inflorescence and flower parts from *Phipps 6929* (UWO); infructescence and fruit parts from *Phipps & O’Kennon 7002* and 6975 (UWO); and sterile shoot from *Phipps 6894a* (UWO). Scale bars = 1 cm.
Frutex, 3–6 m tall, ramuli unius anni mediocris brunnei vel atrobrunnei, in juventute sparsim pubescentes; spinae validae, 2–4 cm longae, in juventute nitenter atrobrunneae, recurvatae. Folia decidua, petiolata; petioli 1–2 cm longi, sparsim pubescentes, eglandulares vel cum glandulis nigribus in juventute (Creston); laminae 3.5–6 cm longae, ovatae vel ovato-rhombeae, aliquando late ellipticae vel anguste ovatae, lobis 3–4 + acutis, marginibus subtiliter dentatis, venis 4–5 per latus, aliquantum impressa, in juventute dense appresso-pilosis, pilis attritis in maturitate, subter pubescentes praecipue in venis, coriaceae, super nitentes praesertim in juventute, crescentes rubrae, aeneae in autumno. Inflorescentia panicula convexa, 10–20 florata; ramuli varie villosi, glandulo-maculati, bracteolis linearibus caducis glandulo-marginatis. Flores 12–15 mm diam., conspersae cupuliformes in juventute; hypanthium externo villosum solo basale vel glabrum omnino; lobi calycis anguste triangulares, 3–4 mm longi, marginibus glandularibus, abaxiale cum pilis paucis; petala ± circularia, alba; stamina 10, antheris albis vel raro pallide roseis; carpelli et styli 2–3(–4). Fructus 8 mm diam., plerumque urceolatus, glaber, coccineus in juventute sed in maturitatem coloris vini vel atropurpureus (raro fere niger), si in conditione bona cum lobis calycis longis in-signe erectopatentibus (sed aliquanto brevioribus vel reflexis); pyreneae 2–3, dorsilater sulcatae, lateribus ± planis, paulo pungibus vel paulo erosus.

Bush, 3–6 m tall; 1 year old twigs mid to dark brown; young shoots thinly pubescent; thorns stout, 2–4 cm long, shiny deep brown when young, recurved. Foliage deciduous, petiolate; petioles 1–2 cm long, thinly pubescent, eglandular with small black glands when young (as at Creston, B.C.); blades 3.5–6 cm long, ovate to ovate-rombic, or less commonly broad elliptical to narrow-ovate, with 3–4 sharp lobes per side, margins finely double toothed, 4–5 veins per side, somewhat impressed above, densely appressed hairy when young above, this abrading with age, pubescent principally on the veins beneath, somewhat coriaceous, glossy above especially when young, expanding leaves reddish, the fall colour bronze. Inflorescence a domed panicle, 10–20 flowered, the branches variably villous, gland-dotted, with caducous linear, gland-margined bracteoles. Flowers 12–15 mm diam, notably cup-shaped when young; hypanthium externally villous only at base or completely glabrous; calyx lobes narrow triangular, 3–4 mm long, the margins glandular, abaxially with a few hairs; petals ± circular, white; stamens 10, anthers ivory or occasionally very pale pink; carpels and styles 2–3(–4). Fruit 8 mm diam., generally flask-shaped, glabrous, red when young but later burgundy to deep purple (occasionally almost black), when in good condition with strikingly long erecto-patent calyx lobes but these sometimes shorter or reflexed; nutlets 2–3, dorsally sulcate, their sides flat, a little plump, or shallowly eroded.

Distribution.— Widely distributed and common from the Okanagan valley of southern British Columbia and northern Washington to northern Idaho (Fig. 6). This is an extraordinarily handsome hawthorn in late August and early September.

*Craegus okanaganensis* in similar to *C. williamsii* of northwest Montana as illustrated by the numerical analysis (Fig. 1) but with more glossy foliage
of a much more coriaceous texture and the color usually yellowish-green in mid-season, the blades a little broader and the lobes usually less sharp, thorns generally stouter, different anther color, and mature fruits deep purple (Fig. 9d) instead of sometimes blood or deep red; the young fruit is a brilliant red (Fig. 9e) at the stage when *C. williamsii* may be pale to deeper dull red. The color change from brilliant red (late August) to a deep dull purple (late September) is nearly unique among *Crataegus* species. In northern Idaho at 2300 ft, *C. okanaganensis* flowered in 1994 a good week before *C. williamsii* at the same altitude in northwest Montana. Otherwise identical material with five stamens is occasionally found. *Crataegus okanaganensis* was repeatedly collected in the 1980s in Idaho by Fred Johnson though without recognition.

The two taxa may of ser. *Purpureofructi* be separated as follows:

1. Fresh anthers white or cream; inflorescence branches thinly to moderately hairy; hypanthium usually glabrous; leaves coriaceous (Idaho and west). ................................................................. *C. okanaganensis*

1. Fresh anthers bright pink; inflorescence branches densely hairy; lower part of hypanthium densely hairy; leaves thin (nw Montana). ........................... *C. williamsii*

Additional specimens examined: CANADA. BRITISH COLUMBIA: Okanagan Valley, Westside Rd. NW of Vernon, ca. 2 km S of intersection with 97, 1450 ft, hedges on both sides of road, 03 May 1994, *Phipps*, J.B. 6900 (UWO); ca. 1.2 mi E of Enderby on road to Mabel Lake between 200 m & 25 m W of "Autobody collision & repairs" sign, alt. 1275 ft, hedgerow, bush, 3 m tall, fruit burgundy, 20 Aug 1994, *Phipps*, J.B. & *O’Kennon*, R.J. 7016 (UWO); Rough grass with hawthorns on Hwy. 97 near entrance to Kelowna
airport, S side of Airport Dr., alt. 1800 ft, bush 6 m tall, fruit red, slightly deep and dull, ± ellipsoid, 17 Aug 1994, Phipps, J. B. & O’Kennon, R. J. 6795 (UBC, UWO); ca. 8 km NNE of Vernon center at Burke’s Pick-your-own on Pleasant Valley Rd., bottom of roadside, 407 m; 5 m bush, dull burgundy, ellipsoid fruit, 24 Sep 1993, Phipps, J. B. & O’Kennon, R. J. 6777 (BRIT, MONTU, UWO, WS); Shuswap Valley, just E of Enderby, across bridge, S side of rd. on mound by roadside depression, alt. ca. 1250 ft, bush, 5 m tall, 10 stamens, in bud, 05 May 1994, Phipps, J. B. 6912 (UWO); Okanagan Valley, ca. 9 km N of center of Vernon off E side of 97, just S of jct. with 97A & just N of Baker Hogg Road, alt. 350 m, hawthorn thickets to N side of long cleared ride, bush, 5 m tall, 10 white anthers, 03 May 1994, Phipps, J. B. 6894 (UWO); Okanagan Valley, ca. 9 km N of center of Vernon off E side of 97, just S of jct. with 97A & just N of Baker Hogg Road, alt. 350 m, hawthorn (mainly) thickets to N side of long cleared ride, bush, 5 m tall, 10 white anthers, 03 May 1994, Phipps, J. B. 6894a (UWO); Shuswap Valley, ca. 2.8 km E of Enderby on Kingfisher Rd., on hedgerow S side of road opposite house with wooden fence, N side, alt. 1280 ft, bush, 4 m tall, possibly = JBP & RO K 6812, foliage somewhat reddish, stamens 10, cream anthers, 05 May 1994, Phipps, J. B. 6921 (BRIT, UWO); ca. 1.2 m E of Enderby on road to Mabel Lake between 200 m & 25 m W of “Autobody collision & repairs” sign, alt. 1275 ft, hedgerow, bush, 5 m tall, fruit reddish burgundy, 20 Aug 1994, Phipps, J. B. & O’Kennon, R. J. 7017 (UBC, UWO); Salmon Arm, large hawthorn pasture just N of railroad and W of central business section, alt. ca. 1900 ft, bush, 3.5 m tall, opposite building with blue strip, flowers very cup-shaped, anthers 10, very pale pink, 11 May 1994, Phipps, J. B. 6966 (BRIT, CAN, UWO); E side of 97A 0.5 m N of intersection with 97, scrubby slopes with long cleared area, bush, 5 m tall, scarlet fruit, 19 Aug 1994, Phipps, J. B. & O’Kennon, R. J. 7000 (UWO); Okanagan Valley, about 8 km NNE of center of Vernon, Pleasant Valley Rd., behind Vowle’s residence, hedge at S boundary of Burke’s PYO, alt. ca. 380 m, dense, broad mature hedge, bush, 3 m tall, nearest top of hedgerow, 10 anthers, ivory, 02 May 1994, Phipps, J. B. 6882 (DAO, UBC, UWO); Castlegar, near Selkirk College, left-hand slope towards bottom of Rosedale Rd., alt. 970 ft, scrubby area, bush 2.5 m tall, prob. = JBP & RO K 6826, stamens 10, anthers white, 06 May 1994, Phipps, J. B. 6929 (BRIT, TRT, UBC, UWO); Okanagan Valley, Westside Rd. NW of Vernon, ca. 2 km S of intersection with 97, 1450 ft, hedges on both sides of road, 03 May 1994, Phipps, J. B. 6901 (UWO); Okanagan Valley, west side of hwy. at entrance to Kelowna airport, alt. 1800 ft, open scrub, bush, 4 m tall, stamens 10, anthers ivory to palest pink, 05 May 1994, Phipps, J. B. 6907 (BRIT, TRT, UBC, UWO); West side of hwy. 21, just N of, and in view of, Canada Customs post, roadside/forest edge, 2200 ft, tall, 5 m bush, 27 Sep 1993, J.B. Phipps, J. B. & O’Kennon, R. J. 6832 (ID, UWO); NNW of Vernon on Westside Rd., ca. 2.5 km SW of intersection of 97 and 97A, hedges along roadside, back of field, W side of rd., bush, 5 m tall with purple shrivelled fruit, 24 Sep 1993, Phipps, J. B. & O’Kennon, R. J. 6788 (CAN, TRT, UBC, UWO); E side of hwy. 21, ca. 250 m S of Creston Ferry Rd. to Hood Rd., this species very common here, 1970 ft, dense bush, 3.5 m tall, ellipsoid, burgundy fruit, 27 Sep 1993, Phipps, J. B. & O’Kennon, R. J. 6831 (ID, MO, UWO); E side of hwy. 21, immediately S of jct. with BC 3, north of Creston, alt. 1850 ft, swampy bank, 2.5 m tall bush, fruit shrivelled, black, 27 Sep 1993, Phipps, J. B. & O’Kennon, R. J. 6830 (UWO); Castlegar, edge of Campus Rd. ofl Frank Beindler Rd., grassy slopes with scattered hawthorns, bush, 3 m, Ivys sharply lobed, abundant burgundy fruit, 27 Sep 1993; Phipps, J. B. & O’Kennon, R. J. 6826 (BRIT, UBC, UWO, US); Larry Carrier property, E of 97 about 9 km NNE of Vernon, scrubby partly cleared hillside, 475 m, bush, 4 m, reddish foliage, fruit a good purple, 26 Sep 1993, Phipps, J. B. & O’Kennon, R. J. 6819 (UWO); Kalamalka Prov. Park; S of Vernon, within 200 m of yellow gate, at parking lot, damp depression, ca. 1375 ft,
common, multistemmed bush, fruit olbong-orbicular, burgundy, 24 Sep 1993, Phipps, J.B. & O'Kennon, R.J. 6798 (BRIT, UWO); NNW of Vernon on Westside Rd., ca. 2.5–3 km SW of intersection of 97 and 97A, hedges along roadside, back of field, 5 m bush with purple fruit, 24 Sep 1993, Phipps, J.B. & O'Kennon, R.J. 6791 (UWO); E side of hwy. 21, immediately S of jct. with BC3, north of Creston, scrubby banks, 1850 ft, 2.5 m bush, leaves green turning purple, ellipsoid, burgundy fruit, 27 Sep 1993, Phipps, J.B. & O'Kennon, R.J. 6828 (UWO, V); N of Creston, E side of Hwy. 21, grassy banks with hawthorns on top, just S of junction with Hwy. 3, alt. 1850 ft, bush, 2.5 m tall, stamens 10, anthers white, equals JBP & RO'K 6828, 07 May 1994, Phipps, J.B. 6930 (UWO); Salmon Arm, large hawthorn pasture just N of railroad and west of central business section, alt. ca. 1900 ft, bush, 3.5 m tall, fruit bright red, equals JBP 6966, 20 Aug 1994, Phipps, J.B. & O'Kennon, R.J. 7024 (BRIT, TRT, UWO); E side of 97A 0.5 mi N of intersection with 97, scrubby slopes with long cleared area, young plant on south side of site, scarlet fruit, 19 Aug 1994, Phipps, J.B. & O'Kennon, R.J. 7001 (UWO); E side of 97A 0.5 mi N of intersection with 97, scrubby slopes with long cleared area, young plant on south end of site, scarlet fruit, 19 Aug 1994, Phipps, J.B. & O'Kennon, R.J. 7002 (UWO); Hwy. 6 ca. 6 road mi W of Fauquier, west of Arrow Lake in Inookalini Valley, along fenceline in farmland, alfalfa fields, alt. 475 m, bush, 4 m tall, fruit bright red, 22 Aug 1994, Phipps, J.B. & O'Kennon, R.J. 7045a (UBC, UWO); Okanagan Valley NNE of Vernon, Pleasant Valley Rd., hedge behind Vowel's residence, E end boundary fence with Burke's P-Y-O, alt. 380 m, bush 5 m tall, fruit large, plump, purple-red, hairy, with stout erect calyx lobes, 19 Aug 1994, Phipps, J.B. & O'Kennon, R.J. 6996 (UBC, UWO); Slocan Valley, S of Slocan, above swamp crossing river along small road off Hwy. 6 & just N of Perry Siding, hedges and bushy slopes, alt. 1775 ft, bush, 5 m tall, fruit bright red, 22 Aug 1994, Phipps, J.B. & O'Kennon, R.J. 7048 (UWO); Shuswap Valley, just E of Enderby, across bridge, E side of road, 200 m N of gate, alt. ca. 1250 ft, level open field, growing along roadside across from cattle feeder, 4 m tall, fresh anthers cream, 15 May 1995, Donovan, L.S. & D. 2741 (UWO); Shuswap Valley, just E of Enderby, across bridge, E side of road, alt. ca. 1250 ft, level open field, growing along roadside across from cattle feeder, 2.5 m tall, fresh anthers cream, 15 May 1995, Donovan, L.S. & D. 2744 (UWO); Okanagan Valley, Kelowna, service road at W side of airport, alt. ca. 1250 ft, fenceline, bush 3 m tall; fruit brilliant red, ellipsoid, 17 Aug 1995, Phipps, J.B. 7155 (UBC, UWO); Okanagan Valley, Okama, ca. 0.5 mi E of E end of spit, alt. ca. 1320 ft, hedgeline on clay soil, bush, 4 m tall, fruit ellipsoid, red, 17 Aug 1995, Phipps, J.B. 7157 (UWO); Okanagan Valley, Okama, ca. 0.5 mi E of E end of spit, alt. ca. 1320 ft, hedgeline on clay soil, bush, 4 m tall, fruit ellipsoid, 17 Aug 1995, Phipps, J.B. 7159 (UWO).

U.S.A. IDAHO. Bonner Co.: Lower Priest River, river bank, alt. 660 m., scarlet fruit, 07 Aug 1897, Leibig, John B. 2857 (OSC); Pend Oreille R. across from Oldtown, N of bridge, Section 24, T56N, R6W, scrub just above high water mark, dominated by C. columbiana, 2000 ft, 07 Aug 1986, Johnson, Fred 86126 (IDF); Leclede, Riley Creek, 8 m E of Priest R. at Pend Oreille R. (Albenai Falls Reservoir) T56N, R3W sec. 30, riparian fringe along reservoir climax forest, gentle slope, common, 12 Aug 1988, Johnson, F. 88079 (IDF); Pend Oreille R. across from Oldtown, N of bridge, T56N R6W S24, 2000 ft, shrub fringe just above high water mark, abundant, 07 Aug 1986, Johnson, Fred 86126 (ID (#935728); 6 mi E of Priest R, along Albenai Falls Reservoir in T56N, R4W sec. 34 & 35, riparian fringe, 1900 ft, common, 12 Aug 1988, Johnson, F. 88082 (IDF); Section 28, T56N, R3W along Pend Oreille R. reservoir, roadside fringe of trees/shrubs by hayfield, many thornless trees, height to 15 ft, 07 Aug 1986, Johnson, F. 86124 (ID, IDF). Boundary Co.: US 95, about 5 km S of jct. with Idaho 1 & S of turnout on right below tall conifers, alt. 2250 ft, on E plowed field backed by steep rocky, treed slope, dense bush, 3 m tall, stamens 10, anthers
ivory, 08 May 1994, Phipps, J.B. 6932 (ID, UWO); US 95, ca. 5 km S of jct. with Idaho 1 & slightly S of turnout on right below tall conifers, alt. 2250 ft, on E plowed field backed by steep rocky, treed slope, dense bush, 3 m tall, stamens 10, 07 May 1994, Phipps, J.B. 6933 (ID, UWO, WS); US 95 2 mi S of jct. with Idaho 1, W side of road, roadside, 27 Sep 1993, Phipps, J.B. & O’Kennon, R.J. 6834 (UWO); 2.6 mi S of jct. US 95 & Hwy. 1, in T64N, R1E sec.28 (SE of Copeland), roadside shrub fringe, 2200 ft, gentle slope, 18 ft tall x 22 ft wide, 5 main stems 3–5, possible escape, no farms near, 12 Aug 1998, Johnson, F. 88072 (IDF). Kootenai Co.: floodplain of Spokane R. at Coeur d’Alene, 1/4 mi W of US 95, grassy meadow with scattered trees, no slope, open, 2000 ft, rare with C. douglasii, 10 Jun 1982, Johnson, F.D. (IDF #860418); Spokane River, 1/4 mi E of Washington border, 2100 ft, among granitic rocks and sand, shrubs to 3 m, 01 Aug 1986, Johnson, F. 8644 (ID #93729); Coeur d’Alene, 20 Jun 1930, Rust, J.H. (ID), 20 Jun 1930; floodplain of Spokane R. at Coeur d’Alene, 1/4 mi W of US 95, grassy meadow with scattered tree/shrubs, elev. 2000 ft, 10 Jun 1982, Johnson, Fred (ID #93730); floodplain of Spokane R., at Coeur d’Alene, 1/4 mi W of US 95, grassy meadow with scattered trees & shrubs, no slope, open, 2000 ft, 16 Jun 1981, Johnson, F.D. (IDF). WASHINGTON. Okanogan Co.: Westside Rd. ca. 7 km N of Tonasket, 975 ft, along riverside, 7 m bush, smaller leaves, burgundy fruit, 30 Sep 1993, Phipps, J.B. & O’Kennon, R.J. 6868 (UWO); Westside Rd. about 4 km N of Tonasket, alt. 975 ft, bush 5 m tall, riverside thicket with a few poplars, fruit ± erect, lake-red, broad-elliptic, 23 Aug 1995, Phipps, J.B. 7175 (UWO, WS). Spokane Co.: Spokane, damp places, Saksdorf, W.N. 919 (WS), Aug 1889. Whitman Co.: Pullman, Pips, C.V. (CAS), May 1902; Westend; 1800 ft, spring 1976, May, R. 91 (RMV).

ENGLAND: cult. Surrey, Kew, Royal Botanic Gardens; Kew #197-67, 19728; 22 May 1985, Phipps, J.B. 5651.2

The discovery of C. okanaganensis and its clear relationship to C. williamsii merit the creation of a new series, as follows:


Bushes, usually large, to small trees; thorns medium in length (2–4 cm). Leaves generally ± coriaceous (except C. williamsii), blades usually ± rhombic (to elliptico-oblong or rhomb-ovate), usually with 3–4 short outward-pointing lobes per side. Inflorescences 10–25 flowered; flowers not large (10–15 mm diam.); stamens 5–10; carpels and styles 2–4. Fruit red, usually brilliant red in late August, becoming deep blood-red to dark purple at maturity, orbicular to flask shaped; pyrenes 3–4, sides eroded or plane.

Distribution.—A distinctive series with two known species and perhaps a couple of others found from the interior Pacific Northwest and southern British Columbia to northwestern Montana. Crataegus williamsii was origi-
nally placed in series *Rotundifoliae* by Eggleston but the ellipsoid fruit, long calyx lobes in fruit, dark-colored twigs and somewhat erose nutlets suggest a different affinity. Our numerical analysis (Fig. 1) indicates no relationship whatever to *C. ehrysocarpa* in ser. *Rotundifoliae*.

3. **Crataegus phippsii** O’Kennon, sp. nov. (Fig. 7). **Type:** CANADA. BRITISH COLUMBIA: Okanagan Valley, Pleasant Valley Rd., ca. 8 km NNE of Vernon center, bush, 4 m tall, fruit red, 24 Sep 1993, Phipps, J.B. and O’Kennon, R.J. 6780 (HOLOTYPE: UWO; ISOTYPES: BRIT, CAN, TRT, US, WS).

Arbor vel frutex magnus, 5–6(–7) m alta, truncus uno dominantem sed aliquantum cum surculis; ramuli unius anni atropurpurei-brunneni, venteres atrocineneri; in juventute dense et breviter pubescens; spinae aliquantum sparsae, atrobrunneae vel nigrae, leviter recurvatae, aliquantum tenues, 2–4 cm longae. Folia decidua, petiolata; petioli 1.5–2.0 cm longi, pubescentes; laminae 4–8 cm longae (sed ad 10 cm vel plus in blasris elongationis), late ellipticae vel ovatae vel deltoideo-ovatae, lobis fere 3 ± vadosis obusis vel late angulatis per latus, marginibus breve dentatis; ca. 4 (–5) venis secondaris per latus, supra breviter appresso-pubescentes subter breviter pubescentes praepicue in venis, aliquantum coriaceae postea. Inflorescentia panicula depressa, 6–12 florata; ramuli dense breviter-tomentosi, bracteolati; bracteolae lineares glandulo-margini. Flores 15–22 mm diam.; hypanthium externo breviter tomentosum; lobi calycis late triangulares, ca. 5 mm longi, abaxiale pubescentes praepicue proximale, marginibus glandulo-laciniati; petala ± circularia; stamina 10, antheris roseis pallide; styli carpellique 2–4, stigmatis capitatis. Fructus 12 mm diam., breve-pubescentes, maturenes ad coccineo ad pruneo-purpureum vel nigrum, ± orbiculores vel late urceolati, lobis calycis reflexis; pyrene 3, vadosit sulcatae dorsale, lateribus planis.

Tree or large bush, 5–6(–7) m tall, with main trunk, but sometimes suckering; 1 year old twigs dark purple-brown, older dark gray, young shoots densely short pubescent; thorns somewhat sparse, deep brown to black, slightly recurved, somewhat thin, 2–4 cm long. Foliage deciduous, petiolate; petioles 1.5–2.0 cm long, pubescent; blades 4–8 cm long (but on shoots of elongation to 10 cm or more), broadly elliptic to ovate or broad deltoid-ovate, with about 3 ± shallow rounded to broadly angled lobes per side, the margins short-dentate; about 4–5 secondary veins per side, shortly appressed hairy above, shortly hairy especially along the veins below, somewhat coriaceous later. Inflorescence a 6–12-flowered flattened panicle, the branches densely short-tomentose, bracteolate, the bracteoles linear, gland-margined. Flowers 15–22 mm diam; hypanthium externally densely tomentose; calyx lobes broad-triangular, ca. 5 mm long, pubescent abaxially, especially below, the margins glandular-laciniate; petals ± circular; stamens 10, anthers pale pink; inside of hypanthial cup mostly glabrous, bristly at center; carpels and styles 2–4, the stigmas capitatae. Fruit 12 mm diam., short-hairy, ripening through shades of red to plum-purple to black in colour, ± orbicular to broadly flask-shaped, pubescent, with reflexed calyx lobes; nutlets 3, shallowly dorsally ridged, lateral walls ± plane.

**Distribution.**—This species is not so common as the other two described
Fig. 7. Line drawing of *C. phippsii* O’Kennon. Inflorescence flowers and parts from *Phipps 6891* (UWO); infructescence, fruit and parts from *Phipps 6780 and O’Kennon* (UWO); two smaller isolated leaves from *Phipps 6780 and O’Kennon* (UWO); magnified leaf (bottom left) from *Phipps 6891* (UWO). Scale bars = 1 cm.
in this paper but is nevertheless widespread and has been found at fourteen localities ranging from the Okanagan Valley of southern British Columbia and northern Washington to the Flathead Valley of Montana (Fig. 8). We have never found it numerous at any site.

*Crataegus phippsii* is one of the most distinctive species of hawthorn to have been found in North America in recent decades and does not appear to be closely similar to any other known in the west, a feature emphasized in Figure 1. It is a large hawthorn, reminiscent of *C. mollis*, the latter a common species of the interior of the continent, in foliage, habit and pubescence while in its red (Fig. 9a) changing to purple (Fig. 9b) to black fruit it is similar to a number of mostly previously undescribed species of the Pacific Northwest and British Columbia. The foliage colours attractively in autumn (Fig. 9b, 9f). The mature bark sometimes flakes off in longitudinal strips, an unusual feature in hawthorns (Fig. 9c).

*Crataegus phippsii* was first collected by B.T. Butler (nos. 521–523) in 1908 and these specimens were cited by Eggleston (1909) in his protologue for *C. williamsii*. The many differences from *C. williamsii*, however, show that *C. phippsii* in not in this affinity. That Eggleston thought it somewhat distinct is shown by his annotations on the sheets of “var. ovata,” a name, however, never published. Beyond this brief glimpse of notoriety, the present species, very striking to the present authors, remained totally overlooked until our collections of recent years.

The large, broad leaves with rounded lobes and hairiness of all parts suggests an affinity with series *Molles*. Superficially, it most nearly resembles the local species *C. noelensis* Sarg. of Missouri, a taxon which, however, has not been seen for many years. A combination of stamen number, anther color, foliage size and shape, and fruit color are the main characters distinguishing the species in the *Molles* group as shown in the following key. For convenience, I am including *C. greggiana* in this key although it is now placed in sect. *Greggianae*.

**KEY TO C. PHIPPSII AND MEMBERS OF SERIES MOLLES**

1. Foliage small, on short shoots mainly 4 cm long.  
2. Flowers 1–1.5 cm diam.; stamens usually 10. ........................................ *C. greggiana*  
2. Flowers ca. 2 cm diam.; stamens 20. ........................................... *C. lanuginosa*

1. Foliage larger, on short shoots generally 5–8 cm long.  
3. Anthers pink.  
5. Fully ripe fruit orange-red; leaves ± unlobed. ........................................ *C. noelensis*  
5. Fully ripe fruit deep purple to black; leaves evidently lobed. ........ *C. phippsii*  
6. Fruit red. ................................................................. *C. texana*  
6. Fruit yellow. ............................................................. *C. viburnifolia, C. kellogii*  
3. Anthers white to cream.
7. Stamens 20. ................................................................. C. mollis
7. Stamens 10. ............................................................... C. submollis, sens. lat.

Additional Specimens examined: CANADA. BRITISH COLUMBIA: Okanagan Valley, 8 km NNE of center of Vernon, Pleasant Valley Rd., behind Vowle’s residence, hedge at S boundary of Burke’s PYO, dense, broad mature hedgeline, bush 4 m, commencing flowering, 7-8 pale pink anthers, 02 May 1994, Phipps, J.B 6878 (BRIT, CAN, TRT, UBC, UWO, US); Okanagan Valley, 8 km NNE of center of Vernon, Pleasant Valley Rd., behind Vowle’s residence, hedge at S boundary of Burke’s PYO, dense, broad mature hedgeline, bush 4 m, foliage glossy, pedicels hairy, 10 pink anthers, 02 May 1994, Phipps, J.B. 6880 (CAN, TRT, UBC, UWO); Okanagan Valley, rough, scrubby slope above dirt road NW-bound into O’Keefe Ranch, opposite L. & A. Cross Rd. off 97A, alt. 1290 ft a.s.l., stamens 10, anthers light pink, equals JBP & RO’K 6803, 03 May 1994, Phipps, J.B. 6891 (UBC, UWO, WS); ca. 10 km N of Vernon center, on dirt road N-bound into O’Keefe Ranch off Hwy. 97A nr L.& A. Cross Rd., dry rocky hillside, suckering clump of trees to 5 m, 25 ft across, bark coarse, plated, peeling, fruit purple, 25 Sep 1993, Phipps, J.B. & O’Kennon, R.J. 6803 (CAN, UWO); Pleasant Valley Rd. ca. 8 km NNE of Vernon Center, southern boundary hedge of Burke’s PYO behind Vowles’ residence, alt. ca. 380 m, dense, broad mature hedgeline of Crataegus, bush 4 m tall, fruit deep red, 24 Sep 1993, Phipps, J.B. & O’Kennon, R.J. 6780 (BRIT, CAN, MO, UWO); ca. 5 km NNE of Enderby, on E-W rd. between Shuswap R. and Hwy. 97A, long hedgerows, alt. ca. 1375 ft, bush, 5 m tall, fruit red, 21 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7038 (UWO); ca. 3 km NE of Enderby on road to Sicamous (Hwy. 97A), bottom of scrubby slope on east side, alt. ca. 1400 ft, clump of 5 m bushes, redish fruit, 21 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7037 (DAO, UWO); ca. 5 km ENE of Armstrong on E-W aligned rd. just ENE of Armstrong airport, hedgerows, S side of road, alt. 1450 ft, bush 5 m tall, 21 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7041
Fig. 9. Various pictures of *C. phippsii* O’Kennon and *C. okanaganensis* J.B. Phipps & O’Kennon:
(UWO); ca. 6 km N of Armstrong, branch of Deep Creek, thickets, primarily C. douglasii, in narrow flood-plain, alt. 1450 ft, tree 4 m tall, fruit red, 21 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7034a (UWO); ca. 3 km NW of Armstrong, N-S road parallel to Schubert Rd. and ro the W of it, E side, alone by telephone pole, alt. ca. 1400 ft a.s.l., bush 3.5 m tall, dark green leaves, dull reddish fruit, 21 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7033 (BRIT, UBC, UWO).

U.S.A. MONTANA. Flathead Co.: about 0.5 km along Tower Rd. off US 93, near SW corner of Flathead Lake, hawthorn thicket along trail, rear of small field, alt. 2950 ft, equals JBP 7078, bush 7 m tall, overtopping all others, at popcorn, anthers pink, 20 May 1997, Phipps, J.B. & O’Kennon, R.J. 7591 (MONTU, UWO). Lake Co.: Hwy. 93, mi post 63.4, Tower Rd., (major pablillo), 2.0 mi. NW of Polson Bridge, 8–(11–12)–14 flowers, 10 pink anthers, leaves hairy, shaggy, in green bud stage (forced), 18 May 1995, O’Kennon, R.J. 13156 (UWO); Flathead Lake, SW border, 29 Aug 1908, Butler, B.T. 522 (NY); Rocky Point Road NW of Polson at 1.7 mi of hwy 93 and 0.3 mi NE of Jim’s Road, alt. 2920 ft, extensive thickets near lakeshore behind new housing, bush, 5 m tall, fruit orbicular, reddening, 25 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7086 (BRIT, ID, MO, MONTU, UWO); Flathead Lake, SW border, 19 Aug 1908, Butler, B.T. 523 (NY); Flathead Lake, off Tower Rd., off hwy 93 few mi NW of Polson, thickets along creek back of field, alt. 3050 ft, tree 5 m tall, fruit partly deep oxblod, partly paler, 25 Aug 1994; Phipps, J.B. & O’Kennon, R.J. 7078 (DAO, MONTU, UWO, US); Flathead Lake, SW border, 19 Aug 1908, Butler, B.T. 521 (NY).

WASHINGTON: Okanogan Co.: Palmer Lake, N side., open hawthorn thicket at upper level of pebble beach at picnic spot/campsite, just E of Chopata Lodge, small tree, 6 m tall, mostly finished flowering, stamens 10, anthers pale pink in bud, = JBP & RO’K 6874, 04 May 1994, Phipps, J.B. 6904 (ID, MO, UWO, WS); W of US 97 on crossroad at Ellisford, in floodplain to S side of road, bush, 7 m tall, anthers 10, pale pink, equals JBP & RO’K 6876, 04 May 1994, Phipps, J.B. 6906 (US, UWO, WS); Palmer Lake, N side, open hawthorn thicket at upper beach level on campsite just E of Chopata Lodge, alt. 1150 ft, fine tree, 7 m tall, burgundy fruit; 30 Sep 1993, Phipps, J.B. & O’Kennon, R.J. 6874 (DAO, ID, MO, UWO, WS); E shores of Palmer Lake, 0.7 mi S of campsite at N end, thickets, alt. 355 m, bush, 4.5 m tall, deep plum-red fruit, 28 Aug 1994, Phipps, J.B. & O’Kennon, R.J. 7108 (BRIT, ID, UWO, WS); Okanogan Valley, cross-road at Ellisford, alt. 950 ft, bush 7 m tall in field in floodplain, S side of road, fruit blackish, 01 Oct 1993, Phipps, J.B. & O’Kennon, R.J. 6876 (UWO, WS).

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Phipps and O’Kennon, New species of Crataegus from Western North America


BOOK REVIEW


The subtitle understates the amount of information in this tightly organized compendium of information about plant used by Zulu traditional healers. The authors have chosen to arrange their entries in phylogenetic order to facilitate comparisons between related plants. As this publication deals exclusively with plants of southern Africa, the classification follows that used in the National Herbarium. Genus numbers reflect the standards used in herbaria arranged in the Englerian system with additional standards for ferns and grasses. These are referenced in the introduction.

The entry for each species includes geographical distribution, a short description, local names in English, Afrikaans and Zulu followed by documented use by Zulu healers and then those referring to use by other groups in southern Africa. Physiological effects, Chemical constituents and biological properties are added where information is available. These gaps will tease and stimulate further research conducted, it is hoped, under the ethical and legal codes protecting intellectual property rights.

There is a wealth of information not only on the medicinal uses of these plants, but by the social and cultural uses too. These range from love potions to charms against lightning and incense to invoke the goodwill of ancestors. However, the authors do warn readers not to experiment!

For those who do not own a copy of Watt and Breyer-Brandwijk's 1962 edition the Medicinal and Poisonous plants of Southern and Eastern Africa this book is a must. For those fortunate to own a copy this will be a valuable supplement, for at least a third of the 1032 species mentioned here are new.

With the worldwide renewal of interest in natural products this book has a huge potential readership. In each foreword, we are reminded of the value, and ephemeral nature, of traditional knowledge. This book makes it less likely we will lose the traditional ethnobotanical knowledge of the Zulu nation.—Fiona Norris
TAXONOMIC CLARIFICATION OF ATRIPLEX NUTTALLII (CHENOPODIACEAE) AND ITS NEAR RELATIVES

HOWARD C. STUTZ
Department of Botany and Range Science
Brigham Young University
Provo, UT 84602, U.S.A.

STEWART C. SANDERSON
USDA Forest Service Shrub Sciences Laboratory
Provo, UT 84601, U.S.A.

ABSTRACT

In 1874 Sereno Watson described *Atriplex nuttallii* as a new species, citing his number 981 collection, made in 1868 from northern Nevada, as a representative. His collection consisted of three plants each collected from a separate population all mounted on one sheet. One is *A. canescens*, two are the new species, *A. nuttallii*. Failure to recognize the original collection and collection site of *A. nuttallii* has resulted in assignment of the name *A. nuttallii* to several different *Atriplex* species in western North America. However, by using quantitative as well as qualitative differences, *A. nuttallii* is readily distinguished from its near relatives *A. canecata, A. falcata, A. gardneri,* and *A. tridentata*. The principal distinguishing features include plant size and habit, leaf dimensions, fruiting-bract size and shape, fruiting bract appendages, chromosome number, saponin content, flavonol content, dates of anthesis, and geographic distribution.

RESUMEN

En 1874 Sereno Watson describió *Atriplex nuttallii* como nueva especie, citando su recolección número 981, hecha en el norte del estado de Nevada, E.E.U.U., como representativa. Consiste esta recolección en tres plantas, de distintos lugares pero colocadas todas en un mismo pliego de herbario. Una de ellas es *A. canecens* y dos son de la nueva especie, *A. nuttallii*. El no darse cuenta los botánicos de la colecta original y su lugar de origen ha tenido como consecuencia la aplicación del nombre de *Atriplex nuttallii* a varias otras especies de *Atriplex* del oeste de Norte América. Sin embargo, usando tanto características cuantitativas como cualitativas, se distingue fácilmente *A. nuttallii* de las especies afines, *A. canecata, A. falcata, A. gardneri,* y *A. tridentata*. Las características de mayor utilidad son la altura de la planta, las dimensiones de la hoja, la forma y tamaño de las brácteas frutíferas, sus apéndices, el número de cromosomas, contenido de saponinas, contenido de flavonoides, fecha de anthesis, y la distribución geográfica.

INTRODUCTION

In 1874, Sereno Watson described *Atriplex nuttallii* as new (Watson 1874) and listed his collection number 981, obtained in 1868 in northern Nevada, as a representative of the species. This collection consists of three plants
collected at different times in separate locations in northern Nevada, all mounted on one herbarium sheet (GH!) (Fig. 1), and each labeled by Watson as *Atriplex canescens* Moq. The plant on the right is *A. canescens* (Pursh) Nutt. collected in June, 1868, in Unionville Valley, Pershing County, Nevada. The other two are *A. nuttallii*. The middle plant, which appears to have been broken and folded back, was collected in September, 1868, in Thousand Springs Valley, Elko County, Nevada. The plant on the left was collected in July 1868 in Reese Valley, Lander County, Nevada. Currently there are still extensive populations of these species in the valleys where Watson collected them.

As shown in Figure 1, several botanists have recognized differences between these three plants and have provided annotations for them. In 1951, Grant D. Brown annotated the plant on the right as *Atriplex canescens* (Pursh) Nutt. In 1962, C.A. Hanson annotated the plants on the left and right as *Atriplex bonnevillensis* Hanson and the central one as *Atriplex falcata* (Jones) Standley. In 1972, I.J. Bassett and C.W. Crompton annotated the plant on the right as *Atriplex canescens*, the central one as *A. nuttallii* var. *falcata*, and designated on the annotation label, the left specimen as the lectotype of *Atriplex nuttallii* S. Watson. Later, McNeil et al. (1983) designated as the lectotype of *A. nuttallii*, a specimen collected in Saskatchewan, Canada, by Bourgeau (s.n.), in 1857, and included by Watson among 10 other collectors of *A. nuttallii*, in addition to Watson 981. However, as directed in the International Code of Botanical Nomenclature, Article 9.9 (Greuter et al. 1994), — "when the material designated as type is found to belong to more than one taxon, a lectotype — may be designated," and, as described in Article 7.5 of the 1988 edition of the code (Greuter et al. 1988), "A lectotype is a specimen or illustration selected from the original material to serve as a nomenclatural type when no holotype was designated at the time of publication —. When two or more specimens have been designated as types by the author ... the lectotype must be chosen from among them." Since Watson listed in the protologue, his number 981 as a representative of the new species, he ostensibly considered it typical and, since this collection consists of three specimens, one of them must be chosen as the lectotype. Consequently, the lectotype of *Atriplex nuttallii* is the specimen on the left (GH) as annotated by Bassett and Crompton in 1972. The designation by McNeil et al. of a specimen collected in Saskatchewan, Canada as the lectotype of *A. nuttallii*, was therefore unnecessary. The illustration in Bassett et al. (1983) of the Saskatchewan plants, is representative of a diploid *A. gardneri* (Moquin-Tandon) Hall & Clements which is common throughout southern Alberta, southern Saskatchewan and northern Montana but very different from *A. nuttallii* of northern Nevada. In his protologue, Watson de-
Stutz and Sanderson, Atriplex nuttallii and its near relatives

Fig. 1. Atriplex nuttallii. The lectotype of Atriplex nuttallii (Watson 981, upper left corner) collected in Reese Valley, Lander County, Nevada, July 1868. The central element is A. nuttallii collected in Thousand Springs Valley, Elko County, Nevada, September, 1868. The specimen on the right is Atriplex canescens collected in Unionville Valley, Pershing County, Nevada, June 1868.
scribes *A. nuttallii* as being 1–2 feet high. This is the stature of the *A. nuttallii* plants in the populations he collected in northern Nevada (Table 1) but not *A. gardneri* plants which are mostly 6–12 inches tall, nor *A. canescens* plants which are seldom less than 30 inches in height. The Saskatchewan plant illustrated in Bassett et al. (1983) appears to be ca 12 inches in height.

In the botany treatment of the King expedition (Watson 1871), Torrey provided identification for Watson’s collections and Watson provided the descriptions (footnote, page 287). Referring to *Watson 981*, Torrey identified it as *Obione canescens* Moq. and Watson applied that name to each of the three plants. Watson’s description of the collection specifically referred to his number 981 and indicated that “most of the specimens have nearly or quite wingless fruit. Others have the bracts considerably dilated, though still less than is frequently the case (982),” indicating that he recognized it as being anomalous, quite unlike other *Obione (Atriplex) canescens* plants. As shown in Figure 2, there is considerable variation in the fruiting-bract characteristics of plants in the Reese Valley population, with none being truly 4-winged.

Since Watson, following Torrey’s identification, labelled each of the three specimens (*Watson 981; Obione canescens*), he apparently assumed the variation he saw in the populations in northern Nevada to be representative of the variation displayed by *Atriplex* shrubs throughout western United States. This is confirmed in his later description of *A. nuttallii* (Watson 1874) wherein he lists *Atriplex canescens* Nuttall, not of James, *Obione canescens* Moq., and *Atriplex Gordoni* Hook. as synonyms and gives its distribution as “from the Saskatchewan to Colorado and Northern Nevada.”

This broad interpretation by Watson appears to have been the initiation of a series of misconceptions concerning the geographic distribution of *A. nuttallii* that we interpret to be confined to northern Nevada and northwestern Utah (Fig. 3). Standley (1916) listed the type locality of *A. nuttallii* as “on the denuded hills of the Missouri River, about 15 miles below the confluence of the White River, South Dakota.” Since this is the location given by Nuttall (1818) as the type locality of *Atriplex canescens* (Pursh) Nutt., Standley clearly confused the two. Furthermore, this locality for *Atriplex canescens* (*Calligonum canescens* Pursh) invites correction because its origin given by Pursh (1814) is “in the plains of the Missouri River, near the Big Bend” which is several kilometers upstream from the confluence of the White River.

Standley (1916) also mistakenly listed the distribution of *A. nuttallii* as “alkaline plains and hillsides, Manitoba and Saskatchewan to northern Utah, Colorado and western Nebraska” without mentioning Reese Valley and Thousand Springs Valley in northern Nevada.
Fig. 2. Fruiting-bracts of six randomly selected plants of *Atriplex nuttallii* from a population in Reese Valley, ca 1 km west of Battle Mountain, Lander Co., Nevada. Each row across represents one individual. Bar = 15 mm.
Hall and Clements (1923) likewise failed to include the type locality of A. *nuttallii* in their description of the distribution of *A. nuttallii* as "Saskatchewan and South Dakota to western Nebraska, New Mexico, Arizona, northwestern California, eastern Washington, and Alberta."

Recently, Basset et al. (1983) cited the distribution of *A. nuttallii* as "from the Peace River District of Alberta to Manitoba. In the United States specimens have been found as far south as Colorado." Clearly this does not refer to the *A. nuttallii* described by Watson from Nevada.


Standley (1916) listed eight species as close relatives of *A. nuttallii* (Series Nuttallianae): *A. buxifolia*, *A. cuneata*, *A. falcata*, *A. gardneri*, *A. neomexicana*, *A. oblancoalata*, *A. pringlei* Standley, and *A. tridentata*. As suggested by Hall...
and Clements (1923), A. pringlei appears to be an insignificant variant of A. acanthocarpa (Torr.) S. Wats and A. ob lanceolata is non-distinguishable from A. gardneri. A. neomexicana is a common reoccurring hybrid between A. cuneata and A. confertifolia (Torr. & Frem.) S. Wats. (Hanson 1962) and A. luxifolia is synonymous with A. gardneri. The remaining four species, A. cuneata, A. falcata, A. gardneri, and A. tridentata, were treated by Hall and Clements (1923) as subspecies of A. nuttallii. Since they and A. nuttallii are clearly distinct phenotypically (Pope 1976, Tables 1, 2, Fig. 4) and geographically (Figs. 3, 5–8) we consider them best treated as separate species as proposed by Standley (1916).

Because Watson listed A. gordoni (A. gardneri) as a synonym of A. nuttallii, Hanson (1962) argued that the epithet nuttallii was superfluous and hence illegitimate and that A. gardneri was the correct name for Watson’s A. nuttallii. This view was later accepted by Pope (1976) Stutz (1978), Stutz et al. (1979), and Welsh (1984). However, as noted by McNeil et al. (1983), the listing of A. gordoni (A. gardneri) as a synonym of A. nuttallii was accompanied by a question mark and is therefore not a legitimate synonym and, according to the Code, Article 55.2, note 1, (Greuter et al. 1994) the epithet nuttallii is therefore not nomenclaturally superfluous.

As discussed by McNeil et al. (1983) the other synonyms of A. nuttallii listed by Watson: (Atriplex canescens Nuttall, and Obione canescens Moq.), are also not legitimate synonyms.

MATERIALS AND METHODS

To better define A. nuttallii and its near relatives, herbarium specimens of the suffrutescent Atriplex species of western North America were examined in several herbaria (BRY, CAS, GH, MO, NY, PH, RM, RSA, US, UC) and specimens were collected and studied from the original collection sites of each of the species included in the study (except A. gardneri for which the exact location is not known). In addition, morphological measurements, saponin production, flavonoid content, and cytological studies were made of plants in several populations of each species. The morphological measurements included fruiting-bract characteristics, plant height and width, and leaf length and width. Chromosome counts were obtained from plants in several populations of each species (Figs. 5–8). In some cases the counts were obtained from root tips squashed in aceto-carmine stain, but most were from aceto-carmine squashes of pollen-mother-cells derived from anthers fixed in 5% acetic acid and stored under refrigeration. Saponin content was determined by hemolysis of red blood-cells as described by Sanderson et al. (1987). Flavonoid content was determined by paper chromatography as described by Sanderson and Stutz (1984).
TABLE 1. Plant and leaf characteristics of *Atriplex nummularia* and its near relatives. Measurements were obtained from 20 plants in each population. Diploid *A. canadensis* is not included because of extensive between-population variation. N = number of populations. Data = mean with coefficient of variation in parentheses. Values in each column with the same letter are not significantly different (p<.05).

<table>
<thead>
<tr>
<th>Taxon</th>
<th>N</th>
<th>Height (cm)</th>
<th>Width (cm)*</th>
<th>Volume (dm³)*</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>l/w</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>A. nummularia</em> (6x)</td>
<td>9</td>
<td>32.6(0.41)A</td>
<td>47.4(0.39)A</td>
<td>101.5(0.94)A</td>
<td>24.1(0.33)A</td>
<td>4.0(0.21)B</td>
<td>6.0(0.22)A</td>
</tr>
<tr>
<td><em>A. canadensis</em> (4x)</td>
<td>31</td>
<td>12.8(0.31)B</td>
<td>51.2(0.33)A</td>
<td>41.3(0.88)AB</td>
<td>20.9(0.22)A</td>
<td>8.3(0.28)A</td>
<td>2.6(0.19)BC</td>
</tr>
<tr>
<td><em>A. falcata</em> (2x)</td>
<td>12</td>
<td>12.9(0.44)B</td>
<td>24.6(0.31)B</td>
<td>9.4(0.74)B</td>
<td>23.7(0.58)A</td>
<td>3.6(0.41)B</td>
<td>6.5(0.23)A</td>
</tr>
<tr>
<td><em>A. gardneri</em> (2x)</td>
<td>6</td>
<td>9.8(0.52)B</td>
<td>48.9(0.11)AB</td>
<td>25.2(0.76)AB</td>
<td>19.9(0.09)A</td>
<td>3.8(0.21)B</td>
<td>5.4(0.11)AD</td>
</tr>
<tr>
<td><em>A. gardneri</em> (4x)</td>
<td>8</td>
<td>10.9(0.59)B</td>
<td>49.8(0.44)A</td>
<td>42.3(1.45)AB</td>
<td>19.4(0.19)A</td>
<td>5.3(0.28)B</td>
<td>3.8(0.18)BCD</td>
</tr>
<tr>
<td><em>A. tridentata</em> (6x)</td>
<td>13</td>
<td>23.9(0.38)A</td>
<td>41.8(0.46)AB</td>
<td>63.8(1.25)AB</td>
<td>28.7(0.53)A</td>
<td>4.1(0.33)B</td>
<td>6.79(0.28)A</td>
</tr>
</tbody>
</table>

* Width of *A. tridentata* does not include root sprouts.
* Volume = height × (width)²
Table 2. Fruiting-bract characteristics of Atriplex nutallii and its near relatives. Measurements were made on 20 fruits from several randomly selected plants in each sampled population. Diploid A. cuneata is not included because of extensive between-population variation. N = number of populations. Data = mean with coefficient of variation in parentheses. Values in each column with the same letter are not significantly different (p<.05).

<table>
<thead>
<tr>
<th>Taxon</th>
<th>N</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>l/w</th>
<th>Volume (mm³)</th>
<th>Apex</th>
<th>No. of Terminal Teeth</th>
<th>Appendages</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. nutallii(6x)</td>
<td>10</td>
<td>4.5(0.10)³</td>
<td>3.0(0.07)³</td>
<td>1.6(0.14)³</td>
<td>39.0(0.15)³</td>
<td>2.4(0.07)³</td>
<td>3.2(0.24)³</td>
<td>2.0(0.14)³</td>
</tr>
<tr>
<td>A. cuneata(4x)</td>
<td>15</td>
<td>6.1(0.16)³</td>
<td>5.0(0.22)³</td>
<td>1.3(0.14)³</td>
<td>165.3(0.59)³</td>
<td>1.8(0.19)³</td>
<td>3.6(0.24)³</td>
<td>3.9(0.17)³</td>
</tr>
<tr>
<td>A. falcata(2x)</td>
<td>12</td>
<td>4.6(0.19)³</td>
<td>2.6(0.14)³</td>
<td>1.8(0.10)³</td>
<td>32.0(0.48)³</td>
<td>3.0(0.00)³</td>
<td>1.0(0.00)³</td>
<td>2.0(0.27)³</td>
</tr>
<tr>
<td>A. gardneri(2x)</td>
<td>7</td>
<td>3.1(0.14)³</td>
<td>2.5(0.21)³</td>
<td>1.3(0.17)³</td>
<td>19.7(0.45)³</td>
<td>1.7(0.19)³</td>
<td>4.6(0.46)³</td>
<td>1.4(0.19)³</td>
</tr>
<tr>
<td>A. gardneri(4x)</td>
<td>10</td>
<td>4.2(0.21)³</td>
<td>3.0(0.31)³</td>
<td>1.5(0.12)³</td>
<td>45.1(1.21)³</td>
<td>1.5(0.05)³</td>
<td>3.8(0.12)³</td>
<td>1.9(0.37)³</td>
</tr>
<tr>
<td>A. tridentata(6x)</td>
<td>13</td>
<td>4.6(0.12)³</td>
<td>3.9(0.16)³</td>
<td>1.2(0.15)³</td>
<td>72.6(0.39)³</td>
<td>2.6(0.15)³</td>
<td>8.5(0.45)³</td>
<td>2.0(0.49)³</td>
</tr>
</tbody>
</table>

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³ Volume = length × (width)².
³ Prominence of central apical tooth was scored 0 to 3 with central tooth absent = 0, small = 1, conspicuous = 2, prominent = 3.
³ Number of lateral appendages was scored 0 to 5 with no appendages = 0, numerous appendages = 5.
RESULTS AND DISCUSSION

Probably because they are dioecious and wind-pollinated, most of the shrubby species of *Atriplex* in North America are unusually rich genetically and can often be best defined by quantitative, in addition to available qualitative, attributes. This is particularly true for *A. nuttallii* and its relatives. As shown in Figures 3, 5–8 and Tables 1–4, although *A. nuttallii* and each of its near relatives can usually be distinguished from each other by some qualitative differences, when combined with differences in quantitative attributes and geographic distributions, they are quite distinct.


Phenotypically, *A. nuttallii* appears to be most closely related to *A. tridentata*. Although highly variable in *A. nuttallii* (Fig. 2), most fruiting bracts of both taxa have multiple, terminal, marginal teeth. Both have oblong or oblanceolate leaves and occupy similar habitats (primarily saline bottoms). Both are hexaploids (2n=54) (a few tetraploid populations of *A. tridentata* have also been found). *A. nuttallii* differs from *A. tridentata* in being taller statured (30–60 cm vs 10–30 cm) (Table 1), woodier, and more phenotypically variable. Much of its variation appears to be the result of hybridization and subsequent introgression from other species, including *A. tridentata* with which it is often sympatric. Plants of *A. tridentata* do not produce saponins whereas some plants of *A. nuttallii* do, some do not (Table 3). *A. tridentata* usually shows aggressive root-sprouting whereas *A. nuttallii* is distinctly caespitose with numerous (60–120), slender (1–3 mm in diameter), woody stems emerging from a single woody crown, 10–50 cm in diameter. Geographically, *A. tridentata* is common in northern Utah, southwestern Wyoming, northwestern Colorado and northeastern Nevada (Fig. 8); *A. nuttallii* appears to be restricted to the alkaline valleys in northern Nevada and northwestern Utah (Fig. 3).


Populations of *A. cuneata* are restricted primarily to eastern Utah, western Colorado and northwestern New Mexico (Fig. 5). In many places they constitute the dominant vegetation on thousands of acres. The common name of *A. cuneata*, “Castle-Valley clover,” connotes its value as a range plant, partly because it is both palatable and nutritious for livestock and wildlife and partly because, were it not there, there would apparently be nothing at all,
Table 3. Cytology, saponin production, flavonoid production, and geographic distribution of *Atriplex nuttallii* and its near relatives. The number of plants examined is in parenthesis.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>2n</th>
<th>Saponins</th>
<th>Flavonols</th>
<th>Geographic Distribution</th>
<th>Date of Anthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chrom. #</td>
<td>s</td>
<td>6-MeO</td>
<td>5-MeO</td>
<td></td>
</tr>
<tr>
<td><em>A. nuttallii</em></td>
<td>54 (11)</td>
<td>+, - (11)</td>
<td>+</td>
<td>- (21)</td>
<td>Jun-Jul</td>
</tr>
<tr>
<td><em>A. cuneata</em></td>
<td>36 (126)</td>
<td>- (69)</td>
<td>+</td>
<td>- (43)</td>
<td>Apr-May</td>
</tr>
<tr>
<td><em>A. cuneata</em></td>
<td>18 (87)</td>
<td>- (72)</td>
<td>-</td>
<td>+ (62)</td>
<td>Apr-May</td>
</tr>
<tr>
<td><em>A. falcatia</em></td>
<td>18 (115)</td>
<td>+ (74)</td>
<td>-</td>
<td>+, - (66)</td>
<td>May-Jun</td>
</tr>
<tr>
<td><em>A. gardneri</em></td>
<td>18 (183)</td>
<td>+, - (32)</td>
<td>-</td>
<td>+ (31)</td>
<td>May-Jun</td>
</tr>
<tr>
<td><em>A. gardneri</em></td>
<td>36 (250)</td>
<td>+, - (65)</td>
<td>+</td>
<td>- (40)</td>
<td>May-Jun</td>
</tr>
<tr>
<td><em>A. tridentata</em></td>
<td>54 (257)</td>
<td>- (111)</td>
<td>+</td>
<td>- (105)</td>
<td>Jul-Aug</td>
</tr>
</tbody>
</table>
of forage value. This is conspicuous in many places where populations of A. cuneata terminate abruptly against clay slopes that are completely devoid of vegetation. It is also evident in sites where populations of A. cuneata have experienced large-scale “die-back” and remain empty until repopulated by new A. cuneata plants.

Atriplex cuneata is mostly tetraploid but throughout its range there are several morphologically distinct diploid populations (Fig. 5). The variation present in disjunct populations of tetraploid A. cuneata is probably the result of introgression from these diploids, or in some cases, tetraploid A. cuneata may have originated polyphyletically from different diploid ancestors.

Atriplex cuneata plants are mostly caespitose and erect with no evidence of root-sprouting or layering. Their fruiting-bracts are usually much larger than the fruiting bracts of A. gardneri (Table 2) and are covered with numerous lateral appendages (Table 2, Fig. 4). They are usually free of saponins, with exceptions only in populations in which introgressive hybridization from other species is suspected. Tetraploid A. cuneata plants test positively for the presence of 6-methoxy flavonols and negatively for the presence of 3-methoxy flavonals. In contrast, diploid A. cuneata plants test negatively for the presence of 6-methoxy flavonols and positively for the presence of 3-methoxy flavonals (Table 3).

Atriplex falcata (M.E. Jones) Standley, N. Amer. F1. 21:68. 1916. Type: IDAHO. WASHINGTON Co.: Weiser, alt. 2,000 ft, 7 Jul 1899, M.E. Jones s.n. (HOLOTYPE: RSA!; ISOTYPE: UC!).

Populations of A. falcata are sporadically common in southern Oregon, northeastern California, northern Nevada, northern Utah, southwestern Wyoming and southern Idaho (Fig. 6). It is mostly diploid (2n=18), but occasional tetraploid populations occur (Pope 1976).

Phenotypically, A. falcata is most easily recognized by its small stature (ca. 13 cm tall × 25 cm broad), small, linear leaves (ca. 24 mm long × 4 mm wide), and small fruiting bracts (ca. 4.5 mm long × 2.5 mm wide),
usually without appendages, and terminating in a distinct, acute, central apex (Tables 1, 2, Fig. 4).

The leaves of *A. falcata* produce abundant saponins (Table 3), a trait that can be useful in field identification either by blowing bubbles in a water emulsion of leaves or by tasting a leaf as it is chewed. When saponins are present, bubbles form readily in a leaf-emulsion and the leaves have a distinctly bitter taste. Both of these tests are positive for *A. falcata* leaves, negative for leaves of *A. tridentata* plants with which *A. falcata* plants are sometimes confused. *A. falcata* plants are also readily distinguished from *A. tridentata* plants by their rooting habit: *A. tridentata* plants are vigorous root-sprouters, whereas *A. falcata* plants are caespitose with a single prominent taproot. Also, *A. falcata* plants produce flowers and fruits early in the spring (May–June) whereas *A. tridentata* plants flower and set fruit mostly in mid to late summer (July–August) (Table 3).

*Atriplex gardneri* (Moq.) Standley, N. Amer. Fl. 21:66. 1916. **Type:** [State?].
La Platte River [date?], Gordon 250 (holotype: GH!, fragments).

*Oedione gardneri* Moq. in DC, Prod. 13:114. 1849.

Populations of *A. gardneri* (2x, 4x) dominate thousands of acres of clay slopes and swales throughout much of southern and eastern Wyoming, central and eastern Montana, western North and South Dakota, southern Alberta,
and southern Saskatchewan (Fig. 7). Most populations are tetraploid but diploid ones are common. In southern Alberta, southern Saskatchewan and north-central Montana, diploid plants can usually be distinguished from tetraploid plants by their smaller stature, smaller, thinner leaves, finer-textured, less woody stems and smaller fruiting bracts. However, throughout most of the saline deserts of Wyoming and southern Montana, diploid and tetraploid plants are phenotypically very similar although both show considerable phenotypic variation both within and between populations. Chromosome counts of plants in populations bordering Interstate Highway 80 in southern Wyoming, showed a preponderance of tetraploids west of the Continental Divide and a preponderance of diploids to the east (Fig. 9). However, no conspicuous ecological differences were evident between the sites occupied by tetraploids and diploids, nor was it possible to consistently distinguish diploids from tetraploids, phenotypically. This was true for plants in natural populations as well as garden-grown specimens. They are, however, clearly distinguishable by flavonoid differences: tetraploids

Fig. 6. Geographic distribution of chromosome counts of plants of diploid \( (2n=18) \) and tetraploid \( (2n=36) \) Atriplex falcata.
always produce 6-methoxy flavonols, diploids do not; diploids produce 3-methoxy flavonols, tetraploids do not (Table 3). Although both diploids and tetraploids sporadically produce saponins (Table 3), diploids are most often heavy producers, tetraploids usually produce little or none.

Atriplex gardneri plants are short-statured, mostly 4–10 cm in height, (Table 1), but are often more than 80 cm in diameter. The plants are caespitose, arising from a single deep taproot but often show considerable layering. Their fruiting-bracts are usually smaller (ca. 3–4 mm) and have fewer lateral appendages than those of most near relatives (Table 2, Fig. 4).

Two chromosome races of Atriplex tridentata have been found: tetraploid (2n=36) and hexaploid (2n=54). Hexaploids are, by far, the most common, occurring throughout much of western United States and in most of the valley bottoms in Utah and Nevada that were recently occupied by Pleistocene lakes (Fig. 8). Only three major tetraploid populations are known: one in Juab County, Utah, one in Eureka County, Nevada, and one in Lincoln County, southwestern Wyoming (Fig. 8). Although tetraploid and hexaploid A. tridentata are to some extent, morphologically distinct, the differences do not appear to be sufficient to warrant designation as separate taxa.

Atriplex tridentata differs from other Atriplex species in several features, including linear to oblong, furfuraceous leaves, fruiting bracts with conspicuous terminal, marginal teeth (Fig. 4), late-flowering habit (July-August), and vigorous root-sprouting. A. tridentata plants are mostly herbaceous above ground with a few slender stems growing erect from woody underground crowns and roots.

The extent of root-sprouting in A. tridentata plants is often made conspicuous by its dioecious flowering habit. By noting its flowers, the extent of a single male or single female plant may be easily determined. In some cases individual plants have been found to occupy more than 200 m². Sometimes
Fig. 9. Distribution of diploid and tetraploid populations of *Atriplex gardneri* alongside Interstate highway 80 in southern Wyoming from the Utah border (mile 0) to near Elk Mountain Wyoming. Chromosome counts were made on plants at each mile marker, when available. Stippled bars = diploids, black bars = tetraploids.

A single plant forms a complete carpet in which there are no other plants; at other times the root-sprouting carries a plant around and between plants of other species.

Possibly because of its low saponin content (Table 3), its root-sprouting habit and predominantly herbaceous tissues, *A. tridentata* is often regarded favorably by ranchers as forage for livestock (personal reports).
ACKNOWLEDGMENTS

The authors thank Dr. Richard W. Spellenberg and Dr. Ronald L. Hartman for numerous helpful suggestions, Broken Hill Proprietary Minerals and Brigham Young University for financial assistance and the curators of the following herbaria for loans of specimens and access to their collections: BRY, CAS, GH, MO, NY, PH, RM, RSA, UC and US.

REFERENCES


FLAVONOIDS IN STROPHOSTYLES SPECIES 
AND THE RELATED GENUS DOLICHOPSIS 
(PHASEOLINAE, FABACEAE): 
DISTRIBUTION AND PHYLOGENETIC 
SIGNIFICANCE 

JUAN PABLO PELOTTO and MARÍA A. DEL PERO MARTÍNEZ 

Centro de Estudios Farmacológicos y Botánicos 
Consejo Nacional de Investigaciones Científicas y Técnicas 
Serrano 665, Buenos Aires, 1414, ARGENTINA 

ABSTRACT 

Strophostyles Elliott is the only genus within the Phaseolinae with a center of distribution in the United States. It comprises three species, namely S. helvula (L.) Elliott, S. umbellata (Willd.) Britton, and S. leiosperma (Torrey & A. Gray) Piper, and it is considered as allied to Dolichopsis Hassler, a monotypic genus endemic to South America. This study analyses the leaf flavonoid content from the three Strophostyles species and Dolichopsis paraguariensis Hassler with the aim of examining the phylogenetic relationships among taxa. We isolated 38 glycosides based on kaempferol, quercetin and isorhamnetin. All Strophostyles species were characterized by the presence of isorhamnetin glycosides. However, S. leiosperma showed a distinctive profile while S. helvula and S. umbellata clustered together. In contrast, D. paraguariensis lacked isorhamnetin-based compounds. A cladistic analysis of flavonoid plus morphological data supported Strophostyles monophyly and showed S. leiosperma as the sister taxon of the clade S. helvula-S. umbellata. 

RESUMEN 

Strophostyles Elliott es el único género de las Phaseolinae con un centro de distribución en los Estados Unidos. Comprende tres especies: S. helvula (L.) Elliott, S. umbellata (Willd.) Britton y S. leiosperma (Torrey & A. Gray) Piper, y se considera afín a Dolichopsis Hassler, un género monotípico endémico de Sudamérica. Este estudio analiza el contenido de flavonoides foliares en las tres especies de Strophostyles y en Dolichopsis paraguariensis Hassler con el objeto de examinar las relaciones filogenéticas entre estos taxa. Se aislaron 38 glicósidos de kaempferol, quercetina e isorhamnetina. Todas las especies de Strophostyles se caracterizaron por la presencia de glicósidos de isorhamnetina. Sin embargo, S. leiosperma mostró un perfil distintivo mientras que S. helvula y S. umbellata se agruparon juntas. Por el contrario, D. paraguariensis no sintetizó compuestos basados en la isorhamnetina. Un análisis cladístico conjunto de los datos de flavonoides y caracteres morfológicos apoyó la monofilia del género y mostró a S. leiosperma como el taxón hermano del clado S. helvula-S. umbellata. 

INTRODUCTION 

Strophostyles Elliott is the only genus within the Phaseolinae with a center of distribution in the United States. Its current taxonomic treatment follows the original generic concept (Elliott 1822), but it was previously
associated with unrelated species and reduced to a section of *Phaseolus* (de Candolle 1825; Bentham 1837, 1865) until it was restored as a separate genus including three species (Britton & Brown 1897; Piper 1926). A set of characters precludes merging *Strophostyles* with *Phaseolus*, namely erect style (not coiled), lack of hooked hairs, pedicels shorter than the calyx, and nodes of the inflorescence somewhat swollen (Maréchal et al. 1978). Moreover, *Strophostyles* plants can be recognized by their nearly asymmetric flowers arranged in subumbellate inflorescences, bracts and bracteoles persisting through seed maturation, cylindrical seeds (often pubescent), and linear pods.

*Strophostyles* has also been considered as allied to *Dolichopsis* Hassler (Maréchal et al. 1978; Lackey 1983). Nevertheless, both genera are easily distinguishable by many characters and their quite distinct geographical distributions. The monotypic genus *Dolichopsis*\(^1\) resembles *Strophostyles* mainly in floral morphology (purplish corolla, keel with a not curved to somewhat curved beak, style slightly thickened distally, and stigma terminal oblique) and general appearance, but it is unlike the latter in having symmetric flowers clustered in elongate pseudoracemes and the unique fruit traits such as oblong, very flat pods with oblong seeds implanted through a very long funicle and with the hilum perpendicular to the placenta. The geographic range of *Dolichopsis* is Paraguay and Argentina, in South America, while *Strophostyles* occurs throughout eastern USA, eastern Canada up to south of Quebec and extreme northeastern Mexico.

Phytochemical data on *Strophostyles* species are scanty and include the absence of both leuco-anthocyanins (Baudet 1978) and canavanine (Lackey 1977), and a recent report of flavonoids (Williams et al. 1995). In this study, we expanded on the survey of foliar flavonoids by considering a larger number of samples of the three *Strophostyles* species, i.e. *S. helvula*, *S. umbellata* and *S. leiosperma*, and we added *Dolichopsis paraguariensis* for comparison.

**MATERIALS AND METHODS**

We analyzed the constitutive flavonoids present in the leaves of herbarium specimens belonging to the three *Strophostyles* species and *Dolichopsis paraguariensis*. Samples (100–200 mg) were powdered and extracted under reflux with 80% methanol (x 3). Concentrated methanolic extracts were two-dimensionally chromatographed on paper (BAW/15% acetic acid). Compounds were identified by standard methods (Mabry et al. 1970; Markham 1982). These included complete and controlled (3 min.) acid hydrolysis, enzymatic hydrolysis (B-glucosidase), co-chromatography with authentic markers and UV-Vis spec-

\(^1\) *Dolichopsis* was a genus with two species, *D. paraguariensis* and *D. monticola* (Lackey 1983, Lewis 1991), but recently Delgado Salinas & Lewis (1997) created the new genus *Oryxis* where they placed *D. monticola*. Therefore, *D. paraguariensis* has become the unique representative of the genus.
troscopy. Glucosides were separated from their galactosidic analogues by TLC in the appropriate system according to Budzianowski (1991).

**Plant material.**—Specimens were provided by the Instituto de Botánica Darwinion Herbarium (SI), San Isidro, and the Centro de Estudios Farmacológicos y Botánicos Herbarium (BACP), Buenos Aires.

**Strophostyles helvula** (L.) Elliott


**Strophostyles leiosperma** (Torrey & A. Gray) Piper


**Strophostyles umbellata** (Willd.) Britton


**Dolichopsis paraguariensis** Hassler


**Data analysis.**—A cluster analysis was performed on flavonoid data of 15 herbarium specimens. Similarity matrix was measured using Jaccard's coefficient and a dendrogram was constructed applying the unweighted pair-group method of arithmetic averages (UPGMA). All calculations were done using NT-SYS program (Rohlf 1993).

A cladistic analysis of the flavonoid data plus a set of morphological characters was carried out according to the maximum parsimony principle. Outgroup criterion was used for character polarization. *Vigna adenantha* was chosen as the external group which flavonoid data were obtained following the methods above mentioned (Pelotto, unpublished manuscript). For flavonoids, character states that occurred in the outgroup were scored as 0 and those in the ingroup (*D. paraguariensis* and the three *Strophostyles* species) were scored as 1 (see Appendix, Tables A and B). Morphological data were gathered from the literature and included some multistate characters that were treated as non-additive (see Appendix, Tables A and C). Cladograms were calculated...
using the implicit enumeration routine (i.e.*, of the program Hennig86 (Farris 1988) with all characters equally weighted.

RESULTS AND DISCUSSION

Chromatographic properties of the identified flavonoid glycosides and its distribution in Strophostyles species and *D. paraguariensis* are shown in Tables 1 and 2, respectively. All detected compounds were O-glycosides of flavonols with sugars attached at positions 3 and 7 of the aglycone skeleton. This pattern of glycosilation is very common among the Phaseolinae (Zallocchi & Pomilio 1994; Williams et al. 1995, Pelotto unpublished manuscript).

All three *Strophostyles* species produced glycosides based on the methylated flavonol isorhamnetin plus kaempferol and quercetin. Notwithstanding *S. belvula* and *S. umbellata* showed very similar chromatographic patterns, while the flavonoid profile of *S. leiosperma* was quite distinctive. No rhamnosides were detected in *S. leiosperma* and it only shared the presence of monoglycosides with the other two species. Based on a three-sample analysis within a flavonoid survey of the Phaseolinae, Williams et al. (1995) have also reported the occurrence of isorhamnetin glycosides in *Strophostyles* species and noticed the same interspecific differences. In contrast with our results, Williams and co-workers isolated fewer compounds and did not detect kaempferol glycosides from leaves, although they did from stems and/or flowers.

In turn, *Dolichopsis paraguariensis* samples were characterized by the presence of kaempferol and quercetin glycosides, lacking isorhamnetin. Noticeably, Paraguayan samples contained only kaempferol glycosides while Argentinean one had kaempferol plus quercetin glycosides. However, in a previous work (Zallocchi et al. 1995) both kaempferol and quercetin glycosides were reported from one sample of *D. paraguariensis* from Paraguay, but of the eight flavonol glycosides the authors identified only rutin and kaempferol-3-O-rutinoside were also present in our samples. These differences may be due to the fact that Zallocchi and co-workers analyzed a whole plant extract and therefore their results are difficult to compare with ours.

After the cluster analysis *S. belvula* and *S. umbellata* are closer to *D. paraguariensis* than to *S. leiosperma* (Fig. 1). This is because *S. belvula* and *S. umbellata* have more glycosides (based on kaempferol and quercetin) in common with *D. paraguariensis* than with *S. leiosperma*, even though *D. paraguariensis* does not produce isorhamnetin glycosides.

Cladistic analysis resulted in two most parsimonious trees (length, L = 35, consistency index, CI = 91, retention index, RI = 70, Fig. 2). Both cladograms support *Strophostyles* monophyly but differ in the depicted relationships among *Strophostyles* species. One tree (Fig. 2.A) shows *S. belvula* and *S. leiosperma* as being sibling species, but this hypothesis needs the parallel gain of the characters 19, 22 and 31 on the *S. umbellata* and *S. belvula* branches. The other tree (Fig. 2.B) supports the clade *S. umbellata-S. belvula*
Table 1. Chromatographic characteristics of the identified compounds.

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†DP: deep purple, Y: yellow, YO: yellow-orange
‡glu: glucose, rha: rhamnose, gal: galactose

and requires three reversions (characters 1, 9 and 17). This scenario is preferable to that portrayed on Fig. 2A since a mutation lost is a more probable event than the homoplastic acquisition of isorhamnetin glycosides. Even more, if we suppose reversal of characters 1, 9 and 17 on the S. umbellata branch as being a consequence of sampling error (undersampling), the cladogram becomes shorter with only 32 steps (CI = 100, RI = 100) and the unique solution of a similar analysis. Thus, we consider the tree depicted on Figure 2.B a more plausible ingroup phylogeny.

Flavonoid evolution shows methylation of the flavonol skeleton as an advanced character shared by all Strophostyles species and the absence of rhamnoses in S. leptosperma as an (auto)apomorphous loss.

Morphological traits are congruent with flavonoid data. Subumbellate inflorescence (character 24), persistent bracts and bracteoles (character 26), linear, terete pods (character 27) and seed pubescence (character 28) support Strophostyles monophyly, and are correlated with isorhamnetin monoglycoside production (characters 17 and 18). Strophostyles helvula strongly resembles
Table 2. Glycoside distribution in the analyzed samples. Compounds are numbered according to Table 1. K: kaempferol glycosides; Q: quercetin glycosides; IR: isorhamnetin glycosides; +: present; -: absent.

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S. umbellata, except for its more lobed leaflets and larger pods and seeds. *Strophostyles leiosperma* is rather different from the other two species because of the smaller flowers (character 25) arranged in more pauciflorous inflorescences and its seeds glabrous and shining at maturity (character 29).

Similarly, both *S. helvula* and *S. umbellata* are more widespread and northerly distributed, with the first species reaching Canada, while *S. leiosperma* has a more limited distribution ranging from south of the United States to the extreme northeastern of Mexico (Britton & Brown 1897, Maréchal et al. 1978). Species divergence at chemical and morphological level also correlates with their ecological features; *S. helvula* and *S. umbellata* mostly grow in more mesic sites, while *S. leiosperma* is adapted to live into more xeric habitats.

Regarding the evolution of the growth form, overlapping this character onto our preferred topology suggests that annual growth would have evolved independently in both *S. leiosperma* and *S. helvula*, whereas perennation would be the plesiomorphic state shared by *D. paraguariensis* and *S. umbellata*.

In summary, universal occurrence of isorhamnetin-based compounds in *Strophostyles* species is a good chemical character in defining generic monophyly while individual glycosides are useful characters to trace species evolution. Within the Phaseolinae isorhamnetin glycosides have sporadically been recorded in four *Phaseolus* species (Pelotto, unpublished manuscript) and some *Vigna* and *Macroptilium* species (Zallocchi & Pomilio 1994; Williams et al. 1995). This fact suggests that flavonol methylation has appeared several times in the tribe, making it a valuable phylogenetic marker at the infragenetic level.

Beyond this contribution, flavonoid data from the related genera *Oxyrhynchus* and *Oryxis* are wanting for a complete view of this little group of American species around *Vigna*.
Fig. 2. The two most parsimonious trees (L = 35) generated using the data matrix (see Appendix, Table A) and Vigna adenantha as outgroup. Characters are mapped on the trees as follows: solid bar = non-homoplasious apomorphy, clear bar = homoplasious apomorphy, and cross = reversal. Numbers on the right of the character symbols stand for character numbers (and character state).
ACKNOWLEDGMENTS

We thank the curators of the Instituto de Botánica Darwinion Herbarium (SI) and the Centro de Estudios Farmacológicos y Botánicos Herbarium (BACP) for providing the plant material, and CONICET for financial support. We are also grateful to two anonymous reviewers for suggestions that improved the earlier manuscript.

APPENDICES

Table A. Data matrix for the cladistic analysis including both flavonoid (characters 1–15, 17–23, codified according to Table B) and morphological (characters 24–31, codified according to Table C) data sets and using Vigna admantha as outgroup.

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Table B. Flavonoids. Character numbers are as in Table 1. Character 16 was not included because no hypothesis about homology can be made on a partially identified compound.

Character states

| 1. 0= absent, 1= present | 8. 0= absent, 1= present | 15. 0= absent, 1= present |
| 2. 0= absent, 1= present | 9. 0= absent, 1= present | 17. 0= absent, 1= present |
| 3. 0= present, 1= absent | 10. 0= absent, 1= present | 18. 0= absent, 1= present |
| 4. 0= absent, 1= present | 11. 0= present, 1= absent | 19. 0= absent, 1= present |
| 5. 0= absent, 1= present | 12. 0= absent, 1= present | 20. 0= absent, 1= present |
| 6. 0= present, 1= absent | 13. 0= absent, 1= present | 21. 0= absent, 1= present |
| 7. 0= absent, 1= present | 14. 0= present, 1= absent | 22. 0= absent, 1= present |
|                                      |                         | 23. 0= absent, 1= present |

Table C. Morphological characters, states and polarities.

<table>
<thead>
<tr>
<th>character</th>
<th>states</th>
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<tbody>
<tr>
<td>24. inflorescence</td>
<td>0= pseudoracemose; 1= subumbellate</td>
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<tr>
<td>25. flower size</td>
<td>0= great (&gt; 20 mm); 1= medium (7-15 mm); 2= small (&lt; 7 mm)</td>
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<tr>
<td>26. bract and bracteole</td>
<td>0= persisting no longer anthesis; 1= persisting through seed maturation</td>
</tr>
<tr>
<td>27. pods</td>
<td>0= linear, compressed; 1= oblong, very flat, with false cellulosic septa; 2= linear, cylindrical</td>
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<td>28. seed coat</td>
<td>0= smooth; 1= pubescent</td>
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<tr>
<td>29. seed pubescence</td>
<td>?= inapplicable; 0= persisting in mature seeds; 1= absent from mature seeds</td>
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<tr>
<td>30. hilum</td>
<td>0= parallel to the placenta; 1= perpendicular to the placenta</td>
</tr>
<tr>
<td>31. leaflets</td>
<td>0= entire; 1= lobed to somewhat lobed at base</td>
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REFERENCES


ELLIOTT, S. 1822. A sketch of the botany of South Carolina and Georgia. 2:229.


RUHELLIA JIMULCENSIS (ACANTHACEAE),
A NEW SPECIES FROM THE CHIHUAHUAN
DESSERT AREA, MEXICO

JOSE A. VILLARREAL Q.
Departamento de Botánica
Universidad Autónoma Agraria "Antonio Narro"
Buenavista, Saltillo, Coahuila 25315, MEXICO

ABSTRACT

Ruellia jimulcensis Villarreal sp. nov., from the Jimulco mountains area (southwestern
Coahuila and northeast Durango), is described and illustrated. It is similar to R. occidentalis
(Gray) Tharp and Barkley, and recognized by its relatively smaller flowers, shorter corolla
basal tube and its distribution.

RESUMEN

Ruellia jimulcensis Villarreal sp. nov. del área de las montañas de Jimulco (suroeste
de Coahuila y noreste de Durango), es descrita e ilustrada. Es similar a R. occidentalis (Gray)
Tharp y Barkley, y se reconoce por sus flores más pequeñas, tubo basal de la corola más
corto y su distribución.

KEY WORDS: Acanthaceae, Ruellia, Coahuila, Flora of México.

Ruellia, a tropical and subtropical genus of about 200 species is repre-
sented in the Chihuahuan Desert Region by six species (Henrickson & Johnston,
in press). A new species is proposed as part of the study of the Flora of Coahuila.

Ruellia jimulcensis Villarreal, sp. nov. (Fig. 1). TYPE: MEXICO. COAHUILA: Mpio.
Torreón, Sierra de Jimulco, mina San José, vereda hacia la cima, 103°13’ W, 25°08’ N.
Matorral con Bonetilla anomala, Agave lechuguilla, Acacia berlandieri, Florentia, Hechtia,
Spiraea y Aralia, 1800-1850 m, 10 Ago 1994, J.A. Villarreal Q. 7781 y M.A. Carranza.
(HOLOTYPE: MEXU; ISOTYPES: ANSM, ENCB, TEX).

Ruellia occidentalis (Gray) Tharp & Barkley similis sed differt flores plus brevis, corolla
tubis plus brevis, calyx lobis longius quam corolla tubis; flores cleistogamous absens et
differt distributio.

Perennial herb from clustered fibrous roots; stems erect to ascending 30–
50 cm tall, densely glandular pubescent with straight hairs about 1 mm
long; the internodes 4–10 cm long; leaves with petioles 6–30 mm long,
blades broadly ovate to obovate, 3–10 cm long, 2–8 cm broad, the base
obtuse to rounded, briefly decurrent along the petiole, apex obtuse to acute,
the margin entire to undulate-crisped, both surfaces viscid with abundant
glandular hairs, the dried leaves usually green-yellowish; flowers in dicha-
sia and terminal thyrsoid panicles 5–20 cm long, to 10 cm broad, strongly

Fig. 1. *Ruellia jimulensis*, a complete plant.
Villarreal Q., A new species of Ruellia

glandular-pubescent; peduncles ascending; calyx lobes 15–25 mm long, linear attenuate, united at the very base, 1.0–1.2 mm broad at the base, unequal, strongly glandular pubescent; corolla funnelform, bluish-purple 30–40 mm long, the basal tube 8–12 mm long, the broadly campanulate throat 15–20 mm long, the lobes 8–14 mm long, almost as broad, erose; cleistogamous flowers absent; stamens didymalous, borne at the distal portion of the corolla tube, free filaments 4–10 mm long; anthers 3–4 mm long; style 15–20 mm long; fruit ellipsoid 12–20 mm long, 3–4 mm broad, glandular pubescent; seeds 10–12, circular to oblate, 2.0–3.0 mm long, narrowly winged to the apex, brownish, covered with dense apressed trichomes.

Additional specimens examined: MEXICO. Coahuila: Mpio. de Torreón, Sierra de Jimulco, proximidades al ejido Trinidad, 25° 08' N, 103° 22' W, Matorral de Agave leboguilla, Bouteloua ramosa, Caesalpinia sessilisiflora, Jatropha y Yucca, ladera rocosa, 1900–2000 m, 25 Ago 1983, J.A. Villarreal 4387, M.A. Carranza y A. Rodríguez (ANSM); Sierra de Jimulco, mina San José, 25° 08' N, 103° 13' W, Matorral desértico, 1800–1850 m, 11 Oct 1993, M.A. Carranza 1951 j.f. Noriega (ANSM); ca. 54 air km SSE of Torreón in canyon above Estacion Otto in SW side of Sierra de Jimulco near Mina San Jose, in limestone area with Acacia, Celtis, Viguiera, Partbenium, Jatropha, Trixis, Fouquieria, Yucca, 25° 04' N, 103° 13' W, 1850 m, 12 Sep 1980, J. Henrickson & P. Bekey 18504 (TEX). Durango: Mpio. de Cuenca, Sierra El Rosario, camino a la estación de microondas Sapioris, carr. 49, 30 km al SE de Lerdo, 25° 24' N, 105° 43' W, Matorral de Acacia crassifolia, Viguiera stevioloba, Bursaria sblendentali, Opuntia imbricata y Fouquieria splendens, 1750–1800 m, 16 Ago 1991, J.A. Villarreal 6243 y M.A. Carranza (ANSM); Estacion de microondas Sapioris, ca. 30 km SW of Gomez Palacio on Hwy to Durango 25° 24'30" N, 105° 43' W, matorral desertico microfilo, 1400–1500 m, 25 Mar 1973, M.C. Johnston, T.L. Wendt & F. Chiang 10409 (TEX); just SSE of Estacion Microondas Sapioris, about 20 km NW of Estacion Chocolate, 25° 25' N, 105° 43' W, 1450–1500 m, 14 Aug 1973, M.C. Johnston, T.L. Wendt, F. Chiang & J. Henrickson 12210 (TEX); Microondas Sapioris, along cobblestone road which departs from Hwy 40 N of Estacion Chocolate, ca 15 air mi (25 km) W-SW of Torreon, 25° 25' N, 105° 42' W, Tecoma stans, Agave leboguilla, Esporabir antisyphilitica and diverse cacti, 1300 m, 30 Jul 1991, M. Mayfield, A. Hempel & A. Jack 1093 (TEX); Mexico Hwy 40, 25 mi SW of Lerdo, 6 nov 1964, D. Fry 251 (TEX); Mpio. de Lerdo, 4 mi southwest of Chocolate, route 31, growing beneath Prosopis on clay flat in valley, 23 Jul 1958, D.S. Correll & I.M. Johnston 20008 (TEX); ca. 4 mi SW of Ciudad Lerdo along Hwy 40 to Zacatecas, on limestone hillside with Larrea, Jatropha, Acacia, Opuntia, Agave etc., 25° 31' N, 103° 32' W, 1200 m, 21 Sep 1978, J. Henrickson & E. Lee 17474 (TEX).

Ruellia jimulicensis is found on sandy hillsides and dry canyons at elevations of 1200–2000 m, in xeric shrublands at the complex of mountains near Sierra de Jimulco and Sierra del Rosario.

The new species has leaf blades broadly ovate, obtuse to rounded at the base as R. occidentalis and often with strongly stipitate glandular trichomes covering the stems and inflorescence. It differs in its flowers 3–4 cm long, the basal tube of the corolla 8–12 mm long, the calyx lobes longer than the basal tube, the cleistogamous flowers unknown and its distribution, as marked in the key below. Tharp and Barkley (1949) gave the name R. occidentalis
var. ferrisae to a specimen from the mountains near Monterrey, Nuevo León which is recognized by Henrickson and Johnston (in press) by this name for the specimens described here. The type specimen from the Monterrey area has oblong-obovate leaf blades, lacks stipitate glands on stem and leaves and flower dimensions that better fit with R. nudiflora, a common species in Monterrey area. The populations of the proposed species grow allopatrically in an isolated area at the southwestern corner of the Chihuahuan Desert Region while most of the related species are distributed in the eastern Sierra Madre Oriental (Turner 1991).

The three species of Ruellia previously mentioned can be separated by the following key:

1. Leaf blades ovate to elliptic-obovate, mostly less than 3 cm wide, sparsely to moderately pubescent; lower internodes puberulent to glabrate ......... R. nudiflora
1. Leaf blades broadly ovate to subdeltoid, 4–7(–9) cm wide, usually densely pubescent; lower internodes with abundant stipitate glands .................................. 2
2. Flowers (chasmogamous) 4.5–5.5(–6.5) cm long; basal tube of the corolla 2.5–3.5 cm long, longer than the calyx lobes; cleistogamous flowers (smaller than the chasmogamous) frequently located in the lower nodes; se Texas, ne Mexico (e Coah, ne N.L., Tamps, ne Ver.) ...................................................... R. occidentalis
2. Flowers 3.5–4.0 cm long; basal tube of the corolla 8–12 mm long, shorter than the calyx lobes; cleistogamous flowers absent; sw Coahuila and ne Durango .................................................. R. jimulcensis

ACKNOWLEDGMENTS

I thank Tom Wendt for the loan of specimens for revision from TEX/LL. The illustration was prepared by Cuauhtemoc González de León.

REFERENCES

UNA NUEVA ESPECIE DE AGAVE, SUBGENERO LITTAEA (AGAVACEAE) DE GUERRERO Y OAXACA, MEXICO

ABISAI GARCIA-MENDOZA

Jardín Botánico, U.N.A.M.
A.P. 70-614, Del Coyoacán
04510 México, D.F., MEXICO

ESTEBAN MARTINEZ SALAS

Depto. de Botánica, Instituto de Biología, U.N.A.M.
A.P. 70-233, Del. Coyoacán
04510 México, D.F., MEXICO

RESUMEN

Se describe e ilustra Agave gracilis de los estados de Guerrero y Oaxaca, México. La especie pertenece al grupo Striatae Baker, del subgénero Littaea (Tagliabue) Baker, y muestra similitudes con A. dasylirioides Jacobi & Bouché.

ABSTRACT

Agave gracilis from Guerrero and Oaxaca, Mexico, is described and illustrated. The species is a member of group Striatae Baker, subgenus Littaea (Tagliabue) Baker. It is similar to A. dasylirioides Jacobi & Bouché.

Las exploraciones botánicas recientes realizadas en los estados de Guerrero y Oaxaca, México, revelaron la existencia de una nueva especie de Agave, perteneciente al subgénero Littaea (Tagliabue) Baker, grupo Striatae Baker, de la familia Agavaceae. El grupo Striatae es endémico de México y los cinco taxa que lo conforman se caracterizan por presentar hojas estriadas, lineares, con el margen serrulado, flores campanuladas o cilíndricas con el tubo bien desarrollado y ovario sin cuello que se proyecta hacia el interior del tubo (Gentry 1982).

Agave gracilis García-Mend. & E. Martínez, sp. nov. (Fig. 1). Tipo: MEXICO.

GUERRERO: Municipio de Tlapa, El Salado, 8 km al N de Tlapa, camino a Huamuxtitlán, selva baja caducifolia, 990 m, 16 Nov 1982 (fls), E. Martínez et al. 2639 (holotipo: MEXU; isotipos: BRIT, ENCB, K, MO).

Plantae perennes, caespitosae. Folia 40–60 × 0.4–0.9 cm, linearia, striata, margin subtiliter denticulata, glauca vel viridi-glauc. Flores campanulati 2–2.2(–2.5) cm longi, tubo 3–4 mm longo, 5–7 mm lato; filamenta 2.7–3 cm, longa, in apice tubi inserta; ovarium collo carens, in tubi interiorem projectum; capsulae globosae 9–10 × 8–9 mm.

Plantas perennes, caespitosas, con troncos rastreros de hasta 1 m de largo; rosetas hemisféricas, compactas, 50–80 cm de diámetro, 50–60 cm de alto.
Fig. 1. Agave gracilis. a) planta completa con inflorescencia, b) brácteas superiores del pedúnculo, c) hoja, d) detalle del margen de la hoja, e) flores pareadas en la inflorescencia, f) flor disectada, g) cápsulas, h) semillas. Ilustración basada en los especímenes E. Martínez et al., 2639 y A. García-Mendoza y L. de la Rosa 6508.
Hojas más de 100 por roseta, 40–70 cm de largo, 0.4–0.9 cm de ancho en la parte media, ensanchándose en la base hasta 1–1.5 cm, lineares, estriadas, planas, flexibles, glaucas o verde-glaucas, subcoriáceas; margen finamente denticulado, amarillento; espina 3–6(8) mm de largo, débil, de color pardo-rojizo. Inflorescencia de 1.8–2 m de largo, erecta o ligeramente inclinada, espiga en el cuarto superior o mitad superior del pedúnculo, brácteas del pedúnculo 5–15 cm de largo, 2–4 mm de ancho en la base, disminuyendo en tamaño hacia el ápice, lineares, pardas, débiles, sin espina o ésta apenas marcada; brácteas florales 2–3.5 cm de largo, 1–2 mm de ancho, lineares, pardas, persistentes, más largas que las flores. Flores 2–2.2(2.5) cm de largo, campanuladas, verdes, con el ápice de los tépalos rojizo-oscuros; pedicelos 1 mm de largo, alargándose a 2 mm durante la fructificación; ovario 7–10 mm de largo, 2–4 mm de ancho, cilíndrico, sin cuello, glabro o glabrescente, penetrando ligeramente en el tubo del perianto, éste de 3–4 mm de largo, 5–7 mm de ancho; tépalos 0.9–1.1 cm de largo, 2.5–3.5(4.5) mm de ancho, oblongos; filamentos 2.7–3 cm de largo, insertos en el ápice del tubo; anteras 7–9 mm de largo, 1 mm de ancho, céntricas, rojizas. Cápsulas 9–10 mm de largo, 8–9 mm de ancho, globosas, pardo-oscuras, con el perianto, estambres y estilo de la flor persistentes. Semillas 3–3.5 mm de largo, 2–2.5 mm de ancho, engrosadas en el lado curvo, negras.

**Paratipos:** MEXICO. **Guerrero:** Municipio de Arlixtac, 1 km al O de Santa Isabel, 30 km al E de Chilapa, carr. a Tlapa, 25 Nov 1989 (fl), J.L. Contreras 2651, 2652 (FCME); Municipio de Tlapa, río El Salado en su unión con el río Tlapaneco, 8 km al N de Tlapa, carr. a Huamuxtitlán, 7 May 1997 (fr), A. García-Mendoza y L. de la Rosa 6508, 6511, 6514 (ENCB, MEXU); Municipio de Zumpango del Río, Xochihite, Xochiapa, 23 Abr 1993 (fr), A. Gómez s.n. (MEXU). **Oaxaca:** Distrito de Huajuapan, El Boquerón, cañón del río Mixteco, 5 km al N de Tonalá, 13 Ago 1993, A. García-Mendoza y F. Palma 5811 (MEXU).

La especie aquí descrita se localiza en la cuenca intermedia del río Balsas, en los estados de Guerrero y Oaxaca. Seguramente su distribución se extiende hacia otros afluentes del río y posiblemente más allá, siendo quizás, la planta señalada por Ullrich (1990) para el cerro Yucuyú en el Distrito de Tlaxiaco, Oaxaca. *Agave gracilis* crece en laderas y barrancas abruptas, sobre suelos derivados de rocas calizas, entre los 850 y 1300 m snm. Habita preferentemente en las selvas bajas caducifolias y su ecotónia con los bosques de *Quercus-Pinus*. Algunos de los géneros frecuentes con los que convive son: *Acacia, Agave, Bursera, Euphorbia, Hechtia, Ficus, Forchhammeria, Neobuxbaumia* y *Pachycaerus*.

*Agave gracilis* presenta similitudes morfológicas con *Agave dasylirioides* Jacobi & Bouché, especie de la que se diferencia por su hábito cespitoso, roseta más reducida en tamaño, hojas más cortas y angostas, inflorescencia erecta o ligeramente inclinada y flores más pequeñas; las cápsulas globosas y de tamaño más reducido contrastan con las cápsulas oblongas y más grandes.
Tabla 1. Comparación de algunas características morfológicas entre Agave gracilis y A. dasylirioides.

<table>
<thead>
<tr>
<th>Carácter</th>
<th>Agave gracilis</th>
<th>Agave dasylirioides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plantas</td>
<td>cespitosas</td>
<td>solitarias</td>
</tr>
<tr>
<td>Tronco</td>
<td>hasta 1 m, rastrello</td>
<td>hasta 1.5 m, rastrello</td>
</tr>
<tr>
<td>Diámetro de la roseta</td>
<td>50-80 cm</td>
<td>100-200 cm</td>
</tr>
<tr>
<td>Tamaño de hojas</td>
<td>40-70 x 0.4-0.9 cm</td>
<td>(40-60-100 x 2-3.8 cm</td>
</tr>
<tr>
<td>Color de hojas</td>
<td>glauca o verde-glaucosa</td>
<td>verdes o verde-glaucosa</td>
</tr>
<tr>
<td>Inflorescencia</td>
<td>1.8-2 m, erecto o</td>
<td>(1.5-2-2.6 m, arqueada</td>
</tr>
<tr>
<td></td>
<td>ligeramente inclinada</td>
<td></td>
</tr>
<tr>
<td>Longitud de flores</td>
<td>2-2.2(-2.5) cm</td>
<td>(2.6-3-3.5 cm</td>
</tr>
<tr>
<td>Tubo de la flor</td>
<td>3-4 x 5-7 mm</td>
<td>(8-10-15 x (8-)12-16 mm</td>
</tr>
<tr>
<td>Tamaño de filamentos</td>
<td>2.7-3 cm</td>
<td>3.5-5 cm</td>
</tr>
<tr>
<td>Inserción de filamentos</td>
<td>ápice del tubo</td>
<td>mitad del tubo</td>
</tr>
<tr>
<td>Cápulas</td>
<td>9-10 x 8-9 mm, globosas</td>
<td>(10-)15-20 x 6-9 mm, oblongas</td>
</tr>
<tr>
<td>Semillas</td>
<td>3-3.5 x 2-2.5 mm</td>
<td>3-4 x 2.5-3 mm</td>
</tr>
</tbody>
</table>

de A. dasylirioides; así mismo, las semillas son de tamaño menor en A. gracilis. Una comparación de los caracteres más sobresalientes de ambas especies se presenta en la Tabla 1. Las medidas de A. dasylirioides se tomaron en parte de Gentry (1982) y se ampliaron de acuerdo con observaciones propias. Ambas especies habitan en la cuenca del río Balsas, pero A. dasylirioides ocupa la parte alta, más húmeda y fría, entre los 1900 y 2500 m snm, sobre laderas con suelos derivados de rocas volcánicas, en bosques de Quercus-Pinus con Alnus, Arbutus, Clethra, Cremnophila, Garrya, Hechtia y Salvia. La época de floración de las dos especies se presenta en los meses de octubre y noviembre.

El epíteto específico se refiere al carácter esbelto de la planta.

AGRADECIMIENTOS

Agradecemos la revisión del manuscrito a Raquel Galván, Susan Verhoek, Wendy Hodgson y Fernando Chiang. La descripción latina fue hecha por el último autor. La ilustración es aportación de Albino Luna.

REFERENCIAS

A NEW SPECIES OF MANDEVILLA (APOCYNACEAE) FROM JALISCO, MEXICO

JUSTIN WILLIAMS

Department of Botany
University of Texas
Austin, TX 78713, U.S.A.

ABSTRACT

In preparation for a forthcoming treatment of the Apocynaceae of Mexico, a routine examination of herbarium specimens revealed the following new species, Mandevilla pringlei J.K. Williams, sp. nov. The new species is distinct from other members of its alliance (sect. Torosae) in having subsessile leaves and larger peduncles and flowers. In addition, Mandevilla apocynifolia (A. Gray) Woodson is here presented to be a synonym of M. foliosa (Müll. Arg.) Hemsl.

RESUMEN

En la preparación de un próximo tratamiento de las Apocynaceae de México, un examen de rutina de los espeimenes de herbario reveló la nueva especie siguiente, Mandevilla pringlei J.K. Williams, sp. nov. La nueva especie se distingue de otros miembros de su alianza (sect. Torosae) por tener hojas subsésiles, y pedúnculos y flores más grandes. Además, Mandevilla apocynifolia (A. Gray) Woodson se presenta aquí como un sinónimo de M. foliosa (Müll. Arg.) Hemsl.

KEY WORDS: Apocynaceae, Mandevilla, Jalisco, Mexico

Mandevilla pringlei J.K. Williams sp. nov., (Fig. 1). TYPE: MEXICO. JALISCO: Río Blanco, near Guadalajara, 22 Jul 1902, C.G. Pringle 11357 (HOLOTYPE: US!).

Mandevilla foliosa (Müll. Arg.) Hemsl. affinis sed folis subsessilibus petiolis 2–3 mm longis (vice 10–18 mm in M. foliosa), pedunculis longioribus (7–10 cm vice 0.3–1.2 cm) lobis corollae longioribus latioribusque (12–15 × 10–14 mm vice 5–8 × 2–4 mm) plantis suffrutescentibus (vice lignosibus ramificantibusque).

Suffrutescent herbs to 0.4 m tall, stems pubescent. Leaves 3–7 cm long, opposite, subsessile, pubescent; petioles 2–3 mm long; blades 3–7 cm long, 1.8–2.5 cm wide at middle, ovate-elliptic, apex acute, base sub-cordate, with 2–4 glands at apex of petiole on upper side. Inflorescence lateral, indeterminate, racemose, with 2–10 flowers; peduncles 7–10 cm long, pubescent; bracts 4–6 mm long, narrowly triangular to lanceolate, straight; pedicels 10–17 mm long, pubescent, occasionally twisted. Sepals 5, basally fused, 5–7 mm long, ca 0.5 mm wide, narrowly triangular to lanceolate, straight, pubescent. Corolla salverform, yellow; tube 11–18 mm long, constricted at mouth, lower half internally glabrous, upper half internally pubescent; lobes 12–15 mm long, 10–14 mm wide, obovate, acuminate, occasionally equal in length to the tube but always greater than half its length, spread-
Fig. 1. Holotype of Mandevilla pringlei J.K. Williams.
ing, pubescent. Stamens 3–4 mm long; filaments ca 0.5 mm long, pubescent, straight; anthers ca 3 mm long, bases sagittate with blunt lobes. Pistils 7–11 mm long; style 5–7 mm long, glabrous; ovary ovoid, ca 1 mm long, glabrous; pistil head pentagonal, 2–3 mm long. Nectaries 5, as long as to slightly shorter than ovary. Mature follicles unknown, immature follicles fused at apex, pubescent.

Additional specimens examined: MEXICO, JALISCO: Mpio. Mazamitla, Fraccionamiento Los Cazos, to the S of Mazamitla, 9 Jul 1995, *Machaera* 7351 (TEX); Cerro Viejo, S face, above Zapotitan de Hidalgo, a village 1 mi N of Hwy MEX 15, ca 25 mi due S, or 45 road mi from Guadalajara, base of mountain in open meadow just E of trail, alt 1890 m, 27 Jun 1956, D. P. Gregory & G. Eiten 223 (P, SMU); Huejotitan, Jul 1912, *Dignet s.n.* (P).

**Distribution.**—Mandevilla pringlei is known only from five collections made from the Pine-Oak forest near Guadalajara, Jalisco, Mexico.

The new species honors Cyrus Guernsey Pringle (1838–1911) prominent collector of the Mexican flora, and whose collections led to many a new species in the Apocynaceae, and other families.

All specimens are with flowers and buds, *Machaera* 7351 is also with fruit if the fruits are extremely immature, only 5 mm in length. The closest relative of *Mandevilla pringlei*, *M. foliosa* (Müll. Arg.) Hemsl., has an average follicle length of 10 cm.

It should be noted that according to Pringle’s diary (Davis 1936, p. 199) on the days prior to and after his collections made on July 22, 1902 he was collecting numbers in the 8600 series. This, however, is in contrast to the type collection of *M. pringlei* which is numbered 11357. The diary, however, does specifically state that Pringle was collecting along the Rio Blanco, the type locality of *M. pringlei*, on July 22, 1902. In the numerical listing of Pringle’s collections (ibid) the number 11357 is used twice. One listing is for *E. apocynifolia* A. Gray (= *M. foliosa* see below) the second is for an unidentified species of Asclepiadaceae. In the absence of a thorough explanation of Pringle’s numerical system it is reasonable to assume that the collection number of the above type specimen is simply an error in numbering.

To date the most taxonomically thorough investigation of *Mandevilla* remains Woodson’s (1933) revision. Infrafamilieric relations are at present moderately unclear, however, Woodson provided both subgeneric and sectional divisions which remain undisputed.

*Mandevilla pringlei* is a member of subgenus *Mandevilla* (as evidenced by the lack of glands along the midrib of the upper surface of the leaves) where it relates to section *Torosae*, evidenced by its suffrutescent habit and non-twinning stems (Woodson 1933). *Mandevilla pringlei* is most closely related to *M. foliosa*, sharing with it an erect habit (opposed to the trailing habits of *M. karwinskii* (Müll. Arg.) Hemsl. and *M. torosa* (Jacq.) Woodson) and hav-
ing leaves with an average length greater than 5 cm (vs. 2–5 cm of *M. mexicana* (Müll. Arg.) Woodson). *Mandevilla pringlei* differs from *M. foliosa* in a number of floral and habit characters that are contrasted below:

1. Branching shrubs to 1.5 m tall; leaves petiolate, petioles 10–18 mm long; peduncles 0.3–1.2 cm long; corolla lobes 5–8 (10) mm long, 2–4 mm wide, up to but not exceeding half the length of corolla tube (Fig. 2a); stems, leaf blades, inflorescence, and fruit glabrous or pubescent, but midrib of leaves always pubescent; midrib hairs linear lanceolate 0.15–0.3 mm long (Fig. 3a); throughout Mexico ................................................................. *M. foliosa*

1. Suffrutescent herbs to 0.4 m tall; leaves sessile, petioles 2–3 mm long; peduncles 7–10 cm long; corolla lobes 12–15 mm long, 10–14 mm wide, half or more the length of the corolla tube (Fig. 2b); stems, leaves, inflorescence and fruit pubescent; midrib hairs triangular, 0.1–0.15 mm long (Fig. 3b); Jalisco ................................................................. *M. pringlei*

In the most recent keys to the species of *Mandevilla* (Woodson 1933, 1938), *M. pringlei* keys out to *M. apocynifolia* (A. Gray) Woodson (*Basionym: Echites apocynifolia*). In fact, Woodson (1933) cites the type of *M. pringlei* as a specimen of *M. apocynifolia*. An examination of an isotype of *M. apocynifolia* (Palmer 734; holotype: GH; isotype: NY!), however, reveals that it is a synonym of *M. foliosa* (*Ghiebreght s.n.; holotype: G n.v., photo-holotype F! MO!). Although the type of *M. apocynifolia* is without flowers, it is evident that the sheet represents a specimen of *M. foliosa* due to its branching, petiolate leaves, glabrous stems and fruits, and linear-lanceolate midrib hairs. *Mandevilla foliosa* has both glabrous and pubescent-stemmed populations scattered throughout its range. However, in the region of Jalisco where the type of *M. apocynifolia* was collected the populations have consistently glabrous stems and fruits.
Fig. 3. Scanning electron micrographs of Mandevilla midribs of leaf undersurface showing the length and shape of midrib hairs. A. Mandevilla foliosa (Müll. Arg.) Hemsl. (R. King & T. Soderstrom 4632, TEX). B. Mandevilla pringlei J.K. Williams (Machuca 7351, TEX). White bar on both photos represents 0.1 mm. Microphotographs made by the author using a Phillips 515 SEM (Cell Resource Center, University of Texas Austin).

ACKNOWLEDGMENTS

I would like to thank Paul Fryxell for providing the Latin diagnosis and to him and Billie Turner for reviewing the original manuscript. Thanks is also extended to the curators of F, MO, NY, P, SMU, TEX and US for allowing me the opportunity to observe their specimens. I would also like to credit the staff of the Cell Research Center (University of Texas at Austin) for allowing me access to their scanning electron microscope.

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BOOKS RECEIVED


"The 200 species in this book were selected because of their abundance, desirability, or noxious properties. The list of plants was developed over a nearly 40-year period by coaches of range plant identification teams and faculty from the colleges and universities with range management programs. The formal list is now the Master Plant List for the International Range Plant Identification Contest sponsored by the Society for Range Management (1839 York Street, Denver, CO 80206)." Each species is treated with the following information: Tribe, species, common name, life span, origin, and season, followed by more detailed information on Inflorescence Characteristics, Vegetative Characteristics, Growth Characteristics, Forage Value, and Habitat. An illustration and range map are provided for each plant.
A NEW COMBINATION IN MEXICAN MANDEVILLA (APOCYNACEAE)

JUSTIN WILLIAMS

Department of Botany
University of Texas
Austin, TX 78713, U.S.A.

ABSTRACT

In preparation for a forthcoming treatment of the Apocynaceae of Mexico, it was discovered that Echites holosericea of Sessé & Moc. has priority over the species Mandevilla sertuligera Woodson and M. syrinx Woodson, accordingly Mandevilla holosericea (Sessé & Moc.) J.K. Williams comb. nov. is here proposed.

RESUMEN

En la preparación de un próximo tratamiento de las Apocynaceae de México, se descubrió que Echites holosericea Sessé & Moc. tiene prioridad sobre Mandevilla sertuligera Woodson y M. syrinx Woodson, como consecuencia se propone Mandevilla holosericea (Sessé & Moc.) J.K. Williams comb. nov.


JALISCO: barranca of Tequila, 8 Oct 1893, Pringle 5422 (holotype: MO n.v.).


MICHOACAN: rocky hills, Coru Station, 23 Jan 1907, Pringle 13890 (holotype: US!).


Sessé and Moçino (1887, 1894) described 19 species of Echites and the types for a majority of these names have not been located. In preparation of a forthcoming treatment of the Apocynaceae of Mexico, the author studied the collections of “Echites” of Sessé and Moçino during July 1995 at the Madrid herbarium (MA), and from material borrowed from the Field Museum (F) during December 1996 in order to locate and observe the types of their Echites species. These observations revealed the following novelty.

The type of the species Echites holosericea Sessé and Moç. has up until now

Fig. 1. Holotype of *Echites bolusica* Sessé & Moc.
not been formally identified and presented. The typification of *E. holosericea* has been made difficult because there are no specimens so labeled among the Sessé and Močiño collections at F or MA. Many of the posthumously-published species names of Sessé and Močiño are not the same ones that are written on the specimen labels (Fuertes & Fryxell 1993). Sessé and Močiño (1894) described the species as having opposite subcordate leaves with rusty red-white tomentum covering all parts of the plant and white flowers with a hairy tube arranged in a compact raceme. Only one specimen (Fig. 1) in the Sessé and Močiño collections matches this description. This specimen was labeled by them as "Echites tubulosa N". The name *E. tubulosa* was never validly published by them, however, the letter "N" after the name indicates Sessé and Močiño considered this specimen to be a new species (Fuertes & Fryxell, 1993). Since only one specimen matches the description of *Echites holosericea* and has a letter "N" on the label it is considered here to be the holotype of *E. holosericea*.

In 1936, while the Sessé and Močiño collections were on loan to F (McVaugh 1980), the specimen discussed above was identified by Woodson as *Mandevilla sertuligera* Woodson. This identification was later confirmed by the present author. With the presentation of the above type it becomes evident that the of Sessé and Močiño name has priority over Woodson's. A new combination is thus required and is accordingly made above.

The closest relative of *Mandevilla holosericea* is believed to be *M. syrinx* Woodson. The two species appear to have a close resemblance to one another. Indeed, there are two sheets of the same collection (Pringle 13106, US) that Woodson annotated differently, one sheet he annotated *M. sertuligera* and the other *M. syrinx*. Woodson (1938) keyed *M. sertuligera* apart from *M. syrinx* by its corymbose inflorescence (vs. racemose) and sepals 4–6 mm long (vs. 2–5 mm). Both Pringle specimens key more favorably to *M. sertuligera* (now *M. holosericea*). At present I have only observed paratypes of *M. syrinx* (having been unsuccessful at locating the type at MO), I am inclined, however, to recognize the two species as undifferentiated and regard them both as a synonym of *M. holosericea*.

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BOOKS RECEIVED


The usual indexes follow: Subject Index, Cumulative Index of Contributing Authors, and a Cumulative Index of Chapter Titles, Volumes 24-28.


This volume of Plant Breeding Reviews is dedicated to Arnel R. Hallauer, scientist, maize breeder, and quantitative geneticist. The contents start with a dedication to Dr. Hallauer: 1) Dedication: Arnel R. Hallauer, Scientist, Maize Breeder, Quantitative geneticist. The remaining eight chapters cover a variety of areas in plant breeding. Contents: 2) Molecules involved in self-incompatibility in flowering plants. 3) Genetic mosaics and plant improvement. 4) Quantitative trait loci: Separating, pyramiding, and cloning. 5) Doubled haploid breeding in cereals. 6) Spelt: Agronomy, genetics, and breeding. 7) Cowpea breeding. 8) Recurrent selection in soybean. 9) Gene action and plant breeding. All of this followed by a Subject Index, Cumulative Subject Index and a Cumulative Contributor Index for volumes 1-15.
TRACHYPOGON MAYAÈNSIS (POACEAE: ANDROPOGONEAE): A NEW SPECIES FROM BELIZE

JOSEPH K. WIPFF
Pure-Seed Testing, Inc.
P.O. Box 449
Hubbard, OR 97032, U.S.A.
joseph@turf-seed.com

STANLEY D. JONES
Herbarium (BRCH)
Botanical Research Center
P.O. Box 6717
Bryan, TX 77805-6717, U.S.A.
sdjones@startel.net

ABSTRACT

Trachypogon mayaènsis, a new species from the Maya Mountains in Belize, is described and illustrated. A key is provided to separate it from other species in Central America. *Trachypogon mayaènsis* is readily distinguished from other Central American species by its annual life cycle, height, leaf blade length and width, and prominent and conspicuous sheath auricles/ligules, that can reach to 6 cm in length.

RESUMEN

Se describe y ilustra una especie nueva, *Trachypogon mayaènsis*, de las montañas Maya de Belize. Se presenta una clave para separarla de las otras especies Centro-americanas. *T. mayaènsis* se distingue fácilmente de otras especies Centro-americanas por su ciclo de vida anual, altura, longitud y anchura de las láminas foliares, sus liguas con aurículas prominentes y conspicuas, y que pueden llegar hasta 6 cm de largo.

*Trachypogon*, a genus of approximately six species, is found in tropical and subtropical America and Africa (Dávila 1994). Two species are found in Central America: *T. spicatus* (C. von Linné) K.E.O. Kuntze and *T. vestitus* N. Andersson. *Trachypogon spicatus* (syns. = *T. montufari* (K. Kunth) C. Nees von Esenbeck; *Trachypogon palmeri* Nash; *T. plumosus* (F. von Humboldt & A. Bonpland ex C. von Willdenow) C. Nees von Esenbeck; and *T. secundus* (J. Presl) F. Lamson-Scribner) is found from southern Texas in the United States to Argentina, and in Africa. *Trachypogon vestitus* is found from Honduras to Brazil. A collection of *Trachypogon* was made in the Maya Mountains in Belize that could not be assigned to any known species and is here described as new.
Trachypogon mayaënsis Wipff & S.D. Jones, sp. nov. (Fig. 1). TYPUS: BELIZE.

Gramen annuum caespitosum, culmis (1.59–)1.95–2.10 m altis; auriculis (3–)4–5–6 cm longis (auriculae ligulae adnatae); folia laminis (30–)43–61 cm longis; inflorescentia 9–30 cm longa.

Plants (1.59–)1.95–2.10 m tall, robust annual, densely cespitose, erect. Leaves cauline (measurements taken from mid-culm leaves); nodes ca. 11, appressed pubescent with trichomes to 2 mm long, rooting at lower nodes; sheaths with ascending to appressed scattered trichomes or glabrous, when pubescent, trichomes 1.3–5.5 mm long, becoming denser at apex of sheath; collar glabrous; sheath auricles (3–)4–5–6 cm long, erect and adnate to the ligules, appressed pubescent or glabrous; ligules (3–)4–5–6 cm long, membranous, firm, brown, veined, appressed pubescent attenuate, adnate to the sheath auricles; blades (30–)43–61 cm long, 6–7.5 mm wide (measurements taken from mid-culm leaves), flat, apically long attenuate and basally long cuneate with the basal portion becoming involute, antorsely scaberulous on both surfaces, margins antorsely scabrous. Inflorescence 9–30 cm long, a spicate raceme or a panicle with two racemose branches; central axis of spicate raceme or the racemose branches (if a panicle) short pubescent, internodes 3–4 mm long (in middle); one pedicellate spikelet terminating spicate raceme or branch. Spikelets paired, one (lower spikelet) of each pair short pedicellate, persistent, awnless, staminate, dorsally compressed; other spikelet (upper spikelet) of pair, longer-pedicellate, deciduous, perfect-flowered, awned, nearly terete. Florets without paleas. LOWER (SHORT PEDICELLED) SPIKELETS: staminate, sometimes with a vestigial ovary present; the lower spikelet either absent or rudimentary in the lowest 4–5 pairs of spikelets in the inflorescence or racemose branch. Pedicels 1–2 mm long, pubescent. Spikelets 6.5–7.6 mm long, 1–1.6 mm wide, pubescent; first glumes 6.5–7.6 mm long, 1–1.6 mm wide, 9–11-veined, coriaceous, partially enclosing rest of spikelet, narrowly elliptic, sparsely to densely short pubescent, keeled, the keels strigose-ciliate, apex bifid, the teeth 0.2–0.3 mm long; second glumes 6.5–7.6 mm long, ca. 1.4 mm wide, 3-veined, narrowly elliptic, the margins overlapping, ciliate; Lower Floret: lemmas 5.2–5.5 mm long; 0-veined, hyaline, ciliate on margins; paleas absent. Upper Floret: lemmas 4.7–4.9 mm long; 3-veined, hyaline, ciliate on upper margins; paleas absent. UPPER (LONG PEDICELLED) SPIKELETS: perfect flowered, awned. Pedicels 2.5–3.1 mm long, pubescent. Spikelets (including callus) 9.5–10.6 mm long, 1–1.4 mm wide, pubescent; callus, at base of spikelet, 1.8–2.0 mm long, pubescent with trichomes to 3.0 mm long; first glumes 7.5–8.5 mm long, 1–1.4 wide,
Fig. 1. *Trachypogon mayaensis* [S.D. Jones 10489 & R. Oliver (BRCH)]. A. Habit (bar equals 5 cm). B. Section of culm showing the auricle/ligule (bar equals 1 cm).
9–11-veined, coriaceous, margins involute and partially enclosing rest of spikelet, elliptic, densely short pubescent throughout, lateral veins near apex strigulose, apex rounded and ciliolate; second glumes 7.7–8.9 mm long, 0.9–1.3 mm wide, 3-veined, coriaceous, narrowly elliptic, sparsely pubescent between veins; upper margins overlapping and ciliate, apex broadly acute and ciliate; Lower Floret: neuter (i.e. without reproductive structures); lemmas 6.5–7.3 mm long, 1.1–1.2 mm wide, 2-veined, hyaline, ciliate on upper margins, apex truncate and ciliate; paleas absent. Upper Floret: perfect; lemmas 6–6.9 mm long, 0.7–1.0 mm wide; glabrous, the lower 1/3 is 3-veined, hyaline and easily tearing, the upper 2/3 is 0-veined, subcoriaceous to coriaceous and flattened, turning into a terete awn; awn 38–50.5 mm long, twice geniculate, pubescent from base to second bend; paleas absent. Stamens 3, anthers ca. 3.8 mm long, 1–1.1 mm wide. Chromosome number unknown.

Etymology.—The specific epithet refers to the Maya Mountain Range in Belize.

Phenology.—November–February.

Distribution.—Known from the Maya Mountains in the Cayo District of Belize and from the state of Oaxaca in México.


KEY TO THE SPECIES OF TRACHYPOGON IN CENTRAL AMERICA
(Modified from Dávila 1994)

1. Plants robust annuals, 1.6–2.10 m tall; auricles/ligules (3–)4–6 cm long;
   leaf blades (30–)43–61 cm long, 6–7.5 mm wide ......................... T. mayaënsis

2. Plants glabrous or rarely with basal sheath sparsely pubescent; inflores-
   cence a spicate raceme, rarely a panicule with two racemose branches ..... T. spicatus
2. Plants with sheaths and blades conspicuously pubescent; inflorescence a
   panicule with 3 (rarely 2) racemose branches or rarely a spicate raceme
   ................................................................. T. vestitus

The closest relative of Trachypogon mayaënsis is probably T. spicatus, from
which it differs by the characters given in the above key; Trachypogon palmeri
Nash (= T. spicatus) is the name given to longer liguled forms of T. spicatus
in Mexico. There is also a taxon in Brazil with long ligules, T. macroglossus
Trinius, but this taxon is perennial with very narrow, involute leaf blades.

Seeds of T. mayaënsis were planted in the greenhouse, of the five plants to
germinate, only one survived the transplanting to a larger container. Once
the plant flowered, it began to branch at the lower aerial nodes (typical of
annuals), but eventually the entire plant died and there were no new tillers
produced from rootstock. This was also observed in the field. The original
material was collected in November 1994, but when we returned to the same site in June 1995, there was no sign of this taxon, though the other associated perennial grasses were still present.

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REFERENCES

BOOKS RECEIVED


The authors have presented most of the known biology of each species, maps of their distribution in more than 100 countries, illustrations designed to help with identification, and an index of common names, and a bibliography of 3300 references to lead students and researchers to further details that are contained in the principal papers. From the cover: "The culmination of four decades of global research, World Weeds presents comprehensive and up-to-date information on over 100 weeds-addressing recent changes in such areas as crop tillage methods, herbicide use, and agricultural runoff. This monumental work, featuring a wealth of original data from the authors, provides extensive coverage of the know biology of each species. Each entry contains a full botanical description, plus important details on habitat requirements and distribution, seed production, ecology, physiology, crop impact, and more." It is generously supplied with excellent line drawings.


TAXONOMY OF THE SPOROBOLUS FLORIDANUS COMPLEX (POACEAE: SPOROBOLINAE)

ALAN S. WEAKLEY
The Nature Conservancy
P.O. Box 2267
Chapel Hill, NC 27515-2267, U.S.A.

PAUL M. PETERSON
Department of Botany
National Museum of Natural History
Smithsonian Institution
Washington, DC 20560-0166, U.S.A.

ABSTRACT

The Sporobolus floridanus complex is defined to include five North American species. Keys, descriptions, distributions, illustrations, and habitat information are provided for: S. curtissii, S. floridanus, S. silveanus, S. tereifolius, and a new member of the complex from North Carolina, South Carolina, and eastern Georgia, Sporobolus pinetorum Weakley and P. M. Peterson. A lectotype is chosen for S. floridanus. The taxonomic and ecological relationships of these five species, as well as the related S. junceus and S. heterolepis, are compared and discussed. Sporobolus curtissii, S. floridanus, S. pinetorum, S. silveanus, and S. tereifolius are all relatively narrow endemics of various portions of the southeastern Coastal Plain. Each of these five species is the locally dominant or codominant grass in fire-maintained pinelands with open canopies of Pinus palustris, P. serotina, and/or P. elliottii var. elliottii. The geographic distributions and many ecological requirements of the S. curtissii, S. floridanus, S. pinetorum, and S. tereifolius overlap, but they can be separated on a hydrologic gradient.

RESUMEN

El complejo Sporobolus floridanus es definido para incluir cinco especies de Norte America. Se proporcionan claves, descripciones, distribución, ilustraciones, e información del hábitat para: S. curtissii, S. floridanus, S. silveanus, S. tereifolius, y un nuevo miembro del complejo de Carolina del Norte, Carolina del Sur y del este de Georgia, Sporobolus pinetorum Weakley & P.M. Peterson. Un lectotipo es escogido para S. floridanus. Las relaciones taxonómicas y ecológicas de estas cinco especies, así como de las especies afines S. junceus y S. heterolepis, son comparadas y discutidas. Sporobolus curtissii, S. floridanus, S. pinetorum, S. silveanus, y S. tereifolius son todas relativamente endémicas restringidas a varias partes del sureste de la llanura costera. Cada una de las cinco especies, es el pasto localmente dominante o codominante en terrenos de pinos mantenidos por quemas con dosel abierto de Pinus palustris, P. serotina, y/o P. elliottii var. elliottii. La distribución geográfica y muchos de los requerimientos ecológicos de S. curtissii, S. floridanus, S. pinetorum, y S. tereifolius se solapan, pero pueden ser separados en base a un gradient hidrológico.

Sporobolus R. Br. is a worldwide genus of approximately 160 species occurring in the tropics, subtropics, and warm temperate regions (Clayton &
Renvoise 1986). In the New World the genus is represented by approximately 45 species that generally occur on disturbed habitats, i.e., roadside to open prairies and savannas (Peterson et al. 1995, 1997; Peterson et al., in press). *Sporobolus* is characterized by having spikelets with one floret, 1-veined lemmas, fruits with free pericarps, and ligules with a line of hairs. These characteristics also are found in two other genera, *Calamovilfa* (A. Gray) Hack. and *Crypsis* W.T. Aiton. These three genera seem to share a common ancestor and are the only New World members included in the subtribe Sporobolinae (Chloridoideae: Eragrostideae).

The species of *Sporobolus* occurring in the southeastern United States form a heterogeneous assemblage that may be informally divided into groups based on characteristics of the inflorescence, spikelet, plant longevity, and general aspect. One of these groups, characterized as long-lived, perennial, clump-forming species, with open panicle inflorescences and relatively large spikelets, consists of *S. floridanus* Chapman, *S. curtissii* (Vasey ex Beal) Small ex Scribner, *S. teretifolius* Harper, *S. silveanus* Swallen, *S. pinetorum* Weakley & P.M. Peterson (a new species described here), and, more peripherally, *S. juncus* (P. Beauvois) Kunth and *S. heterolepis* (A. Gray) A. Gray. In the course of conducting conservation, taxonomic, ecological, and herbarium studies in the southeastern United States, it has become apparent that this group is poorly understood and has been much confused by earlier authors, current collectors, and field workers. As a consequence, an overlooked species has remained unnamed. We will try to clarify this situation with a detailed discussion of the five members of what we call the *S. floridanus* complex (*S. floridanus*, *S. curtissii*, *S. teretifolius*, *S. silveanus*, and *S. pinetorum*), with less detailed discussion of *S. juncus* and *S. heterolepis*.

**TAXONOMIC HISTORY**

Because of the general similarities of the taxa in the *Sporobolus floridanus* complex, there has been widespread confusion about their circumscription and distribution, and much erroneous information can be found in earlier systematic treatments and in the ecological literature, and numerous herbarium specimens are misidentified. A review of previous treatments of the complex and its closest relatives will help define problems resolved in this paper.

The two morphologically peripheral taxa were the first to be named. The species currently known as *S. juncus* was described by Beauvois in 1812 in *Heleochloa*, and transferred to *Sporobolus* by Kunth in 1829. *Sporobolus heterolepis* was first described as *Vilfa heterolepis* by A. Gray in 1835, and transferred by Gray to *Sporobolus* in 1848.
The first of the core members of the *S. floridanus* complex was named by Chapman (1860) as *S. floridanus*. It is fairly well characterized in his description:

"*S. floridanus*, n. sp. Panicle diffuse, large; spikelets (purplish) on long hair-like stalks; glumes acute, the lower one barely shorter than the obtuse paleae, the upper a third longer; leaves rather rigid, flat, pungent, very rough on the edges—Low pine barrens, Middle and West Florida. September.—Culm 2–4 feet high. Leaves 1–2 feet long. Panicle 1–1.5 feet long" (Chapman 1860, 1883, 1897).

The description, the location in Florida, and specimens collected by Chapman at the time make the identity of *S. floridanus* clear. The only species occurring in Florida likely to be confused with *S. floridanus* would be *S. curtissii*, but it is contradicted by various parts of Chapman’s description, especially the “panicle ... large,” the markedly unequal glumes, the rough-edged leaves, and the length of the blades and the panicle. No type specimen was cited, however, and we lectotypify *S. floridanus* below.

The next to be named was *S. curtissii*, as *S. floridanus* var. *curtissii* (Beal 1896). A year later, Lamson-Scribner elevated the taxon to specific rank (Lamson-Scribner 1897). The distribution of *S. floridanus* was given as “moist pine barrens near the coast, North Carolina to western Florida,” apparently on the basis of G. McCarthy's specimen at US (cited below) from Wilmington, North Carolina, which is actually *S. pinetorum*. We know of no specimens of *S. floridanus* from locations north of southern South Carolina.

Harper (1901) made a characteristically idiosyncratic addition to information on the group with his collection of *S. floridanus* in Sumter Co., Georgia, about which he commented “not definitely known outside of Florida before.” He elaborated on the roughness of the leaves mentioned by Chapman and stated “I made some tests of their strength. A leaf from the first collection (no. 547) 5.5 mm. wide, not twisted, and perfectly dry, sustained a weight of 27 pounds without breaking.”

In 1906, Harper described *S. teretifolius* from collections in Georgia, commenting that it is “a frequent and characteristic inhabitant of moist pine-barrens in the Altamaha Grit region,” and that “it is unmistakable when seen in the field” (Harper 1906). He provides excellent and clear character differences between *S. teretifolius*, *S. curtissii*, and *S. floridanus*, as well as an excellent illustration of the highly distinctive leaf cross-section.

The first two editions of J.K. Small's flora (1903, 1913) treated *S. curtissii* and *S. floridanus*, and gave generally accurate information about morphology, habitat, and distribution. *Sporobolus floridanus* was stated as occurring in “Georgia and northern Florida,” and *S. curtissii* was found in “Georgia, Florida, and Alabama.” Small then added *S. teretifolius* (Small 1933). The habitat of all three species was given as “moist pinelands, Coastal Plain,”
with distributions of “Fla. and Ga” for _S. floridanus_, “Fla. to N.C.” for _S. curtissii_, and “Ga.” for _S. teretifolius_. The extension of the distribution of _S. curtissii_ to North Carolina was apparently based on North Carolina specimens of _S. pinetorum_ misidentified as _S. curtissii_. In his key, Small (1933) distinguished the three species as follows:

Leaf-blades narrowly involute ........................................... _S. teretifolius_
Leaf blades flat.

Pedicels appressed to the branches: leaf-blades about 1 mm wide .......... _S. curtissii_
Pedicels spreading: leaf-blades 2-4 mm wide ................................ _S. floridanus_

Although this key generally serves to distinguish the three species, it has been, in part, responsible for continued taxonomic confusion about the three species and a fourth, _S. pinetorum_. The blades of _S. teretifolius_ are anatomically oval, not involute; the blades of _S. curtissii_, _S. floridanus_, and _S. pinetorum_ are flat, becoming involute when dry, either during drought conditions in the field, or as a result of drying for herbarium specimens. The narrow blades of _S. curtissii_ and _S. pinetorum_ usually fold when dried in a plant press. Specimens of _S. curtissii_ and _S. pinetorum_ often have involute blades that superficially resemble those of _S. teretifolius_. A second problem with the key involves the width of the blade; both _S. curtissii_ and _S. pinetorum_ have blades regularly reaching and sometimes exceeding 2 mm in width (when flat), and _S. floridanus_ characteristically has a leaf blade 3-10 mm wide (though the very narrowest blade on a plant may be as narrow as 2 mm wide). Therefore, specimens of _S. curtissii_ and the heretofore unnamed _S. pinetorum_ have often been incorrectly identified as _S. teretifolius_ (by taking the first lead) or _S. floridanus_ (by correctly taking the second lead in the first couplet, but then incorrectly choosing the second lead in the second couplet by placing too much emphasis on a blade width of ca. 2 mm).

Hitchcock (1935) treated _S. floridanus_ (“low pine barrens, Georgia and Florida”), _S. curtissii_ (“dry pine barrens, North Carolina, Georgia, and Florida”), and _S. teretifolius_ (“moist pine barrens, Georgia”). Once again, the inclusion of North Carolina in the distribution of _S. curtissii_ was apparently based on miss identification of specimens of _S. pinetorum_.

Blomquist’s (1948) book on the grasses of North Carolina treated all material of this complex in North Carolina as _S. curtissii_, but states “According to Swallen (1941) the North Carolina plants assigned to this species may belong to _S. floridanus_ Chapm.” As will be seen below, neither species has been documented for North Carolina; instead, North Carolina is within the distribution of _S. pinetorum_ (undescribed at the time and in some ways generally intermediate in characteristics) and _S. teretifolius_ (not collected in North Carolina until 1991).

Swallen (1941) added _S. silveanus_ to the group, based on material from eastern Texas. Its distribution in Texas and the western Gulf Coastal Plain
of Louisiana makes it allopatric relative to other members of the *S. floridanus* complex. Swallen contrasted it with *S. floridanus* and *S. teretifolius*, yet various characters (such as the appressed and larger spikelets) suggest a closer relationship to *S. curtissii*. It also seems to show a clearer connection to *S. heterolepis* than do other members of the *S. floridanus* complex, a relationship which seems especially plausible given its proximity to *S. heterolepis* and its habitat preferences for barrens with prairie affinities.

Hitchcock and Chase (1950) provided the only treatment to date with as many as four of the species in the complex: *S. floridanus* ("low pine barrens, North Carolina to Florida"), *S. curtissii* ("dry pine barrens, North Carolina to Florida"), *S. teretifolius* ("moist pine barrens, North Carolina and Georgia"), and *S. silveanus* ("open woods, western Louisiana and eastern Texas"). The attribution of *S. floridanus*, *S. curtissii*, and *S. teretifolius* to North Carolina are all based on misidentifications of *S. pinetorum*. This is because of the generally intermediate morphology of *S. pinetorum*, and because the key was not constructed very carefully for even the then-known members of the group. Among the problems are that *S. silveanus* (which has markedly appressed spikelets) can only be reached by following the lead for "spikelets not appressed, the branches and pedicels somewhat spreading"; *S. floridanus* is separated from *S. silveanus* by having glumes "about equal" rather than "unequal," when they actually have similarly subequal first glume to second glume ratios; *S. teretifolius* is separated from *S. floridanus* by the accurate but often mis-interpreted "blades terete vs. blades flat or folded" character; and *S. curtissii* is separated from the others by a subjective and difficult to interpret couplet about pedicel length and orientation.

Radford et al. (1964), by contrast, recognized only one species (*S. teretifolius*) in the complex as occurring in North Carolina and South Carolina. Unfortunately, all material seen by them was actually the undescribed *S. pinetorum*. Radford et al. (1968) added *S. floridanus* (alleged to occur in pinelands in Lancaster County, South Carolina) and attributed *S. teretifolius* to "savannahs" in thirteen counties in southern North Carolina and northern South Carolina. Their key distinguished *S. teretifolius* from *S. floridanus* by "blades terete or subterete" vs. "blades flat or folded." All material seen by them was actually *S. pinetorum*, often with narrow folded blades so as to superficially mimic *S. teretifolius*. Additionally, many of the county records are based on misidentified specimens of *Calamovilfa brevipilis* (Torrey) Scribn, and likewise specimens supposedly documenting county record distributions for *Calamovilfa brevipilis* are in many cases actually *Sporobolus pinetorum*. In truth, both *Sporobolus pinetorum* and *Calamovilfa brevipilis* occur (or formerly occurred) in most or all counties in southeastern North Carolina and in the adjacent counties of South Carolina.

Godfrey and Wooten's (1979) manual of southeastern United States wetland plants treated only *S. floridanus* and *S. curtissii*, inexplicably omitting *S. teretifolius*
(which occupies wetter habitats than \textit{S. curtissii}) and \textit{S. silveanus} (which occurs in wetland situations in Louisiana, part of the geographic range of their flora). Because of this, their treatment is of limited value in understanding this group.

Brown (1993) addressed confusion between \textit{S. silveanus}, the most western species in the complex, and \textit{S. heterolepis}, resulting in the deletion of \textit{S. heterolepis} from the floras of Texas and Louisiana, and the addition of \textit{S. silveanus} to the flora of Oklahoma.

\textbf{SYSTEMATIC TREATMENT}

\textbf{KEY TO THE SPECIES}

1. Panicle branches distinctly whorled at lower nodes \hspace{1cm} \textit{S. junceus}
1. Panicle branches single at lower nodes (though a few branches may be irregularly approximate in pairs or threes) \hspace{1cm} \textit{S. heterolepis}

2. First glume scaberulous, subulate above an expanded base; spikelets gray to nearly black; base of plant relatively fibrous; grain spherical; plants of rocky barrens and prairies of physiographic provinces inland from the Coastal Plain

2. First glume glabrous, linear-lanceolate to lanceolate, the base not abruptly expanded; spikelets purplish (fading tan); base of plant smooth and hard, made up of the indurated leaf bases; grain oblong (when present, usually abortive); plants primarily of pine savannas and seeps of the Coastal Plain of North Carolina, South Carolina, Georgia, Florida, Alabama, Louisiana, and Texas, but extending further inland in southern Oklahoma and eastern Texas

3. Blades terete or subterete (wiry), 0.5–1.2 mm wide, oval in cross-section (deeper than wide), sometimes irregularly channeled for portions of their lengths (but lacking any flat portion), margins smooth, distal portions often curling and twisted; pedicels with scattered ascending hairs

3. Blades flat, 0.8–10 mm wide, flat or V-shaped in cross-section (much wider than deep), with free margins their entire length, margins scaberulous (glabrous to scaberulous in \textit{S. curtissii}), distal portions normally stiff and straight (note that the blades of the narrower-leaved species can appear superficially wiry); pedicels without scattered ascending hairs, either glabrous to scaberulous or scabrous

4. Lower glume usually as long or longer than the upper glume with lower/upper ratio averaging 0.90–1.15; culms 30–80(-90) cm tall; panicle 10–25 cm long; pedicels 0.5–4(-8) mm long, appressed, usually shorter than the spikelet; leaves less than 30 cm long, smooth on the margins

4. Lower glume usually shorter than the upper glume with a lower/upper ratio averaging 0.60–0.90; culms 30–150 cm tall; panicle 15–50 cm long; pedicels 2–22 mm long, spreading or appressed; leaves mostly more than 30 cm long, scaberulous on the margins

5. Pedicels appressed; lemmas 4.4–6.5 mm long; purple; anthers 3.5–5 mm long; blades 1–2.5 mm wide and bluish-green; plants known west of the Mississippi River

5. Pedicels appressed; lemmas 4.4–6.5 mm long; purple; anthers 3.5–5 mm long; blades 1–2.5 mm wide and bluish-green; plants known west of the Mississippi River

4. \textit{S. silveanus}
5. Pedicels spreading; lemmas 3–4.3 mm long, purplish-brown; anthers 2–3.4 mm long; blades either wider than 2.5 mm, or dark green; plants from east of the Mississippi River .............................................. 6

6. Blades (2–)3–10 mm wide, bluish-green; panicles (18–)30–50 cm long, 4–15 cm wide; lower/upper glume length ratio averaging 0.75–0.90; plants from southern South Carolina, Georgia, eastern Alabama, and northwestern Florida .......... 2. S. floridanus

6. Blades 1.2–2(–3) mm wide, dark green; panicles 15–30 cm long, 2–6 cm wide; lower/upper glume length ratio averaging 0.60–0.80; plants from eastern North Carolina, northern South Carolina, and eastern Georgia ................................................................. 3. S. pinetorum


Caespitose perennials. Culms 30–80(–90) cm tall, erect, nodes all basal; base diameter 1–2 mm, flattened; internodes glabrous. Sheaths glabrous to appressed hairy, hairs up to 4 mm long; base shiny and endurated; margins hyaline; summit with a tuft of hairs, hairs up to 4 mm long. Ligules 0.2–0.6 mm long, a line of hairs. Blades 5–22(–28) cm long, 0.8–2(–2.2) mm wide, flat to folded or involute, green, remaining green well into winter, mostly glabrous above and below; base densely pilose on upper surface, white to grayish hairs up to 4 mm long; margins glabrous to scaberulous. Panicles 10–25 cm long, 2–10(–13) cm wide, mostly open, contracted when immature, pyramidal to ovate; main axis glabrous to scaberulous; pulvini in axils of primary branches glabrous or occasionally hairy; primary branches 2–9(–10) cm long, ascending to spreading 10–80° from culm axis, not floriferous on lower 1/3; secondary branches mostly appressed; pedicels 0.5–4(–8) mm long, usually shorter than spikelet, appressed, glabrous. Spikelets 3.5–6(–6.6) mm long, purplish-brown. Glumes (2.9–)3.5–6(–6.6) mm long, linear-lanceolate, membranous, 1–veined, equal to subequal; ratio of lower/upper glume length 0.90–1.15(–1.33); lower (2.9–)3.5–6.2 mm long, apex acuminate; upper 3.2–6.6 mm long, apex acuminate. Lemmas 3.4–4.5 mm long, ovate to lanceolate, membranous, 1–veined, glabrous; apex acute. Paleas 3.4–4.5 mm long, ovate, membranous, glabrous; apex acute. Stamens 3, anthers 1.5–2.8 mm long, yellow to purplish. Grains 1.1–1.4 mm long, fusiform, reddish-brown.

Common name.—Curtiss’ dropseed.

Distribution and habitat.—Eastern South Carolina south to central peninsular Florida, west to Florida Panhandle. Mesic to dry-mesic pine woodlands, in soils seasonally saturated at the surface or rather well-drained throughout the year, usually under Pinus palustris, and sometimes also with Quercus spp.; 0–100 m. Sporobolus curtissii characteristically occurs in the following Na-
Fig. 2. Geographic distribution of *Sporobolus curtissii* (A), *Sporobolus pinetorum* (B), and *Sporobolus teretifolius* (C).

...tional Vegetation Classification plant associations: *Pinus palustris/Serenoa repens—Vaccinium myrsinites/Aristida beyrichiana—Sporobolus curtissii* Woodland; *Pinus palustris/Quercus incana—Quercus stellata/Aristida beyrichiana—Sporobolus junceus—Nolina georgiana* Woodland; *Pinus palustris—(Pinus elliottii var. elliottii)/Sporobolus pinetorum—Aster reticulatus—(Sporobolus curtissii)* Woodland (Weakley et al. 1998). Flowering July to November (or less typically at other seasons if stimulated by fire).

Comments.—When fertile, *S. curtissii* is readily distinguished by the short-pedicled, appressed spikelets, and by the large lower glume. Vegetatively, *S. curtissii* is distinctive in its short leaf blades and tendency to have glabrous leaf margins. Post-fire foliage tends to be narrow, stiff, and erect, while unburned plants produce leaves that are shorter, wider, and laxer. It occupies drier habitats than *S. floridanus*, *S. teretifolius*, and *S. pinetorum*, though it can be found in mixed populations with all three species.


Robust caespitose perennials. Culms (40–)100–200(–250) cm tall, erect, nodes all basal; base diameter 1.5–6 mm, flattened; internodes glabrous. Sheaths glabrous to appressed hairy, hairs up to 5 mm long; base shiny and endured; margins hyaline; summit with a tuft of hairs, hairs up to 6 mm long. Ligules 0.2–0.7 mm long, a line of hairs. Blades (10–)25–50 cm long, (2–)3–10 mm wide, flat to folded, pale bluish-green and yellowing in age, mostly glabrous above and below; base often sparsely hairy, hairs up to 6 mm long; margins scaberulous. Panicles (18–)30–50 cm long, 4–15 cm wide, mostly open, contracted when immature, pyramidal to ovate; main axis scabrous; pulvini in axils of primary branches hairy or glabrous; primary branches 4–15 cm long, ascending to spreading 10–90° from culm axis, not floriferous on lower 1/3; secondary branches ascending to spreading; pedicels 2–14 mm long; usually longer than spikelet, spreading, scaberulous. Spikelets (3.7) 4–6 mm long, purplish-brown. Glumes (2.5–)2.8–5.7 mm long, linear-lanceolate, membranous, 1–veined, subequal; ratio of lower/upper glume length (0.60–)0.75–0.90(–0.94); lower 2.5–5.1 mm long, apex acuminate;
upper 3.7–5.7 mm long, apex acuminate to acute. Lemmas 3–4 mm long, ovate to lanceolate, membranous, 1-veined, glabrous; apex acute. Paleas 3–4 mm long, ovate, membranous, glabrous; apex obtuse to truncate, rarely minutely bifid. Stamens 3, anthers 2–3.1 mm long, purplish. Grains 1.7–2 mm long, fusiform, reddish-brown.

Common name.—Florida dropseed.

Distribution and habitat.—Southeastern South Carolina south to northern peninsular Florida, west to Florida Panhandle. Wet to wet-mesic pine woodlands, in soils semi-permanently to seasonally saturated at the surface, and even in places where water may pond for weeks, usually under Pinus elliottii var. elliottii, Pinus palustris, or Taxodium ascendens Brongn., and also in seepage bogs, treeless swales, and depressional wetlands in pineland landscapes; 0–100 m. Sporobolus floridanus characteristically occurs in the following National Vegetation Classification plant associations: Pinus palustris–Pinus elliottii var. elliottii/Ctenium aromaticum–Aristida beyrichiana–Sporobolus floridanus Woodland; Pinus palustris–Pinus elliottii var. elliottii/Styrax americanus var. pulverulentus/Sporobolus floridanus Woodland (Weakley et al. 1998). Flowering July to November (or less typically at other seasons if stimulated by fire).

Comments.—This is a common and conspicuous grass within its range,
and is often a dominant to codominant component of wet pinelands. The wide leaves with distinctly bluish cast are distinctive in this species.


3. *Sporobolus pinetorum* Weakley & P.M. Peterson, sp. nov. (Figs. 1, a–e; 2). Type: U.S.A. NORTH CAROLINA. Cumberland Co.: Fort Bragg Army Base, Matricel Danger Zone, ecotonal seepages and moist swales in upland *Pinus palustris* savannas Weakley s.n., 31 Aug 1993 (HOLOTYPE: US!; ISOTYPE: NCU!).

A. *S. floridani* laminis foliorum 1.2–2(–3) mm latis atrovirentibus, inflorescentis 15–30 cm latis, culmis 45–120 cm altis, ratione longitudinalibus glumarum inferiorium/superiorium 0.60–0.80, recidit.

Caespitose perennials. Culms (30–)45–120(–180) cm tall, erect, nodes all basal; base diameter 1–3 mm, flattened; internodes glabrous. Sheaths glabrous to appressed hairy, hairs up to 4 mm long; base shiny and endurated; margins hyaline; summit with a tuft of hairs, hairs up to 4 mm long. Ligules 0.2–0.6 mm long, a line of hairs. Blades 20–50 cm long, 1.2–2(–3) mm wide, flat to folded or involute, dark green, remaining green well into winter, mostly glabrous above and below; base often sparsely hairy, hairs up to 4 mm long; margins scaberulous. Panicles 15–30 cm long, 2–6 cm wide, mostly open, contracted when immature, pyramidal to ovate; main axis
scaberulous; pulvini in axils of primary branches hairy or glabrous; primary branches 2–8 cm long, ascending to spreading 0–50° from culm axis, not floriferous on lower 1/3; secondary branches ascending to spreading; pedicels 2–22 mm long, usually longer than the spikelet, spreading, scaberulous. Spikelets 3.5–6.5 mm long, purplish-brown. Glumes 2.4–6.5 mm long, linear-lanceolate, membranous, 1–veined, subequal to unequal; ratio of lower/upper glume length (0.58–0.60–0.80(–0.83); lower 2.4–4.5 mm long, apex acuminate; upper (3.5–)4–6(–6.5) mm long, apex acuminate to acute. Lemmas 3.4–4.3 mm long, ovate to lanceolate, membranous, 1–veined, glabrous; apex acute. Paleas 3.4–4.4 mm long, ovate, membranous, glabrous; apex obtuse to truncate, often bifid with teeth up to 0.4 mm long. Stamens 3, anthers 2.5–3.4 mm long, purplish. Grains 1.8–2.2 mm long, fusiform, brown.

Common name.—Carolina dropseed.

Distribution and habitat.—Eastern North Carolina south to northern South Carolina; and disjunct in eastern Georgia. Wet to moist pine woodlands, in soils seasonally to semi-permanently saturated, usually under Pinus palustris and Pinus serotina, also sometimes associated with Taxodium ascendens and (in Georgia) Pinus elliottii var. elliottii. Sporobolus pinetorum characteristically occurs in the following National Vegetation Classification plant associations: Pinus palustris–(Pinus elliottii var. elliottii)/Sporobolus pinetorum–Aster reticulatus–Sporobolus curtissii Woodland; Pinus palustris–Pinus elliottii var. elliottii/ Styrax americanus var. pulverulentus/Sporobolus floridanus Woodland; Pinus palustris–Pinus serotina/Sporobolus pinetorum–Aristida stricta–Eryngium integrifolium Woodland; Pinus palustris–Pinus serotina/Sporobolus pinetorum–Ctenium aromaticum–Eriocaulon decangulare var. decangulare Woodland; Pinus elliottii var. elliottii–Taxodium ascendens/Hypericum brachyphyllum /Sporobolus pinetorum–Dichanthelium scabriusculum Woodland (Weakley et al. 1998). July to November (or less typically at other seasons if stimulated by fire).

Comments.—This species has been overlooked until now because its overall morphology places it centrally in the complex, allowing it to be variously confounded with S. floridanus, S. curtissii, and S. teretifolius. Despite its “intermediate gestalt,” it has a unique combination of characters that warrant taxonomic recognition. Moreover, it occurs in mixed populations with S. floridanus (in eastern Georgia), S. curtissii (in eastern Georgia), and S. teretifolius (in southeastern North Carolina), and in these situations the taxa are easily distinguishable and show no signs of intermediacy or hybridization. Sporobolus pinetorum is locally abundant in seasonally saturated pinelands within its range; because it does not typically flower except following fire, casual field observers have often overlooked its presence and misidentified it as Aristida stricta.

sandhill, 1.3 mi SW of Patrick near US 1, 29 Sep 1956, Radford 18761 (NCU); Sandhills National Wildlife Refuge, 16 Apr 1992, Sorrie et al. 6246 (USCH); Sandhills National Wildlife Refuge, 1995, Pittman s.n. (US); Hudsonia Flat, 6 Oct 1993, Sorrie 7746 (NCU).

4. *Sporobolus silveanus* Swallen, J. Wash. Acad. Sci. 31:350. 1941. (Figs. 1, g; 3). Type: U.S.A. TEXAS. Orange Co.: 10 mi NE of Orange on U.S. 90, 30 Sep 1940, Silveus 6441 (holotype: US-1817963; isotypes: US-1867557!, US-2209343). Densely caespitose perennials. Culms 70–120 cm tall, erect, nodes sometimes visible, mostly basal; base diameter 1.5–4.5 mm, rounded or flattened; internodes glabrous. Sheaths mostly glabrous to appressed hairy, hairs up to 4 mm long; base shiny and endureted; margins hyaline; summit with a tuft of hairs, hairs up to 4 mm long. Ligules 0.2–0.8 mm long, a line of hairs. Blades 15–52 cm long, 1–2.5 mm wide, flat to folded or involute, bluish-green, glabrous above and below; margins scaberulous. Panicles 21–50 cm long, 5–12(–15) cm wide, open and few flowered; pyramidal to ovate; main axis scabrous; pulvini in the axils of primary branches glabrous; primary branches 6–20 cm long, ascending and loosely spreading 20–50° from culm axis, not floriferous on lower 1/4–1/2; secondary branches appressed to loosely spreading; pedicels 3–8(–14) mm long, longer or shorter than spikelet, mostly appressed, scabrous. Spikelets 4.5–7(–7.2) mm long, purplish. Glumes 3–7 mm long, linear-lanceolate to lanceolate, membranous, 1-veined, subequal to unequal, ratio of lower/upper glume length 0.6–0.9; lower 3–4.6 mm long, apex acuminate; upper 4–7.2 mm long, often appearing 3-veined with lateral folds that resemble veins; apex acuminate. Lemmas 4.4–6.5 mm long, lanceolate, membranous, 1-veined, glabrous; margins often hyaline; apex acuminate to acute. Paleas 4.5–6.7 mm long, lanceolate, membranous, glabrous; apex obtuse to truncate, minutely erose. Stamens 3, anthers 3.5–5 mm long, purplish. Grains 1.8–2.5 mm long, obovoid, laterally compressed, light brownish.

Common name.—Silveus dropseed.

Distribution and habitat.—Western Louisiana west to eastern Texas and north to southeastern Oklahoma. Wet to mesic pine woodlands under *Pinus palustris*, also in adjoining glade and barren openings, and in blackland prairies, 5–200 m. *Sporobolus silveanus* characteristically occurs in the following National Vegetation Classification plant associations: *Pinus palustris*/*Sporobolus silveanus*/*Muhlenbergia capillaris*—*Liatris pycnostachya* var. *lasiophylla* Woodland; *Sporobolus silveanus*/Carex weadig Herbaceous Vegetation; *Sporobolus silveanus*/*Tridens strictus* Herbaceous Vegetation (Weakley et al. 1998). Flowering July to November (or less typically at other seasons if stimulated by fire).

Comments.—There has been some confusion between this species and *S. heterolepis*. Allen (1992) and Thomas and Allen (1993) reported *S. silveanus* from Calcasieu Parish, Louisiana, and *S. heterolepis* from Allen Parish and/or Calcasieu Parish, but all specimens are actually *S. silveanus*. Similarly, both
S. silveanus and S. heterodepis have been historically reported from eastern Texas (Correll and Johnston 1970; Gould 1975; Johnston 1990; Hatch et al. 1990). Brown (1993) determined all material from Texas and Louisiana to be S. silveanus, and reported S. silveanus as a state record for Oklahoma, a conclusion followed by Taylor and Taylor (1994) and Jones et al. (1997). Sporobolus silveanus has a bluish color in the field, and closely resembles Muhlenbergia expansa (Poir.) Trin., with which it often grows.


Caespitose perennials. Culms (20–)35–80(–100) cm tall, erect, wiry, nodes all basal; base diameter 1–2 mm, flattened; internodes glabrous. Sheaths glabrous to appressed hairy, hairs up to 4 mm long; base shiny and endurated; margins hyaline; summit with a tuft of contorted hairs, hairs up to 4 mm long. Ligules 0.2–0.4 mm long, a line of hairs. Blades (10–)25–54 cm long, 0.5–1.2 mm wide, tightly involute or terete, green to yellowish-green, senescing or turning tan in late autumn, glabrous above and below; base often sparsely hairy, hairs up to 3 mm long. Panicles 10–26 cm long, 1–9 cm wide, mostly open to somewhat contracted when immature, narrowly pyramidal to ovate; main axis scabrous; pulvinii in axils of primary branches often hairy; primary branches 1–8 cm long, ascending to spreading 0–40° from culm axis, not floriferous on lower 1/3; pedicels 3–18 mm long, longer than spikelet, usually spreading, with scattered ascending hairs. Spikelets 4–5.6 mm long, purplish-brown. Glumes 2–5.6 mm long, linear-lanceolate, membranous, 1-veined, unequal, ratio of lower/upper glume length (0.55–)0.55–0.70–
0.77); lower 2–3.8 mm long, apex acuminate; upper 4–5.6 mm long, apex acuminate. Lemmas 3.4–4.4 mm long, ovate, membranous, 1-veined, glabrous; apex acute. Paleas 3.3–4.4 mm long, ovate, membranous, glabrous; apex acute. Stamens 3, anthers 1.5–2.6 mm long, purplish. Grains not seen.

Common name.—Wireleaf dropseed.

Distribution and habitat.—Southeastern North Carolina south to southern Georgia, west to extreme southeastern Alabama. Wet to moist pine woodlands, under Pinus serotina, Pinus elliottii var. elliottii, and Pinus palustris, in soils; 10–150 m. *Sporobolus teretifolius* characteristically occurs in the following National Vegetation Classification plant associations: *Pinus palustris—Pinus serotina/Magnolia virginiana/Sporobolus teretifolius—Carex striata* Woodland (Weakley et al. 1998) and others not yet described. Flowering July to November (or less typically at other seasons if stimulated by fire).

Comments.—The terete leaves (well figured by Harper 1906) are distinctive. Dry blades (either on dried specimens or in nature under dry field conditions) of the other eastern species with narrow blades (*S. curtissii, S. pinetorum*) can superficially resemble those of *S. teretifolius*, and have caused confusion. *Sporobolus curtissii*, however, has much shorter blades and generally occurs in drier habitats, and the blades of *S. pinetorum* have distinctly rough margins (best felt by running one's finger along the blade towards its base, or seen at 10× or greater magnification).

ditch at ecotone to pocosiny swamp, 16 Jul 1991, Waakley & Schafale s.n. (US). **Columbus Co.** Old Dock Savanna, south of SR 1928, ca. 0.9 mile W of Old Dock, then south on logging road ca. 0.3 mi, 15 Jul 1991, Waakley & Schafale s.n. (US). **SOUTH CAROLINA.**

**Georgetown Co.** pine savanna in Bates Hill Plantation, ca. 4.0 km SE of the US 701/SC 261 intersection, 5 Sep 1989, Taggart s.n. (USCH). **Horry Co.** along powerline, situated between Mose Swamp and Grass Bay, take SC 109 ca. 2 mi NW of Baker Crossroads, then W and intersect with Santee Cooper Power right-of-way, 22 Sep 1992, Pittman & Jordan s.n. (USCH). **Kershaw Co.** mesic slope, SC 28-102, 2.8 mi N of SC 12, 29 Sep 1958, Duke 2979 (NCU).

**RELATIONSHIPS WITHIN SPOROBOLUS**

Stapf (1898), Bor (1960), Clayton et al. (1974), and Baaijens and Veldkamp (1991) have suggested infrageneric classifications in *Sporobolus* based primarily or strictly on Old World species, and a more worldwide classification is still lacking. Based on possession of an open or contracted panicle, caespitose perennial lifeform, non-whorled branch insertion, intravaginal new shoot initiation, and first glume shorter or as long as the second Pilger (1956) erected group four in subgenus *Sporobolus*. He further divided group four into two smaller groups α & β. *Sporobolus heterolepis*, *S. floridanus*, *S. teretifolius*, and *S. lasiophyllus* Pilg. are members of Pilger's “β” group. We agree with Pilger's assessment that *S. heterolepis*, *S. floridanus*, and *S. teretifolius* appear to be closely related. However, *S. lasiophyllus* has a few unique characteristics, such as its strictly basal leaves with sheath bases that are densely lanate and thickened, and its plumbeous to dark-brownish spikelets.

Small (1933) divided *Sporobolus* of the southeastern United States into seven groups, which are not considered validly published because their rank was not indicated. He placed *S. junceus* as “*S. gracilis* (Trin.) Merr.”, *S. floridanus*, *S. curtissii*, and *S. teretifolius* in “Graciles,” distinguished by perennial, bunchgrass habit, large (more than 3 mm long), purplish to brown spikelets, and glumes unequal, the second as long as the floret. *Sporobolus heterolepis* was not known by Small to occur in his “flora area,” so it is unknown whether he would have placed this with “Graciles” or not.

We informally recognize the *S. floridanus* complex, consisting of five species (*S. curtissii*, *S. floridanus*, *S. pinetorum*, *S. silveanus*, and *S. teretifolius*) with very similar morphological features and generally similar ecological requirements (primarily restricted to pine savannas on the Coastal Plain). All five species exhibit the following characteristics: caespitose perennials; basal sheaths shiny and endurated (apparently as “fire-proofing”); panicles open at maturity, with ascending panicle branches, pyramidal to ovate, primary branches not floriferous on lower 1/3; spikelets purplish-brown to purplish; lower glume linear-lanceolate to lanceolate, apex acuminate; grain fusiform to obovoid. Additionally, all five species occupy fire-maintained pinelands of the southeastern Coastal Plain, and produce culms only following removal of foliage by fire
(or rarely, by mechanical disturbance) [Weakley 1998].

The $S.\ floridanus$ complex appears to have its closest affinities with two pairs of species: 1. $S.\ heterolepis$ and $S.\ interruptus$ Vasey, and 2. $S.\ junceus$ and $S.\ purpurascens$ (Swartz) Hamilton. $Sporobolus\ heterolepis$ and $S.\ interruptus$ appear to be sibling species, $S.\ heterolepis$ being widely distributed in central North America, and extending as an uncommon disjunct into eastern North America, and $S.\ interruptus$ being endemic in northern Arizona. They share several characters which distinguish them from the $S.\ floridanus$ complex: spikelets plumose (vs. purplish fading to tan), grains globose (vs. elongate and laterally flattened), scaberulous lower glumes (vs. glabrous), and fibrous sheath bases (vs. shiny and indurated). $Sporobolus\ heterolepis$ appears to be particularly closely related to $S.\ silveanus$, the most western of the $S.\ floridanus$ complex, and the one most likely to have been geographically and ecologically in contact with $S.\ heterolepis$ in recent times. Ecologically, $S.\ heterolepis$ is a species of glades, prairies, and barrens, usually overmorfic, ultramafic or calcareous rock outcrops in the interior, “hard rock” physiographic provinces of central North America (extending as a rare disjunct east to and occasionally beyond the Blue Ridge Mountains), as well as on loess and glacial tills.

$Sporobolus\ junceus$ and $S.\ purpurascens$ also appear to be siblings, $S.\ junceus$ being a species primarily of the southeastern United States Coastal Plain (from southeastern Virginia west to eastern Texas), but extending inland to adjacent provinces, while $S.\ purpurascens$ is distributed in southern Texas, Mexico, the West Indies, and into tropical America. They share several characters which distinguish them from the $S.\ floridanus$ complex: panicle branches distinctly whorled in well-marked verticils (vs. panicle branches alternate or sometimes irregularly paired or approximate) and spikelets smaller (3.0–3.8 mm long vs. 3.5–7.2 mm long).

**DISTRIBUTION AND ECOLOGY**

$Sporobolus\ curtissii$, $S.\ floridanus$, $S.\ pinetorum$, $S.\ silveanus$, and $S.\ tereifolius$ are all relatively narrow endemics of various portions of the southeastern Coastal Plain (Figs. 2, 3). Each of these five species is the locally dominant or codominant grass in fire-maintained pinelands with open canopies of $Pinus\ palustris$, $P.\ serotina$, and/or $P.\ elliottii$ var. $elliottii$ (Weakley et al. 1998). The geographic distributions and many ecological requirements of the four more eastern species overlap, but they can be separated based on a hydrologic gradient. Understanding the differing but overlapping distributions and ecological niches of the species within the group provides an important basis for the systematic treatment.

The five species of the complex share a set of apparent adaptations to the
fire-maintained habitats in which they occur. All have the basal sheaths thickened and cartilaginous, rightly investing the growing tips of the rhizomes, and protecting it from damage or destruction by fire. This is a conspicuous feature of herbarium specimens (if not removed by overzealous preparation), appearing as a stramineous, shining, thickened (almost bulbous) base of the plant. The bases of Calamovilfa brevipilis and Calamovilfa curtissii (Vasey) Scribn. are very similar. Species of the S. floridanus complex re-sprout quickly following fire, with green leaf material protruding beyond the blackened basal sheaths within days following fire. Like other southeastern bunchgrasses adapted to fire-maintained pinelands, including Calamovilfa brevipilis, C. curtissii, Aristida stricta, A. beyrichiana, and Ctenium aromaticum, all five Sporobolus species generally produce culms only after having their leaves removed by fire, although they will sometimes flower in response to mechanical disturbance. For this reason, nearly all herbarium specimens have the upper portions of the basal sheaths conspicuously blackened.

General exclusion of fire from much of the pineland habitat of the five species of the S. floridanus complex, combined with their flowering only in response to fire, means that the species are often overlooked or misidentified, and that they are severely under-represented in herbaria despite their local abundance. The four narrower-bladed species, S. pinetorum, S. curtissii, S. teretifolius, and S. silveanus, are often actively or passively misidentified as other sympatric pineland bunchgrasses, such as Aristida stricta, A. beyrichiana, or Muhlenbergia expansa. Entire savannas of a hundred hectares or more dominated by S. pinetorum have been assumed to be "longleaf pine/wiregrass," though in reality Aristida stricta may be completely absent. For this reason, it is important that field biologists become familiar with the vegetative characters which allow recognition of these taxa in sterile condition.

The complex reaches its greatest diversity in the Coastal Plain of Georgia, where S. floridanus, S. curtissii, S. teretifolius, and S. pinetorum are all found, and co-occur in various combinations of two and three species, along with the related S. juncens. Sporobolus silveanus is the only species of the complex that is fully allopatric, and the only one that occurs west of the Mississippi River. In southeastern North Carolina, S. pinetorum and S. teretifolius occur in wet pinelands dominated by mixtures of Pinus palustris, Pinus serotina, and Taxodium ascendens. They generally co-occur with other savanna bunchgrasses, notably Ctenium aromaticum, Calamovilfa brevipilis, Muhlenbergia expansa, and Aristida stricta. Sporobolus teretifolius is restricted to the wettest pine savannas, usually so wet as to exclude Aristida stricta, and it may be the sole dominant, or codominant with S. pinetorum, Ctenium aromaticum, and Muhlenbergia expansa. Slightly less wet savannas have varying mixtures of S. pinetorum, Aristida stricta, Muhlenbergia expansa, and Ctenium aromaticum. A similar
composition, though often with substantial *Calamovilfa brevipilis* as well, is seen in sandhill/pocosin ecotones in the inner Coastal Plain.

A general hydrologic gradient of the five species and the sympatric *S. juncus* would be (from wetter to drier) *S. floridanus, S. teretifolius, S. pinetorum, S. silveanu*, *S. curtissii, S. juncus*. *Sporobolus floridanus* is restricted to habitats which are saturated at least seasonally (and often semi-permanently) and may even have shallow ponds for weeks or even months. The other species are generally intolerant of ponds for more than a few days. *Sporobolus teretifolius* occurs in habitats with semi-permanent to seasonal saturation, whereas *S. pinetorum* occurs in habitats with seasonal saturation. *Sporobolus silveanus* and *S. curtissii* occur in a range of sites, from seasonally saturated to sites which are rarely saturated at the surface for periods of short duration only, and may range up to rather well-drained (though not xeric) sites. *Sporobolus juncus* strictly occupies well-drained sites, ranging into truly xeric, sandhill situations, where it reaches its greatest abundance.

*Sporobolus floridanus* generally occupies the wettest habitats of the complex. Particularly towards the edges of its distribution, it is generally found in very wet situations, often where water stands for periods of time, often in seepage bogs or swales, and generally associated with *Pinus elliottii* var. *elliottii* and *Taxodium ascendens*. Near the center of its distribution, especially in the eastern portion of the Florida panhandle, *S. floridanus* ranges into less wet habitats, and occurs in “mesic flatwoods.” Where its distribution overlaps with *S. pinetorum, S. curtissii*, and *S. teretifolius*, it can occur (with clumps side by side), but it clearly ranges ecologically into wetter sites and avoids drier sites.

The four eastern species in the *S. floridanus* complex commonly co-occur in pineland landscapes, and sometimes occur in mixed populations, with individuals of various species intermixed. In these circumstances, the various species are always readily distinguishable by morphological characters. No intermediates or likely hybrids have been seen. None of these species has been investigated cytologically.

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CARYOPSIS MORPHOLOGY OF LEPTOCHLOA SENSU LATO (POACEAE, CHLORIDOIDEAE)

NEIL SNOW

Department of Biology
Washington University
Campus Box 1137
St. Louis, MO 63130, U.S.A.

P.O. Box 299
Missouri Botanical Garden
St. Louis, MO 63166, U.S.A.

ABSTRACT

Caryopsis morphology of the grass genus Leptochloa was studied regarding the necessity of some authors for segregating Diplachne. The data do not support the separation of Diplachne from Leptochloa based on a putative bimodal distribution of dorsal and lateral cross-sectional compression. The presence or absence of a prominent sulcus and the relative adnation of the pericarp are the only attributes sufficiently distinct to warrant use as phylogenetic markers. However, variations in surface texture and color can be useful regionally as diagnostic characters at the species level.

KEY WORDS: caryopsis, Leptochloa, Diplachne, morphology, systematics, Poaceae, Chloridoideae.

RESUMEN

Se estudió la morfología del cariópside del género Leptochloa dada la supuesta necesidad de algunos autores de separar Diplachne. Los datos no apoyan la separación de Diplachne y Leptochloa basada en una supuesta distribución bimodal de la compresión dorsal y en sección transversal lateral. La presencia o ausencia de un surco prominente y la adnación relativa del pericarpio son los únicos atributos suficientemente diferentes para justificar su uso como marcadores filogenéticos. Sin embargo, las variaciones en textura y color de la superficie pueden ser útiles regionalmente como caracteres diagnósticos a nivel específico.

INTRODUCTION

The genus Leptochloa P. Beauv. s.l. (including Diplachne P. Beauv.) has been the subject of numerous regional systematic studies due to its wide geographic distribution and the relative abundance of herbarium specimens (Hitchcock 1903; Parodi 1927; McNeill 1979; Lazarides 1980; Phillips 1982; Nowack 1994; Nicora 1995). These authors (and others) have disagreed as to whether Diplachne should be segregated from Leptochloa, thereby mirroring

1Current Address: Department of Biological Sciences, University of Northern Colorado, Greeley, CO 80639, U.S.A. Email: nsnow@bentley.unco.edu

the differing opinions of two worldwide generic summaries of grasses (Clayton & Renvoize 1986; Watson & Dallwitz 1992). A frequently cited source of evidence to support the segregation of *Diplachne* has been differences in caryopsis features.

Parodi (1927) apparently was the first to examine cross-sectional shapes critically. He partitioned four neotropical species into *Diplachne* or *Leptochloa* based on relative compression (dorsal or lateral) of the caryopsis, and the presence or absence of a hilar groove. He suggested that *Leptochloa chloridiformis* was aberrant in *Leptochloa* because of its lack of a hilar groove (Parodi, l.c.).

Valls (1978) studied the systematic affinities of *Leptochloa dubia* in relation to the generic boundaries of *Leptochloa*. He illustrated cross-sectional profiles and profiles from the embryonic and hilar sides for seven species. The figures revealed a gradation in cross-sectional profile from nearly round in *Diplachne caudata* to somewhat triangular in *Leptochloa virgata* and *L. scabra*, to relatively flattened in *L. fascicularis* (Valls, l.c.: 103). He also concluded that a hilar depression was a tenuous systematic feature. Despite somewhat limited sampling, his results suggested strongly that caryopsis features intergrade too thoroughly to split *Leptochloa* unambiguously into two genera, although he acknowledged that “some grouping of species can be achieved on the basis of caryopsis type” (Valls, l.c.: 105). Unfortunately, his results were never formally published and have not been cited by subsequent authors.

McNeill (1979: 401) and Nicora (1995: 233) repeated almost verbatim the observations of Parodi (1927) without adducing additional data or citing the work of Valls (1978). Lazarides (1980) observed that Australian species generally could be segregated into *Leptochloa* or *Diplachne* on the basis of caryopsis shape, with the exception of *Leptochloa digitata*, with its flattened shape. Phillips (1982: 144) agreed with Parodi (1927) regarding the utility of caryopsis shape for splitting the genera, but noted exceptions in *Diplachne caudata*, *Leptochloa obtusiflora*, and *L. longa*. Nowack (1994) provided a cursory review of caryopsis shapes for Malesian taxa and concluded that the differences set forth by Parodi (1927) were insufficient to permit recognition of segregate genera.

Based on a recent monographic treatment (Snow 1997), *Leptochloa* (including *Diplachne*) represents forty taxa, with one species, *L. monticola* Chase, being of dubious inclusion (Valls 1978; Snow 1996). Prior to this study, relatively few taxa had been examined critically for variation in features of the caryopsis, and much systematic weight had been placed on the meagre observations that existed. In light of lingering debates about generic boundaries between *Leptochloa* and *Diplachne* (Jacobs 1987) and the emphasis previous authors placed on the utility of the caryopsis to segregate these genera, a survey of all currently recognized taxa of *Leptochloa* was undertaken to evaluate whether features of the caryopsis could be useful as phylogenetic markers.
MATERIALS AND METHODS

Caryopses of all currently recognized taxa in Leptochloa (Snow 1997) were removed directly from herbarium specimens (Appendix 1), placed under a Nikon SMZ-U dissecting microscope with camera lucida attachment, and the profiles were traced by hand. Cypholepis yemenicus was included because it resembles L. eleusine and L. obtusiflora in several respects (Snow 1996), and was used as an outgroup in preliminary cladistic studies of Leptochloa (Snow 1997; see also van den Borre & Watson 1997). In most cases a minimum of three specimens were examined for variation (Appendix 1). The following features were observed: 1) caryopsis shape when viewed from the hilar side (“hilar profile”); 2) caryopsis shape when viewed from a cross-section taken at midpoint with the hilar side oriented above (“cross sectional profile”); 3) the presence or absence of a sulcus or other depression on the hilar side when viewed in cross-section; 4) ornamentation on the outer coat (perisperm); 5) relative adnation of the perisperm to the endosperm, and 6) color of the grain. To standardize the sampled developmental stage, caryopses were selected from spikelets in which florets were beginning to disarticulate, a condition that assures their maturity. In virtually all cases the caryopses from the lowermost floret in the spikelets were selected.

For the sake of precision, descriptive terminology of shapes follows that of the Systematics Association (1962), whereas that of surface ornamentation follows Murley (1951). Given that shape is a continuously varying character, these typologies might not account for the observed and often subtle variations in shape. For example, a caryopsis might have an intermediate elliptic shape of 2.5:1, which is absent from the diagram. Nonetheless, after initial analyses, the diagram shapes appeared adequate to standardize and summarize the majority of both hilar profile and cross-sectional shapes. With respect to cross-sectional shapes, I accounted for the absence of sharp edges by prefixing the terms “obtriangular” (3:2), “shallowly obtriangular” (3:2), and “shallowly obdeltate” with the word “rounded,” which more accurately depicts their shapes. To account for concave inflections of the hilar surface (always oriented above, Fig. 2) I used the terms “sulcus” and “depression,” depending on the degree of concavity. As used here, a sulcus is a vertical or nearly vertically walled groove; a depression refers to any gradual concavity, and will be further modified by the terms shallow, moderate, deep, narrow, and broad. These subjective terms were deemed necessary to describe the observed variation.

RESULTS

The hilar profile for most species was some variation of obovate or elliptic (Fig. 1; Table 1). Only four taxa had ovate hilar profiles (L. fusca subsp.
Narrowly elliptic

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Elliptic

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Widely elliptic

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Ovate

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Obovate

Widely obovate

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Very widely obovate

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Fig. 1. Hilar profiles of caryopses observed for *Leptochloa*. The apex is oriented above.
Leptochloa aquatica 3,9,10 || 8,9,12
L. caudata* 1,2,8 || 2
L. chinensis 8,9 || 2,9
L. chloridiformis 2 || 7
L. coerulescens 8,9 || 2,8
L. decipiens subsp. asthenes 3,8 || 2,8,9
L. decipiens subsp. decipiens 3 || 9
L. decipiens subsp. peacockii 3,8 || 3,9
L. digitata 2,3,8 || 8,12
L. divaricatissima 3 || 2,9
L. dubia* 2,3,11 || 8
L. elesine* 3,8,9 || 8,12
L. fusca subsp. fascicularis* 3,8 || 4
L. fusca subsp. fusca* 9 || 4,8
L. fusca subsp. muelleri* 3,9 || 4,8
L. fusca subsp. uninervia* 3,7,8 || 4
L. gigantea* 3,6,8 || 8
L. longa 3,8 || 9
L. ligulata 3,4 || 2,7
L. malayana* 3 || 9,11

L. marquisensis 2,3,6 || 9,10
L. monticola* 3,8 || 4,8
L. nealleyi 4,9 || 2,9
L. neesii 5,10 || 1
L. obtusiflora 3 || 8
L. panicosa subsp. brachiatia 3,4 || 10,13
L. panicosa subsp. mucronata 3 || 1,2,8
L. panicosa subsp. panicosa 7 || 1,2
L. panicoides* 3,4 || 8
L. rupestris 3 || 10
L. scabra* 2,3 || 9
L. southwoodii 3,4,8 || 1,2
L. squarrosa 2 || 5,11
L. strilankensis 3 || 9,10,11
L. tectonetica* 2 || 8
L. uniflora 2,6 || 6,7
L. virgata 2,3,6 || 6,7,11,12,13
L. viscida* 3,8 || 4
L. xerophila 3 || 2
Cypholepis yemenicus 4 || 8,9

uninervia, L. gigantea, L. uniflora, L. virgata). The widest was the very widely elliptic shape of a few specimens of L. dubia. The thinnest was the narrowly elliptic (3:1) shape expressed by some specimens of L. caudata, L. chloridiformis, L. dubia, L. digitata, L. scabra, L. squarrosa, L. uniflora, and L. virgata (the lattermost sensu lato, including L. barbata and L. procura sensu Nicora 1995). Many species were variable, for example having both elliptic (2:1) and obovate (2:1) shapes. Not surprisingly, the greatest variation in hilar profile shape occurred in widespread species such as L. dubia and L. virgata.

The cross-sectional shape was considerably more variable than hilar profile shape (Fig. 2). Overall, the observed variation ranged from dorsally compressed through circular (no compression) to laterally compressed (Fig. 2). Most taxa had only slight to moderate degrees of lateral or dorsal compression. As with hilar profiles, many taxa showed infraspecific variation in cross-sectional shapes (Table 1). Some specimens of L. neesii appeared circular, whereas others were oblate (Table 1). The greatest degree of dorsal compression was expressed by the depressed obovate (1:2) and transversely elliptic (1:2) shapes. With some modifications, these shapes accounted for some or all of the variation of many species (Table 1). The highest degrees of lateral compression were the obovate (3:2), rounded shallowly obdeltate
(5:6), and rounded shallowly obtriangular shapes. Only _L. squarrosa_ was obovate (with a moderate hilar depression), whereas some representatives of _L. virgata_ were both rounded shallowly obdeltate (5:6) or rounded shallowly obtriangular (2:3).

A distinct sulcus was present only for _L. rupestris_ and _L. uniflora_, although a number of taxa had depressions of varying extent on the hilar surface (see Discussion).

The surface of the pericarp varied from smooth to variously rugose. The following were at least occasionally somewhat rugose: _L. chloridiformis_, _L. decipiens_ subsp. _decipiens_, _L. divaricatissima_, _L. gigantea_, _L. longa_, _L. malayana_, _L. monticola_, _L. nealleyi_, _L. neesii_, _L. obtusiflora_, _L. scabra_, _L. southwoodii_, _L. uniflora_. Whereas a smooth pericarp was consistent for many taxa, those that expressed the rugose condition did so irregularly.

Species with a weakly adnate pericarp (detaching soon after placement in water at room temperature) included _L. chloridiformis_, _L. dubia_, _L. elusine_, _L. fusca_ subspecies _fusca_, _fascicularis_, _minervia_, and _L. obtusiflora_.

The color of the caryopsis varied from very light brown to dark reddish or very dark brown, but most were an intermediate shade. _Leptochloa longa_, _L. obtusiflora_, and _L. squarrosa_ were usually dark brown. _Leptochloa monticola_, a species of dubious inclusion in the genus (Clayton & Renzoize 1986; Valls 1978; Snow 1996, 1997), was usually a dark reddish brown.

**DISCUSSION**

This simple study of caryopsis morphology has revealed more variation within and between taxa of _Leptochloa_ than previously recognized (Parodi 1927; McNeill 1979; McVaugh 1983; Nowack 1994; Nicora 1995). With two exceptions, features of the caryopsis appear to be of little value in _Leptochloa_ as phylogenetic markers, although some are of diagnostic value in keys. These results contrast with those of a recent study in Triticeae, which suggested caryopsis morphology was of systematic value at the tribal level (Terrell & Peterson 1993).

Parodi’s (1927) study was limited to four species in _Leptochloa_ and one in _Gominia_ Fourn., which represents only ten percent of _Leptochloa_ as currently circumscribed (Snow 1997). Another disconcerting aspect was his lack of voucher specimens and uncertain depth of sampling within taxa, although this study does not contradict the profiles of the species he illustrated. Overall, Parodi’s sampling underestimated considerably the variation in cross-sectional shape in _Leptochloa_. This study has revealed nearly continuous variation in cross-sectional shape, from dorsally compressed and non-compressed (circular or oblate) to various degrees of lateral compression. The bimodal compression (lateral or dorsal) of caryopses in _Leptochloa_ recognized by Parodi
<table>
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<th>Transversely elliptic</th>
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<td><img src="image6" alt="Very Widely obovate" /></td>
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<th>Depressed obovate</th>
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<td><img src="image8" alt="Widely depressed obovate" /></td>
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<th>&quot;Rounded&quot; obtriangular</th>
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<td><img src="image10" alt="&quot;Rounded&quot; shallowly obtriangular" /></td>
<td><img src="image11" alt="&quot;Rounded&quot; shallowly obdeltate" /></td>
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**Fig. 2.** Cross sectional shapes of caryopses observed for *Leptochloa*. The hilar side is oriented above.
(1927) simply does not exist for the genus as a whole. As such, variation in caryopsis cross-sectional morphology cannot by itself be invoked as a generic-level character to segregate Diplachne.

The caryopsis profile as viewed from the hilar side ranges continuously from narrowly elliptic through ovate to obovate and very widely obovate (Fig. 1). Whereas the extremes of variation can be useful as diagnostic features between some taxa, the continuous variation makes the hilar profile useless as a phylogenetic marker (Stevens 1991).

Various degrees of concavity occur on the hilar side. Broad, shallow depressions (not illustrated) characterize certain taxa fairly well, such as Leptochloa elasme, L. longa, and L. obtusiflora. Taxa showing this feature irregularly were Leptochloa chinensis, L. dubia, and the related Cypholepis yemenicus. Shallow, relatively narrow depressions (not illustrated) occur in other taxa, although less consistently; these included L. chloridiformis, L. decipiens subsp. decipiens, L. digitata, L. squarrosa, and L. virgata. At best, the degree of concavity is useful only as a diagnostic character in regional keys. However, a prominent sulcus, characterized by its vertical or nearly vertical walls, was a consistent character for L. rupestris and L. uniflora, and is one of only two characters I consider sufficiently distinct and consistent to be phylogenetically useful.

The relative adnation of the pericarp is the second character of the caryopsis useful for phylogenetic inference. It is well known that the pericarp is only weakly adnate to the endosperm in some species of Leptochloa (Izaguirre & Laguardia 1987; Watson & Dallwitz 1992) and some related genera, such as Eragrostis Wolf (Lazarides 1997). In such taxa the pericarp will dissociate from the endosperm quickly when placed in water at room temperature.

Most species in Leptochloa have a smooth outer texture. A few can be rugose, although this feature was unreliable within taxa. For example, a coarse but sparsely rugose surface generally, but not always, characterizes Leptochloa panicea subspecies panicea and mucronata (sensu Snow 1998a, but not sensu Nowack 1994), which helps to distinguish these from the widespread L. panicea subsp. brachitata (Snow 1998a; formerly known as L. filiformis or L. mucronata [Snow & Davidse 1993]).

As the color of the caryopsis often varies with the degree of maturity, only mature specimens should be evaluated for this attribute. Except as a diagnostic feature in keys, in which a few species are dark brown, color is of minimal systematic value in Leptochloa.

I return now to cross sectional shape, which has been discussed extensively regarding the separation of Diplachne from Leptochloa (Parodi 1927; McNeill 1979; Phillips 1982; Nicora 1995). As mentioned above, the perceived bimodality of lateral and dorsal compression discussed by Parodi (1927)
has been invoked to segregate *Diplachne* from *Leptochloa*. The results of this study firmly reject such a notion, given the nearly continuous variation of cross-sectional hilar profiles (Fig. 1).

It also has been suggested that the presence or absence of a distinct keel on the lemma is positively correlated with cross-sectional shape, and is a means by which the genera can be separated (Parodi 1927; McNeill 1979; Nicora 1995). It is true that some taxa with a dorsally compressed caryopsis have flat lemmas at maturity, as for example *L. fusca* subsp. *muelleri*. However, others have little or no such positive correlation. Mature fruits of *L. neesii* can be round or nearly so in cross section, yet still be borne within a keeled lemma (e.g., *Langfield 285*, CANB). This is also true for some specimens of *L. ligulata*, *L. nealleyi*, *L. panicica* subsp. *panicica*, and *L. southwoodii*. Preliminary cladistic studies have failed to consistently group together taxa having dorsally flattened caryopses (Snow 1997).

This study upholds and strengthens the unpublished work of Valls (1978), who concluded that variation in caryopsis shape was too great to support the recognition of *Diplachne*. In particular, the data herein have revealed nearly continuous variation in cross-sectional shape, ranging from dorsal compression through circular to various degrees of lateral compression (Table 1; Fig. 2). The lateral/dorsal compression dichotomy of Parodi (1927) simply does not exist for *Leptochloa*. Moreover, a nearly identical range of cross-sectional shapes can exist in closely related genera, as illustrated in a recent revision of Australian *Eragrostis* (Lazarides 1997: 176).

The most general observation to emerge from this and other detailed anatomical and morphological studies of grasses (Dávila & Clark 1990; Ellis & Linder 1992; Snow 1996; Lazarides 1997) is that broader sampling regimes generally reveal additional variation not encountered in narrower surveys. Such variation cannot be ignored. Future studies therefore should seek both breadth and depth of sampling in order to minimize the chances of incompletely characterizing variation. Underestimates of variation leads to errors in the diagnosis of taxon boundaries and in the accuracy of inferring phylogenetic relationships, the latter being the very basis by which we make and support our classifications.

ACKNOWLEDGMENTS

Generous funding was provided by the National Geographic Society (NGS 5594-95) and the Missouri Botanical Garden (Andrew W. Mellon Foundation). A grant from the National Science Foundation to the Population and Evolutionary Biology Program at Washington University in support of graduate training is also gratefully acknowledged. My thanks to Dr. John McNeill and an anonymous reviewer for helping to clarify the manuscript.
APPENDIX 1

Voucher specimens and herbarium of origin (acronyms follow Holmgren et al. 1990); those lacking herbarium designation are housed at MO. For new combinations and new species in Leptochloa see Snow 1998a, b and Snow and Simon 1997.

Leptochloa australis Scribn. & Merr.: Hitchcock 7004 (US); Pringle 6664 (US); Soderstrom 650 (US); McVay 191-24 (US); Snow 6623.

L. candata (K. Schum.) N. Snow: Van Someren AH9575 (US); Swords 1429 (US); Bogdan 130 (UC).

L. chimenis (L.) Nees: Snow et al. 6980; Katin 254 (K); Poore 440 (K); Darabde 7471 (K.MO); Clayton 5644 (K).

L. claviformis (Hack. ex Stuck.) Parodi: Braboen 179 (LP); Silvers 622 (MICH); Pedersen 3471 (US); Pedersen 2662 (US).

L. coronata Steud.: Adam 17175; Adam 14030; Adam 5094.

L. decipiens (R. Br.) Steap ex Maiden subsp. austroceras (Roem. & Schult.) N. Snow: Snow & Simon 7272; Snow & Simon 7272; Snow & Simon 7337; Crept et al. 2710 (MEL); Thompson & Sharpe HUG11 (BR); Hubbard 5098 (K).

L. decipiens subsp. decipiens: Snow et al. 7247; Snow & Simon 7328; Snow & Simon 7334; Blake 2254 (CANB); Roy s.n. (MEL, accession 234696); Lazarides 5634 (US); Regan s.n. (CANB).

L. decipiens subsp. pacificus (Maiden & Betche) N. Snow: Snow & Simon 7323; Snow & Simon 7329; Snow & Simon 7330; Snow & Simon 7336; Pardie 315D (BR); Bowman s.n. (G, accession 8227-86); Johnson 713 (CANB).

L. digitata (R. Br.) Domin: Snow et al. 7224; Snow et al. 7235; Snow et al. 7246; Borbridge 5326 (CANB); Blake 11506 (CANB); Blake 6320 (CANB); Walter & Walter 2590 (B).

L. distinctissima S. T. Blake: Snow et al. 7228; Snow et al. 7233; Snow et al. 7236; Snow et al. 7241; Lloyd 979 (CANB); Blake 7747 (BR).

L. dubia (Kunth) Nees: Snow 5863; Warmack 46783 (NCU); Kraf 51801; Mearns 1213 (US); Hernandez & Maburn N-2066 (GH); Gould 12183 (K); Castillon 43560 (GH).

L. demissa (Nees) T. A. Cole & N. Snow: Snow et al. 6941; Snow & Burgoyne 6954; Snow & Burgoyne 6963; Snow et al. 6982; Schreiberdi 1895 (PRE); Guy & Ward 7 (PRE); Drige s.n. (S, accession 93/194); Extension Officer 16419 (PRE).

L. fusa (L.) Kunth subsp. fusa: Snow et al. 7215; Snow et al. 7216; Snow et al. 7222; Snow et al. 7232; Snow et al. 7234; Snow et al. 7237; Tracy 9297 (GH); Fry s.n. (GH).

L. fusa subsp. fasciculata (Lam.) N. Snow: Snow 5786A; Snow 5809; Snow 5804; Snow 5809H; Snow 5811A; Snow & Koster 5824; Snow & Koster 5830; Snow 5841; Snow 5842; Snow 5896; Snow 5900; Snow 5901-B; Snow 5901-E; Snow 5923; Pringle 631 (MICH); Pringle 5995 (MEXU); Swallen 4265 (BAA); Waston s.n. (BAA).

L. fusa subsp. muelleri (Benth.) N. Snow: Latz 11 (BR); Maconochie 13433 (BRI); Mast 487 (CANB).

L. fusa subsp. minutissima (J. Presl) N. Snow: Snow & Prinze 6484; Snow & Prinze 6567; Snow & Prinze 6568; Snow 6598.

L. gigantea (Launert) T. A. Cole & N. Snow: Smith 4126 (PRE); Smith 1387 (BRI).

L. igiculata Lazarides: Snow & Simon 7324; Snow 7402; Story & Yapp 25 (CANB).

L. longer Griseb.: Darbridge 2612; Soderstrom 1073 (US); Hitchcock 10377 (US).

L. malayana (C. E. Hubb.) Jansen ex Veldkamp: Yasob 25883 (P).

L. marquesensis (F. Br.) P. M. Peterson & Judw.: Perlman 14919; Perlman 15064.

L. monticola Chase: Holdridge 1955 (US); Ekman 111874 (US).

L. mealy Vasey: Snow 5793B; Snow 5805A; Snow 5920; Covy 20298 (GH); Waller & Bannan 3096 (GH); Johnson 4872 (MICH).

L. neeii (Thwaites) Benth.: Snow & Simon 7378; Snow & Simon 7584; Darbridge & Sumithraarachchi 9180 (MO,US); White 8894 (US).

L. obtusifolia Hochst.: Milne-Redhead & Taylor 7297 (B); Greenway 10666.

L. pancea (Retz.) Ohwi subsp. pancea: Retkowski 4982 (B); Ahmad s.n. (B, accession 175193-120); Hitchcock 19474 (US); Field & Lowe 6B (US); Bucker 35904 (US).

L. pancea subsp. brachisti (Steed.) N. Snow: Snow 5905; Snow 5910A; Snow & Prinze 6529C; Snow & Prinze 6538; Snow 6654; Snow 6672A.

L. pancea subsp. microura (Michx.) Nowack: Snow 5847A.
REFERENCES


XANTHOSTEMON FRUTICOSUS (MYRTACEAE), A NEW SPECIES FROM THE PHILIPPINES

PETER G. WILSON
National Herbarium of New South Wales
Royal Botanic Gardens
Sydney, N.S.W. 2000, AUSTRALIA

LEONARDO L. CO
Herbarium, Institute of Biology
University of the Philippines
Diliman 1101, Quezon City, PHILIPPINES

ABSTRACT

A new species of Xanthostemon, X. fruticosus, presently known only from the Palanan Wilderness in Isabela Province, Luzon, is described and its relationships discussed.

RESUMEN

Una nueva especie de Xanthostemon, X. fruticosus, en la actualidad solamente conocida de la Palanan Wilderness en la provincia de Isabela es descrita y sus relaciones con otras especies discutidas.

Xanthostemon is a genus of around 45 species that occurs in Australia, New Caledonia, the Solomon Islands, Papua New Guinea, Indonesia (Irian Jaya, the Moluccas and Sulawesi) and the Philippines. In the Philippines, only four species have been named and there has been little published on the taxonomy of the genus since Merrill (1952) clarified the application of the names X. speciosus and X. verdugonianus.

In 1991, a preliminary inventory of the Palanan Wilderness was undertaken as a joint project of Conservation International, Leiden University and the Isabela State University. A report of this inventory is given by Co and Tan (1992). One of the vegetation types encountered was a low scrub that occurred on ultrabasic substrate and was dominated by a shrubby Xanthostemon species with large, right red flowers. This has proven to be an undescribed species, most closely related to X. verdugonianus and is here described as X. fruticosus.

Xanthostemon fruticosus Peter G. Wilson & L. Co, sp. nov. (Fig. 1). TYPE: PHILIPPINES. LUZON ISLAND, Isabela Prov.: Aubarede Peninsula, Lanay Spring, ca. 17 km NNW of Palanan Point, 25 May 1991, Leonardo Co 3583 (HOLOTYPE: A; ISOTYPES: PNH, PUH, CAHUP, ISB, L, KEP, US, K, CANB).
Fig. 1. Xanthostemon frenicosus Peter G. Wilson & L. Co. A. Habit. B. Immature fruit showing neatly circumscissile hypanthium. C. Open, mature fruit. D. Detail of leaf showing venation. All from holotype. Scale bar: A, D = 3 cm; B, C = 1 cm.
Xanthostemon verdugiano hypanthio circumsicisso valde affinis sed habitu fruticoso foliis floribusque maioribus pedicellis pedunculisque longioribus et petalis roseis differt.

Shrub ca. 1 m high; young shoots sparsely appressed-hairy, glabrescent. Leaves spirally arranged; petiole 7–10 mm long, 2.5–3 mm wide; lamina obovate, 6–8 cm long, 3.5–4 cm wide, length:breadth ratio 1.6–2.1:1, coriaceous, apex rounded and emarginate; oil glands numerous. Inflorescences crowded toward the apex of seasonal growth unit, subtended by slightly reduced foliage leaves, axillary, the apical bud apparently always growing on (i.e. shoot auxotelic). Unit inflorescences triads; peduncles 5–9 mm long, the upper ones shorter giving a corymb-like appearance to the flowering shoot; pedicels 6.5–10 mm long. Hypanthium cup-shaped, 5–6 mm in diameter, 4–5 mm deep, exceeding the summit of the ovary, ± glabrous. Petals 5, pink, oblong to obovate, 5.5–8 mm long, 3.5–6.8 mm wide. Sepals 5, ± equal, 2–2.7 mm long, 2.5–3.8 mm wide, ± triangular, apex obtuse to rounded. Stamens red ± equally spaced, ca. 22 in a single series around the rim of the hypanthium; filaments 22–25 mm long; anthers 1.2–1.5 mm long, connective broad with one large gland at the apex and 2–5 other, smaller glands. Ovary partly inferior, (2–)3-locular, glabrous. Style 30–35 mm long, extending 3–5 mm beyond the stamens; stigma as wide as or slightly narrower than the style, flat. Fruit depressed-globular, ca. 8 mm diameter, ca. 6.5 mm high, broadly lobed at each loculus; hypanthium nearly circumsicisile 1.5–2 mm above the base, the remnant ± flattened under the capsule. Placentas rod-like, horizontal. Seeds not seen.

Distribution.—Known only from the type locality.

Ecology.—Xanthostemon fruticosus has been found near the coast in a low scrub community occurring on exposed sites on soils derived from an ultrabasic substrate. It is the dominant component of this community type at Lanay which also includes a number of other genera of spreading or erect shrubs (Co & Tan 1992).

Conservation status.—Apparently rare. Only recorded from one of four ultrabasic sites visited in this part of north-eastern Luzon. Ultrabasic areas are very marginal for agriculture but are potentially subject to applications for nickel mining. As a wilderness, the region does have legal status as a ‘Protected Area’ but this may not be an impediment to mining.

Etymology.—The epithet is derived from the Latin, fruticosus, shrubby, referring to the distinctive habit, a characteristic that distinguishes it from the related X. verdugonianus.

The red-flowered X. speciosus Merr. From Palawan and nearby islands has a broader, dish-shaped hypanthium with distinct vesicles and is thus not closely related to the new species but belongs with X. confertiflorus (Sulawesi) and X. youngii (north-eastern Australia) in sect. Vescaria of Gugerli (1940).
Xanthostemon speciosus is usually a tree of 5 meters or more but small trees or shrubs of only 1 meter or so in height have been recorded (e.g. Co 3032, A, PUH, KEP).

Xanthostemon fruticosus is closely related to X. verdugonianus which it resembles in having red flowers with a circumsissile hypanthium. Xanthostemon verdugonianus is a tree up to 26 m high that ranges from north-eastern Mindanao to Sibuyan Island, the latter being over 500 km south of the Palanan area. Despite its range, X. verdugonianus has a very limited habitat and is much sought-after for its durable timber, making it a threatened species (Yao & Ulep 1981, 1983).

The neatly circumsissile hypanthium appears to be unique to this pair of species. Two species in New Caledonia have hypanthia that split and are irregularly circumsissile but these are members of an endemic group of taxa with bullate leaves (sect. Bullata of Gugerli 1940) and do not appear to be closely related to the Philippine species.

The species may be distinguished as follows:

1. Shrub ca. 1 m tall; lamina 6–8 cm long, 3.5–4 cm wide; petiole 7–10 mm long; petals pink. ................................................................. X. fruticosus
1. Tree to 26 m tall; lamina 3–7 cm long, 1–3.5 mm; petiole 4–7 mm long; petals red. ................................................................. X. verdugonianus

ACKNOWLEDGMENTS

The first author is grateful to the directors of A and CANB for loans of, or access to, herbarium specimens examined for this paper. Thanks, also, to Lesley Elkan for the illustration and Jaime Plaza for assistance with the Spanish abstract. The second author thanks Conservation International for funding his field work in the Palanan Wilderness in 1991.

REFERENCES


SEASONAL CHANGES IN CONCENTRATION AND DISTRIBUTION OF HEAVY METALS IN CREOSOTEBUSH, LARREA TRIDENTATA (ZYGOPHYLLACEAE), TISSUES IN THE EL PASO, TX/CIUDAD JUAREZ, MEXICO AREA

WILLIAM P. MACKAY, RICHARD MENA, NICHOLAS E. PINGITORE JR., KEITH REDETZKE, C. EDWARD FREEMAN, HAROLD NEWMAN, JOHN GARDEA, and HECTOR NAVARRO

Laboratory for Environmental Biology and Department of Biological Sciences (WPM, RM, CEF, HN, JG, HN, KR)
Department of Geological Sciences (NEP)
University of Texas, El Paso, TX 79968, U.S.A.

ABSTRACT

We compared seasonal changes in concentrations of four elements, arsenic, cadmium, copper and lead, in samples of various tissues of creosotebush collected in the El Paso, USA/Ciudad Juarez, Mexico region during 1980–81 and 1994–95. Levels in leaf tissue changed seasonally, with concentrations dropping in the spring and late fall, corresponding to the time of leaf drop in the plant. This suggests that most of the heavy metals were simply deposited on the surface of leaves, although data are presented which indicate that internal tissues also have significant levels of heavy metals. These seasonal cycles were less pronounced in the most recent samples. Levels of all four elements in creosotebush were significantly high in the region, as compared to a distant control area. Concentrations of most elements dropped below detection limits within 12 to 30 km from areas of highest concentration. Densities of native Chihuahuan Desert flora and lichens are low in the area, suggesting an apparent negative impact of industrial pollution on the local vegetation. Cadmium and lead levels in creosotebush tissues have dropped over the past 15 years, suggesting that enforcement and strengthening of environmental laws has reduced the air pollution levels in the El Paso area.

RESUMEN

Comparamos los cambios estacionales de las concentraciones de 4 elementos, arsénico, cadmio, cobre y plomo, en muestras de varios tejidos de gobernadora colectados en el área de El Paso y Ciudad Juárez, México durante 1980–81 y 1994–95. Se encontró un cambio estacional de los metales con las concentraciones disminuyendo en la primavera y otoño, que corresponden al momento de la caída de las hojas de la planta. Esto sugiere que hay deposición de los elementos en la superficie de las hojas, aunque presentamos datos de que hay acumulación de metales en los tejidos interiores. Estos ciclos estacionales están menos pronunciados en los últimos años. Los niveles de los elementos son altos en la región, pero están concentrados en un área entre 12 y 30 kilómetros del área con concentraciones más altas. Las densidades de la flora y líquenes en el área son bajas, sugiriendo un impacto negativo de la polución industrial en la vegetación local. Los niveles de cadmio y plomo en los tejidos

ha disminuido en los últimos 15 años, lo que sugiere que la aplicación de las leyes medioambientales ha reducido los niveles de polución en el área de El Paso.

The El Paso/Cd. Juarez area is one of the many regions along the United States/Mexico border which suffers from environmental contamination. The area has been subjected to heavy industrial activity, including smelting and hydrocarbon refining, for over 100 years. This has resulted in an accumulation of heavy metals, especially lead, cadmium, copper and zinc in the local soils (Barnes 1993; Ndame 1993). Arsenic contamination has been previously documented to occur in this region of west Texas (Shields 1991).

These elements and their compounds can cause medical problems in humans and other animals (Elbahri & Benromdane 1991; Louekari et al. 1991). Negative effects of heavy metals on plants have been documented (D’itri 1982; Fernandes & Henriques 1991), including the prevention of the uptake of potassium and phosphorous by roots. Moreover, copper may damage chlorophyll and increase the potency of fungal diseases (Connell & Miller 1984). These effects may eliminate some plant species, with concomitant increases in the abundances of others, thus changing plant community structure. Plants may tolerate heavy metal contamination (Connell & Miller 1984) by excluding metals from sensitive tissues, modifying metabolic pathways to prevent damage or assembling specific enzymes to detoxify heavy metals. The specific effects of heavy metals on the flora of the northern Chihuahuan Desert have not been documented, but Worthington (1989) previously reported a reduction in species richness in native plants in this area, presumably the result of such contamination.

In this investigation, tissues of the dominant Chihuahuan Desert shrub, Larrea tridentata were analyzed, to document continued heavy metal contamination in western Texas. This work is part of a larger study on the effects of heavy metal contamination on the flora and fauna of the northern Chihuahuan Desert and the investigation of bioaccumulation into higher trophic levels.

MATERIALS AND METHODS

We selected a site on the campus of the University of Texas (UTEP) in western El Paso to follow seasonal change in heavy metal concentrations in creosotebush. The site is located within 2 km of a local smelter, which appears to be a point source for the high concentrations of heavy metals in the area. Four elements were included in the analysis: Arsenic, Cadmium, Copper and Lead. Additional sites used to determine the distribution of heavy metals in creosotebush tissues in the region included 62 sampling areas near the border in the United States and six in Mexico within 10 km of the border and of the smelter, of which 52 yielded creosotebush specimens (five repli-
cate bushes at each site). Sites were selected which had native Chihuahuan Desert vegetation located at least 50 meters away from any road. Preliminary analyses showed higher levels of lead next to roadways, which decreased to background levels within a few meters, an effect also noted by Motto et al. (1970), Gratani et al. (1992) and Lebreton and Thevenot (1992).

Leaves were stripped, and twigs were cut from the plants. Roots and trunk tissues were also harvested from plants. Tissues were placed in numbered paper bags and returned to the laboratory. The samples were further cleaned, removing all foreign matter, but were not washed. Bark and exterior tissues were carefully removed from pieces of trunks, to avoid contamination of internal tissues. Tissues from 1980–1981 were collected North of the Education Building on the UTEP campus, as part of another study (Freeman 1982). The tissues were ground and stored dry in glass vials until they were analyzed in 1994. Tissues from 1994–1995 were collected throughout the season from five specific bushes, located in Charlie Davis Park, on the campus of UTEP. This allowed a comparison of the percentages of heavy metals in the tissues of each of the five creosote bushes.

Approximately 20 grams of tissue were placed in a crucible and muffled for three days at 425°C. This relatively low temperature was selected to avoid vaporizing the four elements or their salts (based on the recommendations of Dr. Jim Rayon and Dr. Ken Dodson of the Environmental Protection Agency). After ashing, 100 mg of ash were dissolved in 20 ml of 14% nitric acid (V:V), without filtering. Reagent grade acid and double glass distilled water were used for all solutions. Samples were prepared and stored in glass scintillation vials with polypropylene-lined caps.

Samples were analyzed on a Beckman SpectraSpan 6 direct current plasma atomic emission spectrograph (DCP-AES). We followed the protocol of EPA method 6010 for the inductively coupled plasma emission spectrometer (US EPA 1986). Three of the wavelengths used are those recommended by EPA: 193.696 nm for arsenic, 213.598 nm for copper, and 220.353 nm for lead. The fourth wavelength, 228.802 nm, was substituted for the cadmium analysis to achieve the lowest detection limit. The DCP was calibrated with prepared standard solutions such that the linear calibration curve had an R² of at least 0.995. The samples were analyzed by DCP three times and reported the mean and standard deviation of these readings. If the relative standard deviation was greater than 3%, the sample was reanalyzed. Blanks, duplicate samples and prepared standards (spiked samples) were analyzed at least once every ten samples for quality assurance/quality control. Cadmium concentrations in the samples collected in 1994–1995 were close to or below the limits of detection and therefore we have not presented them. After analysis, the DCP solution values were converted to ppm in the original
ash. The detection limits in the ash for this study were 200 parts per million (ppm) for arsenic, 11 ppm for cadmium, 85 ppm for copper and 130 ppm for lead.

Data were plotted with SURFER (Golden Software Inc., Golden Colorado), using the grid method with inverse squared distances and the surface module (Keckler 1995).

RESULTS AND DISCUSSION

Seasonal changes.—Levels of all four elements varied seasonally during both time periods (Fig. 1). Levels were high in the winter and showed a small drop in the spring when there is a combination of minor leaf drop and strong spring winds. The levels increased during the summer, especially during the early sampling period (Figs. 1a, b, c), but later showed a large drop during the fall when creosote lose a large proportion of their leaves (Mackay et al. 1987). Concentrations increased again during the winter months, especially during 1980–1981. Levels of heavy metals were lower in the 1994–1995 samples (Fig. 1d & f). Cadmium and lead were both approximately 4 times higher in 1980–1981, suggesting that enforcement and strengthening of environmental laws has reduced the air pollution levels in the El Paso area.

Seasonal changes in concentrations of all metals during both sampling periods were statistically significant (Table 1). The first harmonics from Fourier analysis of the means (Little & Hills 1972), corresponding to the seasonal effect, were significant for all years, although the patterns were more pronounced during the first sampling period (Fig. 1) and had correspondingly higher F values (Table 1). Other harmonics were statistically significant in 1980–1981, showing the importance of leaf drop in lowering heavy metal concentrations during these years, although there was no pattern in which harmonic was significant after the first. The lack of significance of higher harmonics during the second sampling period suggests that leaf drop was not significant in reducing heavy metal content during those years.

Contamination of tissues.—It appears that large amounts of the heavy metals arsenic, copper and lead are deposited on the leaves, but heavy metals are also incorporated into the tissues of this plant (Fig. 2). Large concentrations of all three elements were found in the roots. The trunks also had high concentrations of the three elements, which were present in the internal tissues as well. The branches and the leaves also had high concentrations of the three elements. These data suggest that heavy metals may be deposited on the outside of the plant, but is also taken up by the roots and incorporated into the woody tissue.

Heavy metal geographical distribution: Levels of the four elements (arsenic, cadmium, copper and lead) in creosotebush ash were elevated adjacent to the United States/Mexico border on the west side of El Paso (Fig.
MONTHS

Fig. 1: Seasonal changes in heavy metal concentrations in the leaves of the creosotebush, Larrea tridentata during 1980–1981 and 1994–1995. The gap in 1994–1995 is due to lost samples. Error bars represent standard error of the mean, and are not included in a, b, and c as many of the data points are based on a single sample. The months are abbreviated by a single letter on the x axis.

3). Levels of cadmium were as high as 190 ppm in ash, those of copper reached 5200 ppm and lead levels were as high as 1200 ppm (Fig. 3, note that the surfaces in the figures are close to average values and do not extend to these extreme values). The highest levels of the three elements were recorded on the east side of Mount Cristo Rey (Peak 1 in Fig. 3a), on a small mesa west of McNutt Road (Peak 2 in Fig. 3a), and on the UTEP campus (Peak 3 in Fig. 3a). Levels of all three elements were lower on the southwest side of Mount Cristo Rey, perhaps due to a wind-shadow effect. Levels of all three elements rapidly decreased to the east and fell below detection limits at distances of between 12 and 30 km (Fig. 3).
Table 1. Results of Fourier Analysis (Little & Hills 1972) of the periodic functions in Figure 1. Means were used in the analysis.

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* = F value of harmonic significant at 0.05 level, ** = F significant at 0.01 level, *** = F significant at 0.001 level, ns = F value not significant.

The areas with the highest values of As, Cu, Cd, and Pb in creosotebush (peaks 1–3, Fig. 3) coincide with the sites of the highest concentrations of heavy metals in the soils (Barnes 1993; Ndame 1993) and in fluff grass (MacKay et al. 1998). In this locale, Pb in the soils exceeds the EPA TCLP (Toxicity Characteristics Leaching Procedures) regulatory limit at a number of sites, and Cd is reported quite close to the limit. The spatial correspondence between elevated metal levels in the soil and the flora is not unexpected. The mechanism of uptake of heavy metals by creosotebush remains to be elucidated.

Densities of native Chihuahuan Desert flora and lichens are low in the area (Worthington 1989, MacKay et al. in prep.), suggesting an apparent negative impact of industrial pollution on the local vegetation. The specific effects of heavy metals on the flora of the northern Chihuahuan Desert are currently being documented. The demonstrated reduction in species richness in native plants in this area is presumably the result of heavy metal contamination from the smelter. These effects may eliminate some species and increase the abundance of others.
Fig. 2: The distributions of lead, arsenic and copper in specific tissues of the creosotebush from Charlie Davis park on the University of Texas, El Paso campus, El Paso, TX.

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We would like to thank the United States Department of Agriculture, especially J.A. Vigil and J. Underwood, for permission to import plant tissues from Mexico. The Texas Department of Parks and Wildlife, especially David Riskind, allowed us to collect plant tissues in the Franklin Mountains State Park. Ken Dodson and Jim Rayon offered suggestions regarding sample preparation. Our research was supported by the Center for InterAmerican and Border Studies of the University of Texas and by the National Science Foundation (HRD 9253021).

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Fig. 3: The distribution of arsenic, cadmium, copper and lead in the El Paso/Ciudad Juárez area. Charley Davis Park on the UTEP campus is located at the origin in the x-y coordinate system (0,0). Peak one corresponds to the east side of Mount Cristo Rey, Peak 2 to a mesa above (west of) McNutt Road and Peak 3 is on the UTEP campus. Detection limits were 200 ppm for arsenic, 11.2 ppm for cadmium, 84 ppm for copper and 132 ppm for lead.


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NEW PLANT RECORDS FOR DOMINICA, LESSER ANTILLES

STEVEN R. HILL

Center for Biodiversity
Illinois Natural History Survey
607 E. Peabody Drive
Champaign, IL 61820, U.S.A.

ARLINGTON JAMES
Division of Forestry and Wildlife
Botanic Gardens
Roseau, COMMONWEALTH OF DOMINICA

ABSTRACT

Twenty-six vascular plant species are reported here for the flora of Dominica, in the Lesser Antilles. These include two pteridophytes, 13 monocotyledons, and 11 dicotyledons. Four of these species are reported as new to the Lesser Antilles: Marsilea polycarpha Hook. & Grev., Diplacrum capitatum (Willd.) Boeck., Rhynchospora racemosa Wright ex Sauvalle, and Pharns lappulaceus Aubl.

INTRODUCTION

Dominica is a volcanic island located between the French islands of Guadeloupe and Martinique in the Lesser Antilles. It is about 45 km long and 24 km wide. While it is a small island (1088 sq. km), it presents a diversity of habitats along altitudinal and moisture gradients because of its rugged mountainous topography. Several of the mountain peaks exceed 1200 m (Morne Diablotins 1433 m, Morne Trois Pitons 1402 m, Morne Watt 1242 m, Morne Anglais 1223 m). Water is abundant on the upper slopes of the mountains (e.g. at Freshwater Lake, 8459 mm of rain/yr. has been recorded) but rainfall on the western (Caribbean) coast is severely restricted by a rain shadow (< 2000 mm/yr.) and a dry scrub forest prevails. Severe damage caused by hurricanes and agriculture has also provided opportunities for opportunistic species, increasing the diversity. The coastline is very steep, and the
cliffs generally continue precipitously into the ocean. Level land is primarily restricted to river deltas in a few narrow bands near the coast, where most citizens live.

Botanically, Dominica is rather well-known. The dicotyledonous flora was treated by Nicolson (1991) who estimated a vascular flora of 1226 species. The most recent treatment of its pteridophytes and monocots was Howard's six volume *Flora of the Lesser Antilles* (1974, 1977, 1979, 1988, 1989a, 1989b) which included detailed distribution notes within that region, and treated the dicots as well. Whitefoord (1989) added 40 phanerogams and six ferns to the flora. This paper reports twenty-six vascular plant species newly discovered and vouchered for Dominica.

**METHODS**

The plants reported here as new to Dominica were discovered during the period 1990–1997. Approximately 2000 collections were made by the first author for the purpose of assembling a reference herbarium at the Springfield Estate, formerly called the Archbold Tropical Research Center after the late John Archbold who donated the property to Clemson University in 1989. The Springfield Estate is currently leased from Clemson University by a Dominican non-government organization, the Springfield Centre for Environmental Protection, Research, and Education (SCEPTRE). The herbarium there has been informally designated with the acronym "atrc." Specimens donated by several other collectors have also been incorporated into the herbarium.

Collections (2005 numbers) have been made on Dominica during eight visits to the island by Hill as follows: 20 March–26 March 1990 (collection numbers 21230–21379), 4 March–23 March 1991 (22009–22179), 26 July–5 August 1992 (23924–24171), 5 March–16 March 1993 (24612–24847, w/J. Gable & B. Dorsey), 7 December–19 December 1993 (25309–25563, w/L. Renne & D. Bradshaw), 28 May–6 June 1994 (25610–25872), 24 May–9 June 1996 (27861–28262), and 23 February 1997–14 March 1997 (28868–29109, w/L.R. Phillippe). Sets of specimens have been deposited primarily in the Dominican herbarium (atrc), Clemson University (CLEMS), the Illinois Natural History Survey (ILLS), and the Smithsonian Institution (US). Additional duplicates have been distributed to herbaria cited after the individual specimens.

New records of species generally considered to be indigenous to the Lesser Antilles (according to Howard 1974, 1977, 1979, 1988, 1989a, 1989b) are reported here. Some may have actually been introduced to Dominica by human activities, but direct evidence is lacking.
HYMENOPHYLLACEAE

*Trichomanes crinitum* Sw. An epiphyte similar to *Trichomanes crispum* L. but differing in its lobed or pinnatifid, not entire, pinnae. Its general distribution is northern South America to Jamaica, and it has been reported from Guadeloupe, St. Vincent, and Grenada in the Lesser Antilles. We thank A.R. Smith for the identification.

St. George Parish: elfin forest on windswept ridge between Breakfast River and Valley of Desolation, 6 Mar 1997, Hill & Phillippe 29070 (atrc, ILLS, UC).

MARSILEACEAE

*Marsilea polycarpa* Hook. & Grev. A trailing perennial of temporary ponds, this species of northern South America has not been previously reported in the Lesser Antilles. It has several globose sporocarps arranged and attached in a linear fashion on the frond stipes rather than the single basal sporocarp seen in most other species of the genus. Neither the genus nor family have been previously reported from Dominica.


FLOWERING PLANTS

LILIOPSIDA

AGAVACEAE

*Agave dussiana* Trel. The century plants are seldom collected, and none were reported from Dominica by Howard (1979). This species, which is endemic to the Lesser Antilles, is very conspicuous in the dry scrub on the dry rocky hills of the NW coast of Dominica in areas of very low rainfall, growing mostly with cacti. Previous collections are known from St. Barts, Antigua, Montserrat, Guadeloupe, and Martinique.


CYPERACEAE

*Diplacrum capitatum* (Willd.) Boeck. This species is rather common in Venezuela and ranges from Panama to Bolivia as well. This appears to be the first record from the Lesser Antilles. Howard (1979) listed only *Diplacrum longifolium* (Griseb.) C.B. Clarke ex Dur. & Schinz. for the Lesser Antilles, from St. Paul Parish, Dominica. We thank M. Strong for the identification.

Fimbristylis cynosa, R. Br. subsp. spatbacea (Roth) T. Koyama. This is a characteristic, wiry-leaved and tough-rooted, sedge of the windswept flats of the E and NE coasts of Dominica. Pantropical in distribution, it has been collected previously on most of the Lesser Antilles, including Guadeloupe and Martinique.

St. Andrew Parish: roadside 0.5 mi N of Melville Hall Airport, Londonderry Estate, 16 Mar 1993, Hill 24842 (atrc, CLEMS, MO, NY, TAES, USF).

Rhytchospora racemosa Wright ex Sauvalle. This is the first report of this species for the Lesser Antilles. It is relatively common in the Greater Antilles. We thank M. Strong for the identification.


**ORCHIDACEAE**

Brachionidium pernum Cogn. This tiny epiphyte of the upper montane rainforests was previously known from Venezuela and from Guadeloupe, Martinique, and Grenada in the Lesser Antilles. It was to be expected in Dominica but probably has been overlooked because of its small size (< 5 cm tall). We thank D. Nicolson for the identification.


**POACEAE**

Ichnanthus nervosus (Sw.) Doell. var. swartzii K.E.Rogers. Generally distributed in the Antilles and Trinidad, this trailing rainforest species has been collected previously on St. Kitts, Nevis, Montserrat, Martinique, St. Vincent, and Grenada in the Lesser Antilles.


Isachne angastifolia Nash. This thicket-forming grass which often climbs over other plants has been known previously from Puerto Rico, and from Guadeloupe, Martinique and St. Kitts in the Lesser Antilles. The new record is an expected range extension. We thank G. Davidse for the identification.


Isachne arundinacea (Sw.) Griseb. This is another clambering grass of exposed wet mountain slopes, and its general range is Jamaica to Trinidad S to Bolivia and N to Mexico. In the Lesser Antilles it has been previously collected on St. Kitts, Guadeloupe, and Grenada. We thank G. Davidse for the identification.
**St. Paul Parish:** trail to summit of Morne Trois Pitons, N side, just NE of Pont Cassé, 9 Dec 1993, *Hill 25340* (atrc, MO, VT).

*Leptochloa virgata* (L.) Beauv. A very widely distributed grass which ranges from the southern United States through the Caribbean and Central America to South America. It has been collected on many of the Lesser Antilles, including nearby Marie Galante and Martinique, and was to be expected on Dominica.

**St. Peter Parish:** Clement James’ property, Anse à Liane trail to coast, 0.9 km N of Colihaut, 26 Feb 1997, *Hill & Phillippe 28962* (atrc, ILLS, MO, TAES).

*Pharus lappulaceus* Aubl. This wide-ranging, wide-leaved grass is found in forests from the Caribbean and Central America to southern South America. Howard (1979) noted the similar *P. glaber* Kunth from Dominica. We thank T.S. Filgueiras for the identification.


*Phragmites australis* (Cav.) Trin. ex Steud. Probably due to the general lack of suitable habitat, the common reed has not previously been collected on Dominica. Otherwise, it is widespread in both tropical and temperate portions of the world, and has been collected previously in the Lesser Antilles on Guadeloupe, Martinique, and St. Lucia.

**St. John Parish:** marsh at N side of Coconut Beach Hotel, Prince Rupert Bay, Portsmouth, 29 May 1996, *Hill 27993* (atrc, ILLS).

*Spartina patens* (Ait.) Muhl. This grass, usually found in salt marshes and flats along the coast, was a surprising find in Dominica where these habitats are essentially lacking. The species generally ranges from the E coast of North America from Quebec to Mexico, Central America, and the Caribbean. In the Lesser Antilles it has been collected previously on St. Martin, Antigua, and Guadeloupe. We thank D. Nicolson for the identification.


*Urochloa plantaginea* (Link) Webster. Often reported as *Brachiaria plantaginea* (Link) Hitchc., this grass of unstable areas ranges widely from Mexico and the Caribbean to Brazil and Bolivia. As with *Phragmites*, it may be a recent introduction, though Dominica falls within its general range. It has been previously collected in the Lesser Antilles only on St. Lucia. We thank T.S. Filgueiras for the identification.

**St. Paul Parish:** Morne Daniel Road, Canefield, 10 Mar 1993, 24701 (atrc, CLEMS).

**MAGNOLIOPSISIDA**

**COMBRETACEAE**

*Conocarpus erecta* L. The button mangrove (buttonwood) is widely distributed in the American tropics along the coasts of Florida, USA, S through
Mexico and Central America to the Caribbean and tropical South America and it has also been collected in West Africa. Buttonwood has been found on nearly all of the other Lesser Antilles. Hodge (1964) noted: "the common genera of mangrove (Rhizophora, Avicennia, Laguncularia, and Conocarpus) are absent from Dominica, a fact easily accounted for by the lack of sufficient lowland sites on an island where the coastline is very precipitous." Diligent searching by Arlington James and other members of the Division of Forestry and Wildlife have resulted in the verification of the occurrence on Dominica of three of these genera, two of which (Avicennia and Conocarpus) are reported here as new. Of the four genera listed by Hodge, only Rhizophora has not yet been found on Dominica. Laguncularia was reported by Nicolson (1991). Only one individual of Conocarpus has been found.


CONVOLVULACEAE

Convolvulus nudiflorus Desr. This species is widespread in dry scrub in the West Indies, Central and South America. It has previously been collected on the majority of the Lesser Antilles, including nearby Guadeloupe and Martinique, and was to be expected on Dominica. We thank D. Nicolson for the identification.


EUPHORBIACEAE

Euphorbia balbisii Boiss. A species endemic to the Lesser Antilles, also known as Chamaesyce balbisii (Boiss.) Millsp., E. balbisii was previously known only from Barbuda, Antigua, Guadeloupe, and La Désirade. It is a prostrate species of wind-swept salt-sprayed coastal cliffs in Dominica.


FABACEAE

Dalbergia montaria L.f. Generally distributed from Jamaica to tropical South America, Howard (1988) reported that the species previously had been collected in Guadeloupe, Martinique, and St. Vincent. Vélez (1957) reported this species as present on Dominica, but Nicolson (1991) dismissed this as a misidentification. Differing from D. eccentricum (L.) Taubert (which is common on Dominica and has unifoliate leaves) by its pinnately compound leaves (3–5 leaflets), it is rather common locally along the banks of the Indian river. The identification was confirmed by V. Rudd (SFV).

MALVACEAE
_Sida jamaicensis_ L. This wide-ranging species is known from Mexico, the Caribbean, Central America, and northern South America. In the Lesser Antilles it has previously been collected on St. Barts, Antigua, Montserrat, Guadeloupe, and Les Saintes in the dry scrub forests. We thank Paul Fryxell for the identification.

_St. Joseph Parish:_ Morne Raquette (Rachette), Au Piton Road, 4 Jun 1994, _Hill 25808_ (atrc, NY, TEX, USF).

NYMPHAEAECACEAE
_Nymphaea amazonum_ C.Mart. & Zucc. This night-flowering water lily ranges throughout the Caribbean and from Mexico to southern Brazil. It previously has been collected in Guadeloupe, Marie Galante, Martinique and St. Lucia in the Lesser Antilles. Suitable habitat for the species is very scarce on the island. We thank J. Wiersema for the identification.

_St. Andrew Parish:_ roadside 0.5 mi N of Melville Hall Airport, Londonderry Estate, 16 Mar 1993, _Hill 24844_ (atrc, CLEMS).

OLEACEAE
_Forestiera segregata_ (Jacq.) Krug & Urb. Another new discovery in the dry scrub forests of western Dominica, this species ranges from the coastal SE USA, S to the Lesser Antilles. It has been collected previously on Anguilla, Barbuda, Antigua, La Désirade, and Marie Galante in the Lesser Antilles. We thank A. Goldberg and D. Nicolson (US) for the determination.


RUBIACEAE
_Randia nitida_ (H.B.K) DC. This spiny coastal shrub is distributed from Mexico to South America and the Caribbean. In the Lesser Antilles it has been reported from Martinique, St. Lucia, St. Vincent, and Grenada. It is distinguished from the more frequent _R. aculeata_ L. by its flower size (3–3.8 cm vs. 2 cm long in _R. aculeata_) and fruit size (3.2–5 cm vs. 1–1.2 cm long in _R. aculeata_). We thank D. Nicolson (US) for the identification.


RUTACEAE
_Pilocarpus racemosus_ Vahl. This Caribbean endemic ranges from Cuba to the Lesser Antilles. It has been collected previously on Montserrat, Guadeloupe, and Martinique in the Lesser Antilles and was to be expected on Dominica. It is restricted to windswept coastal forests and is associated with the palm _Rhyticocos_ on the N coast of Dominica. We thank D. Nicolson for the identification.

VERBENACEAE

Avicennia germinans (L.) L. The black mangrove was a particularly interesting find on Dominica. While it was thought to be absent by previous authors (see comments under Conocarpus, above) it was located by the second author in recent years at several places, the most unusual one in elevated cliffside sedge-dominated seeps on the NE coast of the island. Other populations are restricted to a few square meters of level land at the mouth of small rivers. Like Conocarpus, Avicennia is widely distributed along coasts from Florida and Texas, USA, to northern South America. It has been found on nearly all of the other Lesser Antilles.


VITACEAE

Cissus obovata M. Vahl. A vine endemic to the Caribbean, C. obovata is easily distinguished from the more common C. verticillata (L.) Nicolson & Jarvis by its trifoliolate rather than simple leaves. It ranges from Cuba, S to the northern Lesser Antilles. Collections previously have been made in the Lesser Antilles on St. Martin, St. Barts, and Barbuda.


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A NEW ADDER’S-TONGUE (*OPHIOGLOSSUM*: OPHIOGLOSSACEAE) FOR NORTH AMERICA

JAMES C. ZECH and PATRICIA R. MANNING

Department of Biology
Sul Ross State University
Alpine, TX 79832, U.S.A.

WARREN HERB WAGNER JR.

Department of Biology
University of Michigan
Ann Arbor, MI 48109, U.S.A.

ABSTRACT

The widespread Old World adder’s-tongue, *Ophioglossum polyphyllum* A. Br. is reported for the first time in North America. Formerly confused with *O. engelmannii* Prantl, we now recognize as *O. polyphyllum* collections from U.S.A. (Texas and Arizona) and Mexico (Hidalgo, Oaxaca, San Luis Potosí, and Zacatecas). The earliest confirmed collection was in 1874. The two species are keyed out and illustrated, and specimens of *O. polyphyllum* are listed. The known county distribution of the species in Texas is mapped, and the habitat and phenology are briefly described.

RESUMEN

La lengua de serpiente del Viejo Mundo, muy frecuente, *Ophioglossum polyphyllum* A. Br. se cita por primera vez en Norte América. Previamente confundida con *O. engelmannii* Prantl, reconocemos ahora como *O. polyphyllum* colectas de E.E.U.U. (Texas y Arizona) y México (Hidalgo, Oaxaca, San Luis Potosí, y Zacatecas). La primera colecta confirmada fue en 1874. Se ofrece una clave de identificación y se ilustran las dos especies, y se listan los especímenes de *O. polyphyllum*. Se cartografía la distribución conocida por condados en Texas, y se describen brevemente el hábitat y la fenología.

The adder’s-tongues, *Ophioglossum* (Ophioglossaceae) are a small group of striking and unusual species, with the highest known chromosome numbers in the plant kingdom. The gametophytes are subterranean, the roots lack root hairs, and the leaf is made up of two parts: the sterile blade portion (trophophore) and the spore-bearing portion (sporophore). The trophophore has complex reticulate venation and is believed to be phyllodial in origin (Wagner 1979). The sporangia are deeply sunken in the apical portion of the sporophore. There are probably as many as 35 species worldwide but two areas, India and Africa, seem to be regions of maximum diversity. Many of the species occur in open arid sites and remain underground until seasonal or sporadic rains stimulate the leaves to push up through the soil and

grow to full size before discharging the spores. In America north of Mexico seven terrestrial species are traditionally recognized: Ophioglossum pusillum Raf., O. vulgatum L., O. californicum Prantl, O. nudicaule L.f., O. petiolatum Hook., O. croatalophoroides Walter, and O. engelmannii Prantl. However, we have recently discovered another species heretofore unknown from the New World. We originally interpreted the plants in question as a narrow form of O. engelmannii (Zech & Manning 1996), but subsequent study reveals a number of differences from that species, and we now identify it confidently as O. polyphyllum A. Br. The earliest collection was in 1874. Clausen's monograph (1938) does not even recognize this species anywhere in the world; he merely synonymized it with O. vulgatum. Nevertheless, we have come a long way taxonomically from the first half of this century, not only in regard to Ophioglossaceae, but Lycopodiaceae, Isoëtaceae, Thelypteridaceae, and many other pteridophyte groups. Lellinger's (1985) manual of North America pteridophytes does not list O. polyphyllum, nor does Flora North America north of Mexico (Wagner & Wagner 1993).

This species has an enormous range: Africa, Asia (e.g., S. China, India), Polynesia (e.g. Hawaii), and now North America. It is probably made up of a number of subspecies, but these are held together by a set of distinctive characters, described below. There is no question that it is most closely related to O. engelmannii. Its main point of resemblance involves the venation pattern in which the major areoles include minor areoles, a condition commonly referred to as bireticulate. In most species the major areoles of adder’s-tongues possess only free included veinlets that themselves do not interconnect. Large specimens of O. nudicaule (the form known as O. ellipticum Hook. & Grev.) usually possess bireticulate veins (Wagner et al. 1984), as does the Old World O. costatum A. Br. (Burrows 1996). Both Ophioglossum vulgatum and O. reticulatum show a tendency toward bireticulation, but the relatively few areoles are coarser and more open. The very fine bireticulation in O. engelmannii and O. polyphyllum is quite distinctive.

Ophioglossum engelmannii is apparently a strictly New World taxon, and limited to North America, including Mexico, and Central America. It is commonly referred to as “Limestone adder’s-tongue” for its tendency to grow on soil layers above limestone. In the United States it usually appears during and after rains, but it may reappear in the same places during later high precipitation periods. Dean P. Whittier of Vanderbilt University has actually forced a new “brood” of leaves to form in late summer by watering a site where the plants normally appear only in the spring (pers. comm.).

A key to the two species is presented below. To see the venation of a dried specimen more clearly, a drop of 95% alcohol placed on the laminar surface will, after soaking in, clear the leaf temporarily and will not damage the
specimen. Collectors should be warned not to break off or remove the characteristic elongate brown leaf sheaths that surround the green leaf bases: collecting can be accomplished best by carefully digging up the specimens. This has the added advantage of showing the roots, and their numbers and relative sizes.

Roots 25(15–30), thinner, mostly 0.6(0.3–0.9) mm thick, yellow to dark brown, commonly somewhat crooked (dried); persistent old leaf bases numerous, 5 (2–9); trophophore narrowly ovate, attenuate proximally and distally, length/width 4, 4.8(3.2–7.7) × 1.2(0.7–1.9) cm; sporangial clusters 1.8(0.6–2.6) × 0.25(0.2–0.3) cm; apicula 1.0(0.3–1.8) mm. .......................... O. polyphyllum

Roots 15(6–24), thicker, 0.9–1.1(0.3–2.0) mm, often darker or blackish, usually straight (dried); persistent old leaf bases few 2(1–4); trophophore broadly ovate to oblong, length/width = 3, 6.0(4.5–8.5) × 2.0(1.5–2.3); sporangial clusters 2.5(2.0–4.0) × 0.25(0.2–0.4) cm; apicula 0.6(0.0–1.3) mm. .......................... O. engelmannii (Fig. 1)

The county distribution of Ophioglossum polyphyllum in Texas is shown in Figure 2 (triangles) in comparison with O. engelmannii (dots). The map shows a dramatic difference in range between the two species. Most of the collections of O. polyphyllum were made along U.S. Highway 90 or on roads nearby: in Brewster County near Alpine and Marathon; in Jeff Davis County near Valentine; and in Presidio County near Marfa. On the basis of our experience, we believe that an effort ought to be made to explore much further afield in other Texas (as well as New Mexico and Arizona) counties, e.g., Hudspeth, Culberson, Reeves, Ward, Pecos, and Terrell in Texas, and also areas to the south in Mexico (e.g., Coahuila, Chihuahua, and Sonora states and southwardly adjacent states).

There are many reasons why O. polyphyllum was not heretofore collected, among the most important being its occurrence among grasses, the shape of the leaf resembling some monocots, and especially the very short period of appearance above ground, which after strong rains probably rarely exceeds two weeks, the latter week presenting only dying straw colored and withered blades.

Plants are found in shallow ditches and troughs along the roadsides (Fig. 3). The adjacent landscape is open rangeland. While no plant species occur consistently with O. polyphyllum, the two most prevalent are the grasses Buchloe dactyloides and Bouteloua curtipendula. Other, less consistent associates are Bouteloua gracilis, Chloris verticillata, Hilaria mutica, Panicum obtusatum, and Bothriochloa sp. Among the forbs are Asclepias oenotheroides, Berlandiera lyrata, Cirsium texanum, Cooperia drummondii, Croton Pottaii, Engelmannia pinamatifida, Ratibida columnaris, and Thymophylla sp. The vegetation is typical Chihuahuan desert grassland, and includes such cactus genera as Coryphantha, Echinocereus, and Opuntia. The substrate involves various clays that are usually deep and allu-
Plants within adder’s-tongue colonies vary from several to hundreds. Vegetative reproduction is accomplished by horizontal roots, the proliferations producing plantlets as far as ten centimeters from the genet.

Our records outside of Texas are very few, and all were previously identified as *O. engelmannii*. In Arizona it was found in “mesas around the Mustang Mts.” The habitats in Mexico (what little is recorded on the labels) appear to be more or less similar to those in Texas. The Rollins and Tryon collection listed below was found in “clay soil over limestone, in shade of small arborescent *Opuntia* in *Larrea* and *Prosopis* desert,” and the Reeder et
Zech, et al., a new Ophioglossum for North America

Fig. 2. Presently confirmed county records in Texas for O. polyphyllum (triangles) and O. engelmannii (dots).

al. collection in “thorn savannah in the open among Eucloë dactyloides and Bouteloua stolonifera.” The Pringle and Purpus Mexican collections lack habitat data.

There is no easily projected certainty about when the plants will appear. Continuous drought will prevent the leaves from expanding and extending above the soil. However, the best months in general are June and July, whenever several rains occur. Apparently, chance rainy periods at any other time, however, will bring forth an "out-of-season" growth, and we now have records from May, August, September, October, November, and December. Our impression is that *O. polyphyllum* "lies in wait" for rain, emerges through tightly compacted soil that has been softened by the water, and then has a fairly short time span to reproduce and disperse spores. However, based upon greenhouse observations, even when water availability is not a factor, trophophores will tend to die back following spore production and dispersal.

It should be noted that *O. polyphyllum* is ecologically a "loner," in the sense that it does not occur microsympatrically along with other species of *Ophioglossum* (or *Botrychium*). Other Ophioglossaceae are noted for forming "genus communities," members of the same or closely related genera that
co-occur syntopically (Wagner & Wagner 1983). To illustrate the usual situation, in the United States in the region from the Carolinas to Arkansas and southward, we find *O. nudicaule*, *O. crotophoroidei*, and *O. petiolatum* (plus the ophioglossaceous *Botrychium bitematum* and *B. lunariae*) together in the same habitat, sometimes side by side and intermixed with each other. But this is evidently not the case with *O. polyphyllum* according to Burrows (1996) who writes that in Africa *O. polyphyllum* is “The one species of *Ophioglossum* that is rarely found as a component of genus communities.”

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NOTES ON THE FLORA OF TEXAS WITH ADDITIONS AND OTHER SIGNIFICANT RECORDS

LARRY E. BROWN
Houston Community College
1300 Holman, Houston, TX 77007, U.S.A.
and
Spring Branch Science Center Herbarium
8856 Westview Drive
Houston, TX 77055, U.S.A. plantman@flash.net

STUART J. MARCUS
Trinity River National Wildlife Refuge
P. O. Box 10015
Liberty, TX 77373, U.S.A. r2rw_tr@fws.gov

ABSTRACT

The following 15 taxa are documented as new to Texas: Alternanthera sessilis, Cyperus eragrostis, Urochloa ramosa, Lindernia crustacea, Phyllanthus fraternus, Stellaria parta, Alysicarpus vaginalis, Cardamine debilis, Rhynchospora debilis, Lilaeopsis chinensis, Rumex paraguayensis, Saccharum coarctatum, Urticaria filiosa, Polygonum meissnerianum, and Cuscuta polygonorum. Significant new collections records are provided for five: Scirpus calamus, Polygonum cespitosum, Phyllanthus niruri, Ludwigia microcarpa, and Armoracia lacunaris. Data are presented to question the presence of Eleocharis compressa in Texas. Taxa are listed alphabetically by family, genus, and species with annotations and citation of voucher specimens.

INTRODUCTION

Floristic work in the Houston area has resulted in a mimeographed plant checklist for: Brazos Bend State Park, Fort Bend County by Larry E. Brown, Frank Gregg, and Kay Lewis; Davis Hill State Natural Area, Liberty County by Larry E. Brown, Charles D. Peterson, and Joe Liggio; and the entire Houston area (Harris and adjacent counties) by Larry E. Brown. In addition, the present authors have just completed a plant checklist for the Trinity River National

Wildlife Refuge, Liberty County. This work coupled with plants sent to
the SBSC herbarium for identification has revealed a number of plants new
to Texas and significant new records for others. Some of these records were
provided to Stanley D. Jones prior to the publication of his book, Vascular
Plants of Texas (Jones et al. 1997). Here we give data to support inclusion of
these plants in this new publication.

Unless otherwise indicated, all collections cited in this paper are in the
Spring Branch Science Center Herbarium (SBSC), Houston, Texas. Duplicates of some collections are at TEX or TAES. Herbarium acronyms follow
Holmgren et al. (1990).

AMARANTHACEAE
Alternanthera sessilis (L.) DC.—A few plants of this pantropical and federal
noxious weed were found growing in the bottomland of the Trinity River
in the Davis Hill State Natural Area; 4 Jul 1994, Brown 18040. Clewell
(1985) reported it for Escambia County in the Florida Panhandle and Tho-
Nelson et al. (1997) reported it new for South Carolina and cited published
reports for its occurrence in Alabama and Mississippi. The key in Mears
(1977) can distinguish the Texas species of Alternanthera, including A. sessilis.

APIACEAE
Lilaeopsis chinensis (L.) Kuntze—Affolter (1985) mapped this species along
the Atlantic and Gulf Coast from Nova Scotia south to Florida and west-
ward along the Gulf Coast to Louisiana (one collection). Thomas and Allen
(1996) mapped it for eight coastal parishes west to Vermillion Parish. The
only Texas collection is from Galveston Bay below the Abshire House in
the Abshire Wildlife Management Area at Smith Point, Chambers County,
7 May 1993, Brown 16926. These plants were submerged at high tide and
exposed during low tide.

BRASSICACEAE
Armoracia lacustris (A. Gray) Al-Shehbaz & Bates (lake cress)—Correll and
Johnston (1970) did not report this white flowered aquatic crucifer for Texas.
The first record appears to be in Al-Shehbaz and Bates (1987) where it is
mapped in Tyler County. We found it to be infrequent in standing water in
the Davis Hill State Natural Area, Liberty County (31 May 1996, Brown &
Ligio 19172) and in the bottomland of the Trinity River National Wild-
life Refuge, Liberty County (26 Apr 1997, Brown & Marcus 20262). These
plants produced numerous flowers but had poor fruit development. Mo-
olecular studies based upon DNA (Les 1994) indicate that lake cress should
be placed into a monotypic genus Neoeckelia as N. aquatica (Eaton) Greene
and that the cause for a poor seed set is suggested by the discovery of a trip-
loid chromosome number of 2n = 28 (Les et al. 1995).
Cardamine debilis D. Don—Plants tentatively identified as this non-native species have been collected in and around nurseries, greenhouses, and yards in the Houston area. These are similar to the native C. pennsylvanica Willd. and another introduced species mostly present in the northeast U.S. and Canada, C. flexuosa Withering. Rollins (1993) separated C. debilis from the other two species by its fibrillose roots and fruits <1 mm wide. Botanists may wish to reexamine their collections, especially those identified as C. pennsylvanica, to see if they may fit the description of C. debilis. It also would be helpful to search for additional characters to separate these three similar species. Lipscomb (1978) cited the Shinners collection as a voucher for the presence of C. pennsylvanica in Texas.


CARYOPHYLLACEAE

Stellaria parva Pedersen—Landry et al. (1988) reported this chickweed new to North America from Acadia and Jeff Davis Parishes in Louisiana. Landry et al. (1989) provided a more complete discussion of its presence in Louisiana and cited an additional collection from St. Landry Parish. Thomas and Allen (1996) added Lafayette Parish to the Louisiana distribution. We discovered this species on a few disturbed sandy sites in the Trinity River National Wildlife Refuge, Liberty County, 11 Mar 1997, Brown & Marcus 20104; 6 Apr 1997, Brown & Marcus 20216. Since the original description is from Argentina in 1961 and the first Louisiana collection is in 1966, Landry et al. (1989) suggest it may have arrived in Louisiana and Argentina from an unknown native source. However, they failed to note that Pedersen (1961) in the protologue reported collections from Argentina and Paraguay in 1869 and 1872 and up to 1957.

CUSCUTACEAE (CONVOLVULACEAE)

Cuscuta polygonorum Engelmann—Correll and Johnston (1970), Hatch et al. (1990), Johnston (1990), and Jones et al. (1997) all include this dodder for Texas, apparently from Yuncker (in Lundell 1943), who included it fide Small. Even though Small (1933) gave its range from Maryland to Texas, the first Louisiana collection of it was in 1979 with a second collection in 1981 (Gandhi & Thomas 1983; Gandhi et al. 1987). The first Texas collection appears to be from Brazos County where it was growing on smartweed in the first bottomland along Highway 30, east of the Highway 6 bypass of Bryan/College Station, Sep 1996, Cheatham. Marshall & Jones s.n.
CYPERACEAE

Cyperus eragrostis Lam.—Tucker (1987, 1994) reported that this species has become naturalized in southeastern Texas but he cited no collections nor furnished details about its status in Texas. Tucker (1987) indicated it is native to the Pacific Coast of the U.S., a waif in South Carolina, and naturalized in southern Europe. It is similar to C. ochracenus Vahl and may be under this name in other Texas herbaria. The key in Denton (1978) can separate these two taxa and other similar species. The larger number of collections from LaPorte near the Barbours Cut Terminal of the Port of Houston suggest it may have arrived in the Houston area by ship.


Eleocharis compressa Sullivan—Correll and Johnston (1970) separate E. compressa and E. acutisquamata Buckley. by the wider compressed culms in E. compressa and the more narrow non-compressed culms in E. acutisquamata. Further, they reported E. compressa only for San Augustine County in East Texas and restricted E. acutisquamata to the Edwards Plateau, the north central, and southeast (Refugio County) portions of the state. In addition, they indicated (page 275) that they are probably conspecific which is suggested by the overlapping culms width measurements used to separate them in their key. We were unable to borrow Texas and non-Texas material of both entities from TEX for they are out on loan to S. Galen Smith for the Flora of North America project. However, in a survey of collections at SBSC and ASTC, we found only specimens referable to E. acutisquamata Buckley in East Texas (San Augustine and Sabine counties). From the specimens available to us, both entities can be readily separated by the nearly round culms (7–9 angled) of E. acutisquamata that are up to 25 cm tall and 0.5 mm wide in contrast to the flat culms of E. compressa that are up to 42 cm tall and 2 mm wide.

Rhynchospora debilis Gale—Gale (1944) described this taxon as a new species and noted its similarity to R. fascicularis (Michx.) Vahl. Both of these
species were growing together at the edge of Galveston Bay on a sandy bench below the bluff next to the Abshire House in the Abshire Wildlife Management Area at Smith Point, Chambers County, 7 May 1993, Brown 16932; 27 May 1996, Brown & Liggio 19138. Here they may be distinguished by the taller (≥ 35 cm), thicker culms (≥ 1.5 mm wide at culm base), and flat leaves (≥ 1.0 mm wide) of *R. fascicularis* in contrast to the shorter (ca. 15 cm) filiform culms (≤ 1 mm wide at culm base) and filiform leaves (≤ 0.5 wide) of *R. debilis*.

*Scirpus cubensis* Poeppig & Kunth [*Oxyccaryum cubense* (Poeppig & Kunth) Lye]—The first Texas collection of this sedge was in 1958 from Eagle Nest Lake in Brazoria County, Hatchkiss 7653 (TEX). The second Texas collection is from Fort Bend County where it was somewhat frequent in a floating mat of vegetation in Elm Lake at Brazos Bend State Park, 7 Nov 1997, Brown 21737. Thomas and Allen (1993) mapped it for eight central and eastern Louisiana parishes, none near the Texas border.

**EUPHORBIACEAE**

*Phyllanthus fraternus* G.L. Webster—The first Texas collection is from downtown Houston growing on bare ground among planted shrubs; 17 Sep 1995, Brown 18753. Webster (1970) indicated it is native to Pakistan and India and sporadically introduced into Africa and America. He cited only three U.S. collections, one from an abandoned field in Seminole County, Florida, and the other two from New Orleans, Louisiana (including the first U.S. collection). It is now mapped for nine Louisiana parishes mostly in the New Orleans area (Thomas & Allen 1996). It may also expand its range in the Houston area.

*Phyllanthus niruri* L. subsp. *latyroides* (Kunth) G.L. Webster—Correll and Johnston (1970) indicated this taxon may be extinct in Texas (the only U.S. records for this widespread tropical American species are from Texas) for they reported it only from the Ottine Swamp in Gonzales County, probably based upon the 1935 Tharp collection at TEX. The only collections since 1935 are the following.

Dewitt Co.: a group of plants ca. 2 ft tall, on sand under bridge on Thomaston Rd, W of Hwy 87 along the Guadalupe River, ca. 2 mi W of Thomaston Community, 11 Oct 1994, Muschelk s.n. (SBSC). Fayette Co.: S bank of the Colorado River at foot of bluff, N of Monument Hill State Historic Site, 11 Oct 1987, Carr 7867 (TEX).

The only known U.S. collections are two in the nineteenth century by Wright, one of which is from the Colorado River bottomland, the one in 1935 by Tharp, and the two recent ones reported here.

**FABACEAE**

*Alysicarpus vaginalis* (L.) DC.—Isely (1990) mentions this native from the Old World tropics as occurring in Texas. He has examined Fabaceae collec-
tions at TEX and probably discovered this Hardin County specimen, 4 mi S of Kountze along roadside, 22 Sep 1960, McLeod s.n. We have collected plants of this legume along a pipeline right-of-way in the Trinity River National Wildlife Refuge, Liberty County, 13 Oct 1996, Brown & Marcus 19731.

LENTIBULARIACEAE

_Utricularia foliosa_ L.—This large flowered, robust, floating bladderwort was not reported for Texas by Correll and Johnston (1970), possibly because Small (1933) indicated that it ranged from Florida to Louisiana. The first report seems to be in Taylor (1989), where it is listed for North Carolina, Georgia, Florida, Mississippi, Louisiana, and Texas. However, Taylor does not indicate its distribution in Texas nor provide specimen citations. The majority of the TEX and LL specimens were identified as the robust _U. vulgaris_ L.

Taylor (1989) considers the North American representatives of _U. vulgaris_ a distinct species, _U. macrorhiza_ Le Conte, and indicates its absence from eastern Texas and most of the southeastern U.S. Coastal Plain.


ONAGRACEAE

_Ludwigia microcarpa_ Michx.—Bridges and Orzell (1989) reported this species new to Texas from two roadside collections in Hardin County. They state these collections are within former extensive wetland pine savannas on the Montgomery and Beaumont Formations of the Pleistocene Epoch. A new county collection, perhaps from a younger formation, is from Chambers County where it was frequent along the sandy roadside of Highway 562 ca. 2.8 mi east of the road to Robbins Point Park, 27 May 1996, Brown & Liggio 19132.

The following collections at SBSC complete the documentation of this species in Texas. These roadside collections suggest it may be spreading westward via highways.

Voucher specimens: Hardin Co.: frequent in a dry roadside ditch along hwy 69/287 ca. 1 mi N of Kountze, associated with _Rhynchospora divergens_ and _Fauina breviseta_, 2 Aug 1986, Brown 10581; frequent in a roadside ditch at edge of a sandy acid area along Hwy 770, ca.
0.4 mi W of intersection with Hwy 1003 between Saratoga and Kountze, 16 Aug 1986, Brown 10641; on acid sandy soil with many bog plants along Hwy 421 ca. 3 mi E of intersection with Hwy 326 N of Sour Lake, 9 Jun 1996, Brown 19202.

POACEAE

Saccharum coarctatum (Fern.) R. Webster—Webster and Shaw (1995) did not consider the presence (Erianthus) or absence (Saccharum) of an upper lemma awn sufficient to separate these two genera. They, therefore, merged Erianthus under Saccharum and made the appropriate combinations under Saccharum. They did not cite any Texas collections of S. coarctatum, possibly because they did not examine sufficient material from Texas herbaria (the only Texas herbarium cited is BRIT). The following collections at SBSC document its presence in the state. The senior author first identified these plants as E. brevibarbis Michx. and then annotated them to S. brevibarbis (Michx.) Pers. var. brevibarbis. Joseph K. Wipff, then at TAES, identified them to S. coarctatum.


Urochloa ramosa (L.) Webster [Panicum ramosum L.; Bachiaria ramosa (L.) Stapf]—This native of tropical Asia has been planted in Texas and other states for erosion control and wildlife food but has not been included in any Texas floristic publications. It is reported for 31 Louisiana Parishes (Allen 1992). An adventive Texas collection is from Chambers County where it was growing at the edge of the Highway 1663 bridge over Whites Bayou northeast of Hankamer, 25 Sep 1993, Brown 17488.

POLYGONACEAE

Polygonum aspicatum Blume—Carr and Hernandez (1993) reported this Asian species new to Texas (first collection from Jasper County in 1992) using the spelling caespitum. We are following the spelling in Kartesz (1994). We discovered this species on moist to dry disturbed sites in the Trinity River National Wildlife Refuge. Here the reddish flowers stand out in contrast to the whitish flowers of P. hydropiperoides Michx. and other similar species.


Additional state collections may be masquerading under this name in other Texas herbaria.

Polygonum meissnerianum Cham. & Schlecht. var. beyrichianum (Cham. & Schlecht.) Meisn.—Correll and Johnston (1970) indicated this species has been re-
ported for Texas but saw no specimens. Park (1988) also saw no Texas collections but reported U.S. collections from Florida and South Carolina and from Plaquemines and St. Tammany Parishes in Louisiana. The only Texas collection known to us is from Orange County where it was growing in a slight swale under a canopy of Chinese tallow trees adjacent to a fallow rice field near Nederland, *Knoules* s.n. The senior author originally identified this specimen as *P. sagittatum* L. and additional collections may be filed under this name in Texas herbaria.

*Rumex paraguayensis* Parodi—This native of southern South America (naturalized in Florida and Louisiana) is now in Texas (Chambers County, present in the East Unit of the Anahuac National Wildlife Refuge off of Hwy 1985, SE of Anahuac, Spring 1991, *Neville* 274). The key in Godfrey and Wooten (1981) can separate this species from *R. obovatus* Danser, a similar naturalized South American species in northern Florida and Louisiana. Thieret (1969) reported both species new to North America and speculated that *R. obovatus* almost certainly occurs in Texas because one collection of it was made within 150 feet of the Texas border. However, based on Godfrey and Wooten's key, our specimen is *R. paraguayensis*.

**SCROPHULARIACEAE**

*Lindernia crustacea* (L.) F. Muell.—This Indo-Malaya native ranges in the U.S. from South Carolina, south to Florida, and along the Gulf Coastal Plain to Louisiana (Godfrey & Wooten 1981). Vincent (1982) mapped it for 15, mostly south central and eastern, Louisiana Parishes. He indicated it is spreading westward and that it may eventually appear in East Texas. We found this short blue flowered species on two disturbed sites in the Trinity River National Wildlife Refuge, Liberty County, 29 Sep 1996, *Brown & Marcus* 19703; 13 July 1997, *Brown* 20581.

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Cyperus fusCUS (Cyperaceae), New to Missouri and Nevada, with Comments on its Occurrence in North America

Paul M. McKenzie
U.S. Fish and Wildlife Service
608 E. Cherry St. Room 200
Columbia, MO 65201, U.S.A.

Brad Jacobs
Missouri Department of Conservation
P.O. Box 180
Jefferson City, MO 65102-0180, U.S.A.

Charles T. Bryson
USDA, ARS, Southern Weed Science Research Unit
P.O. Box 350
Stoneville, MS 38776-0350, U.S.A.

Gordon C. Tucker
Stover-Ehinger Herbarium
Botany Department, Eastern Illinois University
Charleston, IL 61920-3099, U.S.A.

Richard Carter
Herbarium, Department of Biology
Valdosta State University
Valdosta, GA 31698, U.S.A.

Abstract
Field and herbarium studies have documented Cyperus fusCUS as new for Missouri and Nevada. Localities, habitat data, lists of associated species, description, illustrations, photo of habit, and discussion of weedy potential are presented.

Resumen
Los estudios de campo y de herbario han documentado Cyperus fusCUS como nuevo para Missouri y Nevada. Se aportan localidades, datos del hábitat, listas de especies asociadas, descripción, ilustraciones, foto del hábito, y discusión de su potencial como mala hierba.

Introduction
Cyperus fusCUS L. [section Fusci (Kunth) Clarke] is native to Eurasia and the Mediterranean Region of northern Africa, extending from Greenland and Iceland to China south to Spain, Iran, Egypt, Algeria, and northern India (Kükenthal 1936; Tutin et al. 1980). The common name for this species has been listed as "galingale," "brown galingale," or "black galingale" (Weedon & Stephens 1969). It apparently was first discovered in North America based on specimens collected by Herbert A. Young along Revere Beach in Essex County, Massachusetts in 1877 (Knowlton et al. 1911; McGivney 1938). Cyperus fusCUS was subsequently documented in California (McGivney

1938; Tucker 1993), Connecticut (McGivney 1938; Dowhan 1979; Tucker 1995), Maryland, (Kükenthal 1936), Nebraska (Weedon & Stephens 1969; Kolstad 1986; Rolfsmeier 1995), New Jersey (Britton 1886; McGivney 1938), Pennsylvania (Rhoads & Klein 1993), South Dakota (Weedon & Stephens 1969), and Virginia (Hitchcock & Standley 1919; Kolstad 1986; Tucker 1987). Although the species has also been recorded for New York (e.g., Weedon & Stephens 1969; Kolstad 1986), no specimens have been located and the only ones so identified were actually C. diandrus Torr. (Mitchell & Tucker 1997). Although C. fuscus has been present on the North American Continent since at least 1877, its spread apparently has been slow, and outside of brief accounts related to its increase in distribution, there has been little attention given to it in the New World literature.

Given the great attention to new records of Cyperus in North America by Charles Bryson, Richard Carter, Stanley Jones, Barney Lipscomb, Gordon Tucker, and others in the last 20 years (e.g., Lipscomb 1978, 1980; Tyndall 1983; Carter et al. 1987; Carr 1988; Carter 1988; Sundell & Thomas 1988; Carter & Bryson 1991; Webb et al. 1991; Bryson & Carter 1992; Jones et al. 1993; Bryson & Carter 1994; Tucker 1994; Bryson et al. 1996; Carter et al. 1996), it is interesting and somewhat amazing that the species has not been discovered at more localities throughout the United States, especially as Weedon and Stephens (1969) noted that it was a weed of rice fields in the Old World. Outside the United States, the species has been discovered in Canada (Gillet 1970), but it has not been found in Mexico (Tucker 1994) or Central America (Tucker 1983).

DESCRIPTION

The following is a description of C. fuscus based on Kükenthal (1936), McGivney (1938), Fernald (1950), Kolstad (1986), and our observations. Cyperus fuscus (Figs. 1, 2): a caespitose annual with few to numerous culms and reddish-brown fibrous roots; culms upright, inclined, or decumbent, 2–30 (rarely 50) cm long, 1.3–3.0 mm thick, smooth, flaccid, and triangular in cross-section; 2–4 basal leaves per culm, 1–25 cm long, 1–4 mm wide, flat, flaccid, and minutely scabrous toward the acute apex; 2 or 3 leaf-like bracts subtend each inflorescence, varying in length, 2–25 cm long, 1–3(–5) mm wide, spreading, flat, flaccid, and minutely scabrous toward the acute apex; 6–24(–80) densely or loosely congested spikelets per spike; spikelets 8–18(–40) flowered, 3–8(–12) mm long, 1–1.5 mm wide, linear, and compressed; rachillas 0.3 mm wide, 0.2 mm thick, dark brown, straight or slightly curved, and wingless; scales (sometimes called “glumes”) subtending the flowers 0.8–1.2 mm long, 0.8–1.5 mm wide, broader than long, 3-nerved, tan or light brown at the center with narrowly hyaline margins, and the
Fig. 1. *Cyperus fuscus*. A. Habit (top and side views of clump and side view of two erect plants). B. Inflorescence. C. Spikelet. D. Scale. E. Achene (including cross-sectional view and side view of 3-cleft style). (Based on McKenzie 1802 with Jacobs; McKenzie 1804; McKenzie 1807 with Jacobs and Johnson; illustrated by Charles T. Bryson).
surfaces primarily dark reddish-brown to purple; the tips minutely apiculate; achenes 0.9–1.1 mm long, 0.4–0.5 mm wide, gray to almost white, trigonous, and narrowly ovoid; styles 0.4–0.6 mm long, 3-cleft, and not persistent; stamens 2 per flower, 0.7–0.8 mm long; anthers 0.4–0.5 mm long, tan or yellowish, and linear oblong.

Biology, ecology, and distribution

On 9 September 1997, while conducting a search for state-listed species of *Cyperus*, *Schoenoplectus*, and *Lipocarpha* along mudflats of the Missouri River in Cooper County, McKenzie and Jacobs discovered a population of *Cyperus* sp. unfamiliar to them. This *Cyperus* was semiprostrate with the culms radiating like spokes in a wheel and leaning mostly horizontal to the ground (Fig. 2). The most diagnostic features of the sedge were its dark purple to reddish-brown scales, its strongly triangular stems, its bright rusty red roots, its small spikelets, and its pale, trigonous achenes. Specimens were subsequently determined as *Cyperus fuscus*. McKenzie and Jacobs returned to the site on 28 September 1997 and counted 110 plants scattered along the silty mudflats and shoreline of the Missouri River, associated with the following species: *Amanta cocinea* Rottb., *Cyperus diandrus* Torrey, *C. erythrobas* Muhl., *C. odoratus* L., *C. squarrosus* L. (*C. aristatus* Rottb.; *C. inflexus* Muhlenb.), *Eclipta prostrata* (L.) L., *Eragrostis hypnoides* (Lam.) Britton, Sterns, & Pogg., *Finibristylias vahlii* (Lam.) Link, *Leucospora multifida* (Michx.) Nutt., *Lipocarpha micrantha* (Vahl) G. Tucker, *Polygonum* spp. and *Ranunculus sceleratus* L. Although the majority of plants were in full sunlight, some extended into the partial shade of the developing seedlings of *Salix* spp. and *Populus deltoides* Bartram ex Marshall.

Subsequent to this discovery, McKenzie and Jacobs were asked by Rhett Johnson of the Missouri Department of Conservation to identify an unknown specimen of *Cyperus* that had been collected from another site along the Missouri River in adjacent Howard County, approximately 32 km WNW of the original discovery site. McKenzie and Jacobs identified the specimen as *C. fuscus* and visited the site with Johnson on 11 October 1997, where they counted approximately 70 plants scattered along moist, sandy and silty flats adjacent to a chute that had been formed during the 1995 flood of the Missouri River.

Because the discovery of *C. fuscus* in two adjacent counties along the Missouri River suggested that the species could be widely distributed along the river, Jacobs searched locations downstream of the original discovery site and discovered it in Boone, Callaway, and Cole counties. A lack of time due to the season’s first killing frosts prevented additional searches in other counties bordering the Missouri River. With the exception of *Finibristylias vahlii*, associated plants at the second, third, fourth, and fifth sites were mostly identical to those previously mentioned for the original discovery site.
Although the initial North American discovery of *C. fuscus* in Massachusetts was apparently along a sandy beach, many subsequent records along the Atlantic seaboard were associated with “ballast sand” (Britton 1886), or “waste ground, ballast, and wharf areas” (Rhoads & Klein 1993). The Connecticut record comes from a “sandy river shore” (Tucker 1995) and habitat for the species in California has been reported as “damp, disturbed soil, receding shorelines, and puddles” (Tucker 1993). In the Midwest, the initial discoveries of this sedge were made along “wet open sandy flats” of the South Platte River in Lincoln County, Nebraska and “wet sandy clay soil” along the banks of the Keya Paha River in Tripp County, South Dakota (Weedon & Stephens 1969). The accounts by Britton (1886) and Rhoads and Klein (1993) suggest that *C. fuscus* was initially introduced to the New England coast accidentally via achenes that were in ship ballast water that originated in Europe. Introductions into other areas of the country, however, are more difficult to assess. It is possible that waterfowl were responsible for the species’ introduction into Nebraska, South Dakota, and elsewhere. Dunn and Knauer (1975) postulated that waterfowl were responsible for the introductions of *Cyperus flavicomus* Mich. [*C. albomarginatus* (C. Martius & Schrader ex Nees) Steudel], *Fimbristylis miliacea* (L.) Vahl, and *Aeschynomone indica* L. into the Mingo National Wildlife Refuge in southeastern Missouri.
While the source of introduction of *C. fuscus* into Missouri is unknown, the recent and apparent widespread distribution of this sedge along the Missouri River suggests that the species may have become established soon after the 1993 or 1995 floods. At the original discovery site in Cooper County, plants were located at the spot where a large levee break had occurred in 1995. Rolfsmeier (1995) reported that the two Nebraska records of *C. fuscus* were from separate locations along the Platte River. Because the Platte River empties into the Missouri River, and the Keya Paha eventually does the same, it is feasible that Nebraska or South Dakota may have been the seed source for the Missouri populations that became established along the Missouri River following the 1993 and/or 1995 floods. This introduction may be due to soil movement and sedimentation within the Missouri River floodplain.

Rice growers in the United States should be alerted to the potential of this sedge becoming a troublesome weed. Holm et al. (1979) listed *C. fuscus* as a principal weed in Portugal and as occurring in Afghanistan and Israel. Based on the rapid and aggressive spread of its relative *Cyperus difformis* L. in North American rice fields (Lipscomb 1980; Tyndall 1983; Bryson et al. 1996), and because *C. fuscus* is a rice weed in the Old World (Weedon & Stephens 1969; Mingyuan & Dehu 1970; Holm et al. 1979), this species should be looked for in rice producing areas of Arkansas, California, Louisiana, Mississippi, Missouri, Tennessee, and Texas.

Due to the combination of its semiprostrate habit with the culms radiating like spokes in a wheel (Fig. 2), its dark purple to reddish-brown scales, its strongly triangular stems, its bright rusty red roots, its small spikelets, and its pale (almost white), trigonous achenes, this *Cyperus* is unlikely to be confused with any other North American member of the genus. The conspicuous rusty red roots and small trigonous achenes are similar to *C. erythrorhizus*, but the dark purplish scales, strongly triangular stems, apiculate achenes, and stamen number (2 vs. 3 in *C. erythrorhizus*) easily distinguish it from that species. The purplish-tinged scales of *C. fuscus* are somewhat reminiscent of the scales of *C. diandrus*, *C. bipartitus* Torrey, or *C. flavicomus*. It can easily be separated from *C. diandrus* and *C. bipartitus* by its trigonous vs. lenticular achenes, and by its smaller (ca. 1.0 mm vs. 1.8 mm) scales. It differs from *C. flavicomus* by its flattened vs. erect habit, by the lack of white margins on the scales, and by its trigonous vs. lenticular achenes.

The authors noted that bruised fresh and herbarium material of *C. fuscus* possesses a fragrance similar to, but not as strong as, *C. squarrosum* or *C. setigerus* Torr. & Hook. Steyermark (1963) described this odor as that of slippery elm (*Ulmus rubra* Mühl.). Bruhl (1995) stated that "(i)n a few genera of Cyperaceae, a fenugreek (*Trigonella foenum-graecum*) odour is readily detectable in fresh and (especially) herbarium material."

There is apparently some disagreement in the literature regarding the
number of stamens of each floret of *C. fuscus*. In the *Flora of the Great Plains* (Kolstad 1986), two stamens are given in the key but three in the species account. One (McGivney 1938), rarely two (Kükenthal 1936), or two (Tutin et al. 1980) stamens are also cited elsewhere in the literature. George Yatskievych (Missouri Botanical Garden, pers. comm.) examined all voucher specimens from Missouri and noted that florets had only two stamens.

Given the apparent rapid spread of this species along the Missouri River in Missouri and the weedy nature of many *Cyperus* in the Old World, it is likely that this species will be discovered with sufficient effort at other Midwest locations and possibly elsewhere in North America. While studying *Cyperus* specimens at the Missouri Botanical Garden in 1988, Carter discovered a misidentified specimen of *C. fuscus* from western Nevada that originally was determined as *C. acuminatus* Torr. & Hook. The “exposed mudflat” habitat at the Nevada site is apparently similar to that in the San Joaquin Valley of adjacent California described by Tucker (1993). *Cyperus fuscus* was not listed by Cronquist et al. (1977) in the *Intermountain Flora*, nor in Kartesz’s (1987) dissertation on the *Flora of Nevada*. As with California, Missouri, Nebraska, and South Dakota, waterfowl may have been responsible for the introduction of achenes of *C. fuscus* into Nevada. The following data provide documentation for *C. fuscus* in Missouri and Nevada with herbarium abbreviations following Holmgren et al. (1990), except ctb (pers. herb. of Charles T. Bryson).


ACKNOWLEDGMENTS

We greatly appreciate the assistance of George Yatskievych, Missouri Department of Conservation, *Flora of Missouri Project*, Missouri Botanical
Garden, for initially identifying the Missouri specimens and providing additional information on *C. fuscus*. We thank Connie Rutherford, U.S. Fish and Wildlife Service, Ventura, California, for providing information on the species’ occurrence in California. Steve Rolfsmeier of Milford, Nebraska, graciously supplied data on the Nebraska records. The helpful suggestions of George Yatskievych and Robert Kral improved the quality of the manuscript.

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McKenzie, ET AL., Cyperus fuscus in North America 333


THE USE OF ANIMAL-DISPERSED SEEDS AND FRUITS IN FORENSIC BOTANY

BARNEY L. LIPSCOMB

Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102, U.S.A. barney@brit.org

GEORGE M. DIGGS, JR.

Department of Biology
Austin College, Sherman, TX 75090, U.S.A.
& Botanical Research Institute of Texas, gdiggs@austinc.edu

ABSTRACT

A specific case of the forensic use of animal-dispersed propagules is presented, and it is suggested that this type of evidence deserves wider utilization by the law enforcement community. Animal dispersed seeds and fruits are ubiquitous, often cling tenaciously to clothes or other materials worn or used by suspects, and are small and frequently go unnoticed. Furthermore, their identification is relatively inexpensive and technically straightforward, and their presentation as evidence is visually and intuitively obvious, making it ideal for the courtroom. It is also suggested that forensic botany is an excellent topic to use as a case study in college botany or biology classes because of its inherent interest and integrative nature. In order to facilitate such usage, a brief review of some aspects of forensic botany is presented including references to pertinent literature.

RESUMEN

Se presenta un caso específico de propágulos diseminados por animales en uso forense, y se sugiere que este tipo de evidencia puede tener mayor utilización en varios aspectos legales. Las semillas y frutos dispersados por animales están por todas partes, a menudo se enganchan tenazmente a las ropas u otros materiales llevados o usados por sospechosos, y por ser pequeños pasan frecuentemente inadvertidos. Además, su identificación es relativamente barata y técnicamente sencilla, y su presentación como prueba es obvia visual e intuitivamente, convirtiéndose en ideal para los juicios. Se sugiere también que la botánica forense es un tema excelente para ser usado como caso práctico en las clases de biología por su interés inherente y naturaleza integrativa. Para facilitar ese uso se hace una breve revisión de algunos aspectos de la botánica forense incluyendo las referencias bibliográficas pertinentes.

The use of plants in justice and legal systems is thousands of years old, probably beginning in such ways as trials by ordeal (Talalaj et al. 1991; Mabberley 1997). In these cases, suspects were forced to eat poisonous plants and guilt or innocence was determined by survival. Presumably, this was based on a psychological effect of guilt on the vomiting reflex—supposedly, innocent individuals would expel the poisonous material, while the

guilty would retain the poison and thus die; the efficacy of such a technique is obviously questionable. The use of plant material as evidence has also appeared in fictional works, such as the series of books by Ellis Peters about the medieval Welsh monk/herbalist/sleuth, Brother Cadfael (Whiteman 1995) and the works by H.C. Bailey about the detective, Reginald Fortune (Bailey 1936, 1943).

The modern use of plants as evidence in a court case dates to the famous 1930s Lindbergh kidnapping case in which the son of Charles and Anne Morrow Lindbergh was kidnapped and murdered. Largely through evidence provided by botanist Arthur Koehler, Bruno Hauptmann was convicted of the crime in 1935. Koehler demonstrated that the ladder used in the kidnapping was built in part from wood taken from the attic of Hauptmann’s residence (Tippo & Stern 1977; Baden 1983; Haag 1983; Lane et al. 1990; Graham 1997). Koehler’s evidence included identification of the wood based on anatomical characteristics, matching of annual growth rings, and unique markings made on the wood by tools including a lumber yard planer and a hand plane. Detailed accounts of the botanical evidence including photographs and graphics can be found in Tippo and Stern (1977), Haag (1983), and Graham (1997). Graham (1997) gave an extensive list of references. This was a landmark case, not only because it lead to the formation of federal kidnapping laws (Bock & Norris 1997), but also because the obvious value of the evidence provided by Koehler set the stage for future forensic uses of botanical information.

Since that time, there have been numerous other examples of forensic botany (and other biological disciplines such as entomology—e.g., Rozen and Eickwort 1997). The use of plant fragments, pollen grains or fungal spores, plant trichomes (hairs), anatomical evidence from indigestible cell wall material from the stomach contents of crime victims, molecular evidence utilizing DNA, and ecological evidence useful in locating hidden graves, crime sites, or dating when a crime occurred are just a few examples (Bock et al. 1988; Lane et al. 1990; Mestel 1993; Yoon 1993; Blaney 1995; Bates et al. 1997; Bock & Norris 1997; Graham 1997; Lewis 1997; Lindell 1997). The following specific cases show some of the diversity in the field of botanical forensics. Lane et al. (1990) discussed a rape case in which leaves and bark fragments were found in the pants cuffs of a suspect. The material had gotten into his cuffs while he was climbing a tree to gain access to a window of the victim’s house. His claim, that the victim had let him in through a door, did not match the botanical evidence. Another example used by Lane et al. (1990) involved a child abuse case. The parents claimed that the child had been fed a fruit cocktail just prior to dying. However, their story was contradicted when his stomach contents showed no evidence of the anatomically characteristic materials expected from such a meal (e.g.,
stone cells from pears or needle-shaped crystals from pineapples). In the case of a 1989 plane crash near Ruidoso, New Mexico, it was alleged that an engine design flaw had allowed particulate matter (pollen) to build up in the engine and cause the crash. However, it was shown that since the pollen was in fresh condition and had normal cytoplasm and cell walls as seen by electron microscopy, it could not have been exposed to the high temperatures present during engine operation or in the post-crash fire that distorted even aluminum. Further, the pollen was that of insect-pollinated plants found near the storage site of the plane wreckage; such pollen grains are unlikely to be found in any quantity in the atmosphere. Based on the evidence from forensic palynology, it was concluded that the pollen had gotten into the wreckage post-crash during several months of storage and therefore had nothing to do with the accident (Blaney 1995; Brunk 1997; Graham 1997; Lewis 1997). A final example is the use of molecular evidence linking a murder suspect to a palo verde tree (Parkinsonia aculeata L., Fabaceae) at an Arizona crime site where he allegedly dumped the body of a victim. Plant geneticist Tim Helentjaris of the University of Arizona demonstrated that two seed pods found in the suspect’s truck came from a specific palo verde tree scraped by the suspect’s truck at the crime scene. This example is important because it was the first in which plant DNA was used in a criminal case (Mestel 1993; Yoon 1993). Overviews of forensic botany were provided by Lane et al. (1990) in the general science literature and by Bock and Norris (1997) in the forensic science literature.

Our interest in this topic has developed over the course of a number of years during which as plant taxonomists we have been called upon numerous times by poison centers, hospitals, and law enforcement agencies to identify plants or their fragments. We agree with Bock and Norris (1997) that forensic botany is a resource underutilized by the law enforcement community. Further, we believe that forensic botany can be very effectively used in botany or biology courses to show the importance, applicability, and integrative nature of botany. Because forensic botany cuts across all botanical disciplines and because a given case may require many research approaches and techniques, it is a discipline that can stress the integrative nature of botany and science as a whole. Additionally, it is an excellent topic to use in emphasizing problem solving and critical thinking skills. The purpose of the present article is thus two-fold. First, based on our successful use of such information in college teaching, we want to provide in an easily accessible botanical journal a brief review of forensic botany and appropriate references in order to encourage further such usage. Second, we present a specific case of the forensic use of animal-dispersed propagules and suggest that this type of evidence has the potential to be more widely used in criminal investigations.
On July 12, 1995, a sleeping two year old girl was pulled from the first floor window of an apartment in Fort Worth, Texas. The child was sexually molested, but fortunately was found alive about three hours later in a weedy area several hundred meters from where she was abducted. Assorted evidence was used in the case including fingerprints and DNA from semen. However, the easily understandable botanical evidence was an important factor in convincing the jury of the suspect's guilt. Because the Botanical Research Institute of Texas (BRIT) is a well known source of botanical information in the local community, we were contacted by the district attorney's office to identify tiny plant fragments taken from the shoelaces of the suspect. In addition, we were provided with a bag of assorted plant material that had been collected from the crime scene where the child was left (Fig. 1). Upon opening the evidence envelope, we immediately recognized the ca. 4 mm long plant fragments as single-seeded mericarps from a member of the Apiaceae (carrot family). Using a dissecting scope and authenticated specimens in the Botanical Research Institute of Texas herbarium, these were identified as mericarps of *Torilis arvensis* (Huds.) Link, an introduced species commonly known as hedge parsley. The bag of material from the crime scene was then examined and a mature, fruit-bearing plant of hedge parsley was found. Under a dissecting scope, the small mericarps of this species (Fig. 2) are very distinctive. They are densely covered with bristles tipped with microscopic barbs that enhance their attachment to fur or clothing. They also have several very characteristic lines of closely appressed hairs between the bristles. Large photographs of mericarps from both the suspect's shoelaces and the crime scene (Fig. 3) were presented in court by one of us (BLL). Like fingerprints, this was distinctive visual evidence, more easily understood than the scientifically sound but conceptually complex evidence provided by molecular techniques such as DNA analysis. Because the suspect could have possibly picked up the mericarps from some other location, the botanical evidence alone would not have been sufficient for a conviction. However, it firmly linked the suspect with the crime site and in combination with other evidence was successfully utilized by prosecutors Sharon McLauchlin and Larry Thompson and criminal investigator Dennis Timmons. The suspect, David Noel Saddlemire, was convicted of aggravated kidnapping with the jury taking only 55 minutes to reach their verdict (Fig. 4). He was subsequently sentenced to 99 years in the Texas state prison system.

Ectozoochory, the transport of a diaspora or propagule on the outside of an animal, is a common mechanism of dispersal among flowering plants (van der Pijl 1982). While there are various types of diaspores (e.g., vegetative bulbils, fragments of the parent plant), the most common types are seeds, whole fruits, or fruit segments (e.g., mericarps as in the above example). Various methods of attachment are known, ranging from viscous
FORT WORTH POLICE DEPARTMENT
CRIME LABORATORY

RECEIPT

CASE NO. 141868
TYPE CASE Kidnapping/Sexual Assault Child
OFFENSE NO. 95 364266
VICTIM A. S.
SUSPECT David Saddlemire

Received from: Barber Lipscomb Be
Title and Address: Asst Div Ball 509 Pecan St. Ft Worth 76102
DATE 7-8-96 TIME 12:20 AM PM

DESCRIPTION:
Received botanical evidence as listed below:

A tape sealed brown paper bag containing:

1. A tape sealed bag holding plant material
   (11 - Invoice #95C03400).
2. A tape sealed envelope holding:
   A. A tape sealed envelope holding plant
      material collected from right shoe
      #22 (Invoice #95C03410).
   B. A tape sealed envelope holding plant
      material collected from left shoe
      #23 (Invoice #95C03410).
   C. A tape sealed envelope holding a
      subsample of plant material
      (28 - Invoice #95C03471).
3. A tape sealed bag holding plant material
   (28 - Invoice #95C03471).
4. A sealed envelope
   Containing Paper Hold
   Holding Bars for
   Photographing

PRINT Name: Lynn Vardy
SIGNED: Albe Vardy
ADDRESS: FWPD Crime Lab
TELEPHONE NO. 817 877 8084

001-35506-025
8-1-77

Fig. 1. Receipt of botanical evidence from the Fort Worth Police Department Crime Laboratory.
Fig. 2. *Torilis arvensis*. A) habit; B) flower; C) fruit showing mericarps with uncinate bristles; D) cross-section of fruit (drawn by Linny Heagy).
FIG. 3. Photographs of mericarps from both the suspect's shoelaces and the crime scene (Photos by Larry A. Reynolds, courtesy of Tarrant County Medical Examiner).

or mucilaginous substances that cause the propagule to stick to the dispersal agent, to very sharp, barbed or recurved hooks, spines, or awns (van der Pijl 1982). We believe that many of these examples are potentially valuable to law enforcement agencies. From many field trips both for research and with students, it has been our experience that it is rare to return from the field without attached plant material either on the clothes, in pant cuffs, on socks, or embedded in shoelaces. Some of these are merely annoying, while others (e.g., *Aristida* species—threeawn grasses) are extremely irritating when penetrating socks or pants. Many of these seeds or fruits frequently get transferred to the interior of cars on carpeting or upholstery. One does not have to go far from the sidewalk to encounter such plant materials. Because many abundant weedy species are animal-dispersed, yards, abandoned lots, and virtually any weedy or disturbed site will have some such species. Because these plant materials are so frequently encountered and because different plant species are found predominantly in specific habitats and during particular seasons, they are potentially valuable sources of evidence that can link suspects with crime scenes both spatially and temporally. Also, many (e.g., tiny fruit segments of some Apiaceae or tiny fruits of some grasses)
Mr. Barney Lipscomb
Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, Texas 76102

Dear Mr. Lipscomb:

Thank you for your expertise and assistance in the David Saddlemire trial. The case was a complex one and your testimony was very helpful in explaining to the jury one of the circumstances surrounding the offense.

The defendant was found guilty and sentenced to 99 years in the penitentiary. Again, thank you for your assistance. This case was an important one to the State of Texas and this community.

Sincerely,

[Signature]
Sharon McLauchlin
Assistant Criminal District Attorney

Fig. 4. Letter from Tarrant County Office of the Criminal District Attorney confirming the jury conviction of David Noel Saddlemire.

become deeply imbedded in cloth or carpeting, go virtually unnoticed, and often remain attached even after repeated washings or other types of cleaning. Further, seeds and fruits are easily and inexpensively identified by trained botanists using nothing more than a 10X hand lens or inexpensive dissecting scope, taxonomic literature, appropriate illustrations, and herbarium specimens. While molecular forensic techniques can potentially provide very definitive information, they are much more expensive, require sophisticated laboratory facilities, and are less intuitively obvious for courtroom presentation.
Sometimes the attachment of ektzoochorous propagules can be quite tenacious. This means that they could be attached to a perpetrator’s clothing for a very long time, or even enter the flesh. The following are specific examples from mammals that illustrate the point. Sharp-pointed structures such as fruits or awns can penetrate the mouth or other tissues of livestock (and have to be extracted by pliers) or even become subcutaneous and require surgical removal. Veterinarians (John Brakebill, Larry Edwards, Ken Lawrence, pers. comm.) indicate that it is not uncommon to find grassburs (Cenchrus species), awns (e.g., from Hordeum species—foxtail) or the pointed fruits of needle, spear, or threeawn grasses (Nassella or Aristida species) in animals. For example, in North Central Texas, Cenchrus burs are often found embedded between the toes of dogs and grass fruits are known to penetrate buccal tissues including the tongue causing serious problems (Ken Lawrence, pers. comm.). Perhaps more striking is the ability of the sharp fruits of needle grass (apparently, Nassella leuocricha (Trin. & Rupr.) Barkworth [formerly known as Stipa leuocricha Trin. & Rupr.]—commonly called winter grass, Texas winter grass, spear grass, or Texas needle grass) to deeply penetrate flesh. These can become subcutaneous and require surgical removal; for example, they can enter between the toes of dogs and sometimes migrate long distances subcutaneously causing draining tracts that will not heal until the fruit is removed (Larry Edwards, pers. comm.). The most extreme case we are aware of involved a fruit that penetrated through the skin and then the chest wall of a dog, eventually becoming embedded in a lung and causing a fatal case of pneumonia (John Brakebill, pers. comm.). Also tenacious are the spiny fruits of Tribulus terrestris L., puncture vine, of the Zygophyllaceae. These are very painful to both animal and human feet, damage even tires, and are occasionally fatal to livestock if eaten (Correll & Johnston 1970); it would not be surprising to find them attached to various objects and possibly even the tires of a suspect’s vehicle.

Locally in North Central Texas, we believe Soliva pterosperma (Juss.) Less., lawn burweed, (Asteraceae) collected from a soccer field near Arlington, Tarrant Co. (1995), was possibly spread from eastern Texas by athletic shoes; its fruit is easily, and painfully, attached by its persistent, spine-like style (Diggs et al., forthcoming). Such propagules could remain attached to a suspect’s clothing or shoes for long periods of time. Other Asteraceae are well-known as being animal-dispersed with the pappus of many species being modified into an attachment structure. The retrorsely barbed awns of Bidens species, beggar’s ticks, are strikingly effective. In another composite genus, Xanthium, cocklebur, the surface of the bur is conspicuously covered with stiff, hooked prickles ca. 5 mm long and the bur is also terminated by two prominent spines. The attachment of the hooked prickles to clothing or shoelaces is
very effective and they can also easily penetrate human skin. The hooks are strikingly reminiscent of velcro. According to the VELCRO® Industries homepage (www.velcro.com), in the early 1940s, a Swiss inventor, George de Mestral, after a walk noticed “cockleburrs” [presumably Xanthium] on his dog and his pants. He examined the hooked prickles under a microscope and derived the idea for the well known two-sided fastener—one side with stiff, cocklebur-like “hooks” and the other side with soft “loops” like the cloth of his pants. The word velcro comes from the French words velours, velvet, and crochet, hooked.

While some of the examples above were presented to show the tenacity with which diasporas attach, commonly the seeds or fruits are small and merely cling to the fur, feathers, feet, beak, etc. of the dispersal agent with little or no adverse effect. Because they are often small and inconspicuous, they may be particularly valuable from the forensic standpoint. A well known such member of the Fabaceae (legume family) is the genus Desmodium, tickseeds. The fruits or loment are jointed and break apart into 1-seeded flat segments that are the dispersal units; they easily attach to hair or clothing. In North Central Texas for example, there are 12 members of this genus, a number of them occupying rather specific habitats (Diggs et al., forthcoming). Other well known examples are the numerous Apiaceae that have small schizocarps (a fruit that splits between carpels into one-seeded portions called mericarps) whose mericarps are covered with bristles or hairs and become readily attached to many surfaces. These are particularly well known to owners of long-haired dogs because large numbers of the mericarps become entangled in the fur—sometimes the situation is so severe that the only recourse is to shave the dog. The final example given here is the legume genus Medicago, commonly known as bur-clovers. There are numerous introduced species of this genus, many of which have prickly fruits. These fruits can be somewhat larger than those mentioned previously, but are still effective at attaching to dispersal agents. Numerous other examples could be given which have potential use forensically. Fortunately, most are easily identified by experienced field botanists because such researchers have encountered them many times on their own clothing or equipment.

Other less obvious diasporas could also be potentially useful. For example, at the present time, several invasive aquatic species (e.g., Hydrilla verticillata (L.f.) Royle, in the Hydrocharitaceae) are spreading in North Central Texas, apparently by power boars transporting vegetative propagules (plant fragments). In areas of the country where there are numerous relatively new reservoirs and where the distributions of many aquatics, especially introduced species, are spotty, plant material of a given species could easily be used in linking a suspect with a given body of water.
SUMMARY

Forensic botany is a developing discipline that potentially has broader applicability than is seen at present. Technically simple, visually obvious, easily understood, and inexpensive methods such as the use of animal-dispersed seeds and fruits are particularly worthy of further consideration. Because of the inherent interest in criminal cases, the potential for emphasizing problem solving and critical thinking skills, and the integrative nature of the subject, forensic botany is a field that can be useful in botany and biology education.

ACKNOWLEDGMENTS

We would like to thank our colleagues at various law enforcement agencies, poison centers, and hospitals for their cooperation and hard work. Special thanks to Dennis Timmons, Criminal Investigator of the Tarrant County Office of the Criminal District Attorney, and Larry A. Reynolds, Forensic Photographer, for the photographs, which are used courtesy of the Tarrant County Medical Examiner. Thanks also to John Brakebill, D.V.M., Larry Edwards, D.V.M., and Ken Lawrence, D.V.M., veterinarians in Sherman, Texas, John Lanzalotti, M.D. and Bill Vande Water, BSI, for information on fictional uses of plants as evidence, and Kenna Pirkle, an Austin College student, whose Plant Biology class paper on forensic botany prompted us to write this manuscript. Linny Heagy provided the illustration of *Torilis arvensis*.

REFERENCES


NOTES

GLAUCIUM CORNICULATUM (PAPAVERACEAE) IN TEXAS

In May 1993, the senior author was informed by her friends, Don and Jo Robison, about an unusual population of wildflowers growing on their ranch. The population has been growing in the same field since the early 1960s when it first appeared with a cultivated batch of cotton seed (D. Robison, pers. comm.). The cotton was eventually replaced with sorghum alum and other grasses in order to graze cattle and the plant has continued to remain despite grazing upon by cattle during periods of severe drought.

Thousands of these individuals were observed by the senior author growing in a sandy field. The majority of the plants, however, were toward the end of their blooming period and had already developed their fruits (long linear capsules full of tiny black seeds). The senior author took the plant to be a poppy, however, one that she was unfamiliar with.

This plant was later identified as *Glaucium corniculatum* (L.) Rudolph by the junior author by comparison with herbarium collections at TEX. Fortunately, there was already a collection (O’Kennon & Cheatnam s.n.) of *Glaucium* from Texas. This specimen, however, was incorrectly identified (as *G. flavum*, a perennial species with yellow petals and glabrous capsules).

In the years since 1993, Texas experienced a drought and few, if any, of the *Glaucium* in the Garza population had bloomed, preventing further observations by the senior author. In April 1997 sufficient rains brought the *Glaucium* population to bloom allowing the senior author to both observe and photograph (Fig. 1) the population. Later, perhaps as a result of the rains, a third population of *Glaucium* was brought to the attention of the junior author (Bill Henderson, pers. comm.). This population was collected at the Balcones Canyonlands National Refuge. An estimated 100 plants were observed growing in a circular area of about 30 feet in diameter. Two individuals were blooming and five were in fruit, but the majority of the plants were in a juvenile phase too young to flower.

The genus *Glaucium* is native to Southern Europe, the Mediterranean, Hungary and South Central Russia. It has become adventive in California, Kansas, Montana, Nevada, New York, Oregon and Pennsylvania (Barkley 1986; Hickman 1993; Kiger 1997). It is immediately distinguished from other Texas genera in the Papaveraceae by its fruits which are straight, unribbed, linear, capsules up to 25 cm long. *Glaucium corniculatum* is a wholly pubescent annual, 30–40 cm tall, cauliflorous, with clear yellow sap, cauline deeply pinnate unprickled leaves, inflorescence of a solitary flower that has two free sepals and four petals. The petals are a vivid scarlet color, two of them
are wider than the other but all are of equal length (3–4 cm). At the base of each petal is a purple pattern that extends toward the tip about 1/3 the length. The pattern is oval, 10 mm wide and lined with a creamy feather-like design (Fig. 1).

Although collected in Texas as early as 1986 (Keeney 5906) and recently reported in Texas (Jones et al. 1997), and North America (Kiger 1997), *Glaucium corniculatum* has yet to be officially documented in the state. Presented here is an updated key to the genera of Papaveraceae in Texas, a listing of known voucher specimens, and a photo of the flower (Fig. 1).

Below is a revised key to the genera of Papaveraceae in the Manual of the vascular plants of Texas (Correll & Johnston 1970).

1. Acaulescent herbs; petals 8 or more, not crumpled in the bud; stigmas over the valves of the capsule. ........................................................... *Sanguinaria*

2. Acaulescent herbs or (of subcaulescent) confined to the Trans-Pecos; petals 4 to 6, mostly crumpled in the bud; stigmas over the placenta; ........................................................... 2

1. Perianth and stamens borne on the rim of the hypanthiumlike expansion of the receptacle; sepals united into a calyptra; fruit conspicuously ribbed.

2. Perianth and stamens strictly hypogynous; sepals not united into a calyptra; fruit not ribbed. ........................................................... 3

3. Herbage prickly; flowers on short pedicels; capsule dehiscing from the apex by 4 to 6 valves. ........................................................... *Argemone*

4. Herbage not prickly; flowers on long pedicels. ........................................................... 4

4. Stigmatic disk present; capsules short and turgid, to 5 cm long, dehiscing by means of small openings just beneath the truncate summit. ........................................................... *Papaver*

4. Stigmatic disk absent; capsules linear up to 25 cm long, dehiscing longitudinally from the apex. ........................................................... *Glaucium*


Voucher specimens. TEXAS. Garza Co.: community of Justiceburg, on Farm Rd. 3519 on the way to Lake Alan Henry, Don and Jo Robison Ranch, SE corner of Garza Co., ca. 3 mi from Kent Co. line, in field on N side of dirt road, 10 May 1993, *Kirkpatrick s.n.* (TEX). Kerr Co.: W of Hunt on TX 39, dry creek bed on N side of road, 2 May 1993, *O’Kennon & Cheatham s.n.* (TEX). Travis Co.: Balcones Canyonlands National Refuge, 0.2 mi along dirt road NE from intersection with Cow Creek road, dirt road is 3.4 mi N along Cow Creek Road from 1431, just after large yellow house (30° 33' 50" N, 98° 07' 70" W), 3 May 1997, *J.K. Williams et al. 150* (TEX). San Saba Co.: along the Cherokee Creek on the William Clark farm at Bend, on the edge of an over grazed field, 11 May 1986, *Keeney 5906* (BRIT); SE of the William Clark house on the east side of the Cherokee Creek at Bend (1654 plants present), 9 May 1987, *Keeney 6642* (BRIT).

The following partial list of species from the Travis county population
—Zoe Kirkpatrick, Box 696, Post, TX 79356, U.S.A. and J.K. Williams, Department of Botany, University of Texas, Austin, TX 78713, U.S.A.

REFERENCES


HOVENIA DULCIS (RHAMNACEAE) NATURALIZED IN CENTRAL TEXAS

In the late summer of 1997 an unusual tree about 12 m tall was observed at the base of a high limestone cliff above Town Lake on the Colorado River in Austin. It had alternate leaves with prominent veins, and appeared to have strange fruiting structures high on the branches, these structures apparently deformed with galls. The tree was identified as a member of the Rhamnaceae based on the characteristic three-carpellate fruit with a remnant disk at the base, very similar to Colubrina. Comparison with the Rhamnaceae collection at TEX revealed the tree to be Hovenia dulcis Thunberg (Fig. 1), the Chinese raisin tree, which is known to be cultivated in Texas (Jones et al. 1997). Mabberley (1997) suggested Hovenia to be of close affinity to Colubrina, while recent work by Richardson (unpublished data) suggest that it is more closely-allied with Ziziphus. What appeared to be galls are actually peduncles that swell naturally as the fruit develops.

This species is native to mesic forests in China and was introduced into India and Japan for its edible peduncles (Hooker 1872; Rehder 1940; Roxburgh 1975; Sargent 1916). In China the swollen peduncles of the cymose inflorescences have long been used medicinally “to offset the effects of over-indulgence in wine” (Sargent 1916). The peduncles are especially palatable after frost when they redden and the juice sweetens with pear-like flavor (Mabberly 1990; Reich 1991). The fruit itself is not edible.

This tree is known for its cold-hardiness and is cultivated in USDA climate zone 5, with minimum temperatures of -20°F (Dirr 1990; Staff of the L.H. Bailey Hortorium 1976), the equivalent of Milwaukee, WI or Binghamton, NY. It is therefore surprising to find it naturalized in Austin, TX, an area that is much warmer, and more importantly, significantly drier than much of zone 5. The locality where it grows in Austin is a cool, moist microclimate, at the base of a cliff of Edwards limestone and dolomite perhaps 40 m high, facing directly to the northeast. This cliff reaches almost to lake level, except for a very short but steep talus slope of boulders and loamy soil. Vegetation growing at the base of this northeast-facing cliff is almost completely protected from mid-day and afternoon sun, and the presence of a body of water surely modifies the microclimate further. Further exploration via boat several weeks later resulted in the discovery of a larger tree perhaps 100 m upstream, and a smaller tree perhaps 100 m downstream, both at the base of the same cliff. Flowering specimens were later collected in May 1998 from the first tree discovered.

It is possible that this small population of H. dulcis is descended from cultivated specimens that existed at the University of Texas College of Pharmacy
Drug Garden, the only other specimens known from the Austin area. Prior to the mid-1940s this garden existed about four miles to the north-east of the collection site, and was subsequently abandoned and never reconstructed (Beryl Simpson, pers. comm.). Two specimens exist at TEX from this garden, dated 1940 and 1946. It is possible that while *H. dulcis* was cultivated in this garden, birds ate the fruit, roosted on the cliffs and trees by the river, and defecated the seed to the forest soil far below. Until the early 1960’s this portion of the Colorado river was still free-flowing, and large stretches of loamier soil, which is preferred by *H. dulcis* (Dirr 1990; Staff of the L.H. Bailey Hortorium 1976), likely existed. When Town Lake was created in the early 1960’s, perhaps a much larger population of this species was submerged and destroyed, leaving only a small number of individuals growing near the top of the appropriate habitat. During further explorations, no seedlings were observed, and seedling success is probably quite low because numerous other species compete for space on this very thin ribbon of land. Furthermore, the majority of fruiting branches overhang the water, so most
fruit falls directly to the bottom of the lake. Similar habitats exist within the region, so it is possible that H. dulcis occurs unobserved elsewhere.

Voucher specimens: TEXAS. Travis Co.: tree 40 ft tall, growing at the base of a high, NE-facing limestone cliff along the edge of Town Lake, with *Cornus drummondii*, *Platanus occidentalis*, and *Smilax bona-nox*, across the lake from the boat ramp at the University of Texas Brackenridge Field Lab, Austin, 30 Sep 1997, D. Goldman with J. Crutchfield 1105 (BH, BRIT, TEX); same locality but with flowers, 29 May 1998, D. Goldman with P. Griffith 1200 (BH, BRIT, TEX).

Other specimens examined: TEXAS. Travis Co.: cultivated, Austin, 16 Sep 1940, C.C. Albers s.n. (TEX); ex cultivation; Drug Garden, University of Texas, 24 May 1946, C.C. Albers 46ph060 (TEX).

Thanks is given to John Crutchfield and Patrick Griffith for their assistance in obtaining specimens of this plant, and Hobbes Goldman, Beryl Simpson, Billie Turner, Justin Williams, and Tom Wendt for their assistance with the manuscript.—Douglas H. Goldman, Department of Botany, University of Texas, Austin, TX 78713-7640, U.S.A.

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HABRANTHUS TUBISPATHUS (LILIACEAE) NEW TO THE FLORA OF ALABAMA

The Copper Lily *Habranthus tubispatus* (L'Her.) Traub was first collected in Alabama in the northeast part of the city of Troy in Pike County on 15 July 1988 during field work for a Flora of Pike County. This species was then collected in the community of China Grove in the northern part of Pike County on 17 July 1995 and in rural western Bullock County near the area referred to as High Ridge on 12 July 1996. A fourth site southwest of the city of Troy in Pike County was discovered in August of 1997 (Fig. 1). These are the first records of this species from Alabama, and the second record of this species in North America outside of Texas and Louisiana according to Holmes and Wells (1980) and Burkhalter (1984).

*Habranthus tubispatus* (L'Her.) Traub (Liliaceae), also known as *Zephyranthes texana* Herbert or *Habranthus texanus* (Herbert) Herbert ex Steud., is a scapose perennial from a small bulb. Each 10–20 cm scape bears a single yellowish-orange flower produced during the summer months, usually following a rain. The leaves are linear, 3–5 mm wide and up to 25 cm in length, and appear in autumn and wither by early spring. The fruit is ovoid and three lobed containing numerous flat, black papery seed at maturity. The genus *Habranthus* is separated from the genus *Zephyranthes* by Sealy (1937) based upon the filaments of *Habranthus* being of four lengths and the anthers affixed at the middle, while in *Zephyranthes* the filaments are of alternate lengths and the anthers affixed below the middle.

In the city of Troy, Copper Lily is found growing in lawns, along side walks, in a city softball field, a grass parking lot, and a cemetery. All of the sites are to some degree disturbed and other vegetation consists primarily of mixed grasses (predominately *Cynodon dactylon* (L.) Pers., *Paspalum notatum* Fluegge, and *Eremochloa ophiuroides* (Munro) Hack.) and other bulb species (*Ipheion uniflorum* (Lindley) Raf., *Allium bivalve* (L.) Kuntze, and *Allium canadense* L.). Copper Lily is so abundant there that in some lawns it forms a complete ground cover when in foliage. The soils are sandy and well drained. Flowering of Copper Lily is most common in July, August, and September, when periods of drought are broken by summer thunder showers. The foliage appears in late autumn, usually in October, and remains green throughout the winter. The total area occupied by Copper Lily in Troy is about three to five acres, and extends in an unbroken population for 276 meters along Three Notch Street.

In China Grove and in the High Ridge area Copper Lily is found on roadsides and in lawns. It is associated with many of the same species as the population in Troy, with *Cynodon dactylon* (L.) Pers. and *Paspalum notatum* Fluegge

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Fig. 1. Map of Alabama with locations of Pike and Bullock counties.

predominating. The soils in China Grove and in High Ridge are coarse sands and the sites tend to be xeric. Undisturbed areas nearby support a dwarf oak-lichen sandhill community. The population in China Grove extends for 301 meters along Pike County Highway 37 and the High Ridge population extends for 142 meters along Bullock County Highways 7 and 14. Estimates of total population size are three acres for China Grove and two acres for High Ridge.

The fourth population is located about eight miles southwest of Troy near Goshen. It is also found on a roadside and extends for 75 m along Pike County Highway 25. The soil is sandy and the main associate at this site is *Paspalum notatum* Fluegge. This is the smallest population, covering approximately one-half acre.

Monitoring of a planted population of copper lily for five years revealed that the seed generally fell within 15 cm of the parent plant and that seed-
lings were readily produced. Seedlings generally flowered for the first time in their third year of growth without special care.

Holmes and Wells (1980) reinforced the suggestion of H.H. Hume (Sealey 1937) that the distribution of Copper Lily in North America was the result of human activity. They speculated that the distribution of the Copper Lily in North America was most likely the result of traveling Spanish missionaries as all of the Texas and Louisiana populations are near the sites of Spanish missions. As there is no record of a Spanish mission ever having been located in Troy or in Pike county, it is most likely that the species reached Alabama by other means. Historical records of the Troy-Pike county area reveal that in 1865 a man by the name of William Murphree left Troy and moved to Walker County, Texas. In letters to his mother, Murphree states that he is enclosing seeds for her to plant. In other records Mrs. Murphree is noted for planting many of the decorative plants in Troy at that time. The Murphrees lived on Three Notch Street in Troy, the site of the largest Copper Lily population reported above. Walker County, Texas, where Mr. Murphree moved is listed by Holmes and Wells as a place where Copper Lily was collected (1980). We therefore speculate that Copper Lily was introduced into Alabama by the Murphree family from populations in Walker County, Texas. As all of the sites reported above are old communities, it is likely that Mrs. Murphree shared the plant with friends or relatives nearby.

Pike Co.: T10N R21E sect. 29, Troy, U.S. Hwy 29 (Three North Street), north of downtown at Knox Field, abundant along sidewalks and road, lawns, and vacant lots, full sun, sand or clay soil, flowered after shower during drought, no leaves seen, 15 Jul 1988, A.R. Diamond 3210 (AUA); T12N R21E sect. 9, China Grove, just east of Pike Co. Hwy 7, roadside, full sun, dry sandy soil, common, 17 Jul 1995, A.R. Diamond 9691 (AUA); T9N R20E sect. 6, Pike County Hwy 25, 0.2 mi S of U.S. Hwy 29, ca. 75 m along the west side of the road, full sun, flowers yellow, 3 Oct 1997, A.R. Diamond 11131 (AUA).

Duplicates will be distributed at a later date.—Alvin R. Diamond, Jr., Charles P. Chapman, and Jim Brummitt, Department of Biology, Troy State University, Troy, AL 36082, U.S.A.

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**PLANTAGO CORONOPUS** (**PLANTAGINACEAE**) NEW TO TEXAS

*Plantago coronopus* L., native to Europe and the Mediterranean area (Chater & Cartier 1976), was reported as naturalized in California (Dempster 1993). In the eastern United States it has been variously described as rarely adventive on ballast heaps at seaports (Gleason 1952), occurring sporadically about ports without persisting (Fernald 1950), and as a repeated introduction in ballast that does not become established (Gleason & Cronquist 1991). It was not reported in standard floras of the southeastern United States (e.g., Small 1913; Radford et al. 1968), or in the floras of Missouri (Steyermark 1963), New Mexico (Martin & Hutchins 1981), Great Plains (McGregor & Brooks 1986), Arkansas (Smith 1994), Oklahoma (Taylor & Taylor 1994), or Texas (Correll & Johnston 1970). It was also not included in more recent works on Texas plants such as Hatch et al. (1990) or Jones et al. (1997), nor was it listed by Rosatti (1984) in his treatment of Plantaginaceae for the Generic Flora of the Southeastern United States.

As part of the collecting effort for the forthcoming *Shinners & Mahler's Illustrated Flora of North Central Texas* (Diggs et al., forthcoming), a collection made in 1998 in Fort Worth (Tarrant County) is apparently the first documented occurrence of this species for Texas.


At the collection locality numerous individuals were observed as landscape weeds and other individuals were observed in nearby weedy areas. The mode of introduction is unclear, but seeds were possibly introduced with landscape plants. Introduction could also have occurred through spread from intentional cultivation. Since 1997, seeds of *Plantago coronopus* have been offered by Johnny's Selected Seed Company for the specialty salad green market under the name "Minutina" or "Erba stella" and, until recently, seeds were sold by the Ornamental Edibles Seed Company as an "edible landscape plant." Other north central Texas populations have not been found and it is unclear whether the species will become more widely established. However, some individuals were very robust, with one having 65 inflorescences. Also, the species is self-compatible (Delden et al. 1992) and is tolerant to drought, soil compaction, and competition (Mook et al. 1992). The seeds are highly viable and germinate well in soils with low moisture content (Blom 1992).

This species, commonly known as buck-horn plantain, differs from all other plantains occurring in Texas in having deeply pinnately lobed leaves, short hairs on the corolla tubes, and 3- or 4-locular capsules. Other members of the genus occurring in the state have leaves entire or with few teeth or shallow lobes, corolla tubes glabrous, and 2-locular capsules.
Plantago coronopus (Fig. 1) can be recognized by the following description (Butcher 1961; Gleason 1952; Chater & Cartier 1976; Dempster 1993; Rahn 1996): Pubescent annual or biennial with a taproot and leaves in a basal rosette; leaves closely spreading on the ground or ascending, linear to lanceolate in outline, 4–25 cm long, with spreading-ascending, acute, ± linear lobes, the lobes sometimes toothed or lobed; inflorescences sometimes numerous, 5–50 cm long including the leafless, densely hairy peduncle terminated by a narrowly cylindric, dense spike to ca. 12.5 cm long; bracts usually not surpassing the flowers, broadly scarious-margined at base, the keel prolonged into an acuminate tip; corolla tubes covered with short hairs; petals acute; stamens 4; capsules 3- or 4-locular; seeds 3–5 per capsule, dimorphic, one per locule, ca. 1.5 mm long, and one smaller than the others, ca. 0.5 mm long, occurring in an upper compartment in the ovary on the abaxial side; flowering late Apr–Sep.

—Robert J. O'Kennon, Botanical Research Institute of Texas, 509 Pecan Street, Ft. Worth, TX 76102, U.S.A., bokennon@brit.org; George M. Diggs, Jr., Department of Biology, Austin College, Sherman, Texas 75090, U.S.A. & Botanical Research Institute of Texas, gdiggs@austinc.edu; and Ronald K. Hoggard, Department of Biology, University of Central Oklahoma, Edmond, OK 73034, rhoggard@ionet.net.

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PTERIS VITTATA (PTERIDACEAE), A NEW FERN FOR TEXAS

Pteris vittata L., commonly known as ladder brake, Chinese brake, or Chinese ladder brake, is an Asian native well known as an escape from cultivation in coastal areas of the southeastern United States. The species was not included in Small’s 1903 or 1913 treatments of the southeastern flora. Small later (1938) treated the species as Pycnopodia vittata (L.) Small, indicating that it had been collected in Florida many years previously and that during the 1930s it was abundant at several Florida localities (e.g., Everglades). He also indicated that it was established in Alabama, Louisiana, the West Indies, and South America. Currently, Pteris vittata is common in southern Florida where it can be found in almost every habitat with exposed limestone (e.g., pinelands) and on a variety of man-made calcareous substrates (e.g., sidewalks, buildings, old masonry) (Nauman 1993). Radford et al. (1968) cited a South Carolina record and noted that it was a rare escape. Nauman (1993) mapped the species as occurring from southern South Carolina south to Florida and west to eastern Louisiana; he also showed isolated occurrences in southern California and the District of Columbia.

Pteris vittata was not included in the Texas flora by Correll (1956, 1966), Correll and Johnston (1970), Stanford (1976), Hatch et al. (1990), or Jones et al. (1997), nor has it been reported from Oklahoma (Taylor & Taylor 1994). It is now known from Texas based on the following collection:

Voucher collection: Texas. San Saba Co.: ca. 3 mi N of Bend, on the Edwards Plateau, growing from a limestone boulder with Adiantum capillus-veneris L. at edge of Rough Creek (tributary of the Colorado River), 6 Nov 1987, J.W. Stanford 5308 (BRIT, HPC, SPLT).

Subsequent flooding has destroyed the site. The identification was confirmed by Jim Blandingame (South Plains College, Levelland, TX).

Of the five Pteris species in the United States (most occurrences are in the southeastern part of the country), four are introduced and one, P. babamensis (J. Agardh) Fée, is native to south Florida (Nauman 1993). Besides P. vittata, only P. multifida Poir. (spider brake, Chinese brake, Huguenot fern), is known from Texas. This widely cultivated native of China is naturalized in east and southeast Texas and the Rio Grande Valley (Correll & Johnston 1970; Hatch et al. 1990). The deeply palmately 3-divided pinnae (at least some) of P. multifida are quite distinctive.

Pteris vittata can be recognized and distinguished as follows: stems short-creeping, stout, densely scaly; leaves clustered, strictly 1-pinnate (the pinnae without lobes or divisions), 0.3–1 m long including petiole; pinnae 12–20(–30) pairs per leaf, linear-lanceolate to linear-attenuate, 2–18 cm long, 4–9 mm wide, long-attenuate or sharply acute apically, asymmetrically cordate to widened or truncate basally; serrulate marginally; distal pinnae conspicuously

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longer than proximal pinnae (leaf blades thus oblanceolate in outline) with the terminal pinna typically longest; petioles and often rachises densely scaly; sori usually of a continuous narrow band near the margins of the abaxial surface of the pinnae (thus most of the abaxial blade surface exposed) (Long & Lakela 1971; Nauman 1993; Smith & Lemieux 1993). The species is a tetraploid, with $2n = 116$ (Nauman 1993). An illustration and a detailed description are available in Small (1938). A recent treatment of Pteris, including a key to taxa occurring in the United States and an illustration of P. vittata, can be found in Nauman (1993).

—Jack W. Stanford, Department of Biology, Howard Payne University, Brownwood, TX 76801, U.S.A., jstanfor@bptux.edu and George M. Diggins, Jr., Department of Biology, Austin College, Sherman, TX 75090, U.S.A. & Botanical Research Institute of Texas, 509 Pecan Street, Ft. Worth, TX 76102, U.S.A., gdiggs@austin. edu.

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LYCIANTHES ASARIFOLIA (SOLANACEAE)
NEW AND WEEDY IN TEXAS

In July of 1997 an unknown plant was collected in Houston and sent to Texas A&M for identification. It proved to be Lycianthes asarifolia (Kunth & Bouché) Bitter, a member of the Solanaceae native to South America. This species has been previously known in North America only from New Orleans, Louisiana (Darwin & Feibelman 1991). De Rojas and D'Arcy (1997) incorrectly cited that collection as being from Texas.

This species is recognizable by its prostrate habit, having slender stolons that root at every node. The leaves are strongly cordate, entire, and long-petioled. Sometimes a second leaf is produced at non-flowering nodes: if the primary leaf is relatively large, the second leaf is usually small and often stipule-like; when the primary leaf is relatively small, the second is often nearly the same size. The flowers are white, rotate, and ca. 1.5 cm broad. The yellow anthers are connivent around the style and poricidally dehiscent. The fruit is an edible reddish-orange berry ca. 1.3 cm in diameter, closely subtended by the truncate calyx. Plants are self-infertile (Dean 1997). A good illustration can be found in the article by De Rojas and D'Arcy and images of the Houston plants can be seen at Texas A&M's Bioinformatics Working Group Image Gallery page (http://www.csdl.tamu.edu/FLORA/imaxxsol.htm). Note that the leaves of the Houston plants are nearly all rounded apically rather than pointed as in the article illustration.

A visit to the collection site revealed that this plant has overrun several residential yards in Houston, forming a dense, attractive ground cover in shaded areas. It is apparently reproducing both vegetatively and sexually, for numerous flowers and immature fruits were seen in early December 1997 and mature fruits were collected in March 1998. (Darwin and Feibelman found no fruit in the Louisiana population and none has since been seen on plants grown from cuttings taken from that population.) The authors also suspect that propagules are being carried from yard to yard on the equipment of landscape maintenance companies. The exact time and point of introduction is not known, but the population has been in existence for three or more years. Residents' attempts to control the plant by hand-pulling, mowing, herbicide application, and removal of infested sod have proved unsuccessful. It appears to be tolerant of Houston's winter weather and suffers only partial dieback during the hottest summer days. Should this plant become established in nearby Memorial Park (a large, wooded area), it could be nearly impossible to eradicate. Herbicide trials were begun in one of the Houston yards in March of 1998. After two rounds of tests, no treatment has pro-
vided complete control, and treatments which have weakened the *Lycianthes* have also damaged the surrounding turf.

It is possible that this plant could become a noxious weed in southern Texas. The USDA Animal and Plant Health Inspection Service is conducting a formal risk assessment. (The Louisiana Department of Agriculture has considered surveying for the plant in the New Orleans area.) The authors encourage identification, documentation, and destruction of any new colonies subsequently discovered. Should other populations of this plant be found, please contact one of the authors.


We thank Michael Nee (NY) for his assistance in identifying this plant.

---Monique Dubrule Reed, Biology Department, Texas A&M University, College Station, TX 77843-3258, U.S.A. and Mary Ketchersid, Agricultural and Environmental Safety, Texas Agricultural Extension Service, College Station, TX 77843-2488, U.S.A.

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**FIRST REPORT OF THE GENUS BURMEISTERA (CAMPAagnarULACEAE) FROM HONDURAS**

*Burmeistera* Triana (Campanulaceae: Lobelioidae) is a genus of 96 species endemic to the Neotropics (Lammers 1998); it was last monographed by Wimmer (1943). The genus is closely related to two other Neotropical endemics, *Centrapgon C. Presl and Siphocampylus Pohl* (Pepper et al. 1997; Lammers 1998). All are large robust plants (herbaceous or suffruticose perennials, shrubs, subshrubs, or lianas) with large flowers (corollas averaging 30–60 mm long or more) borne singly in the axils of the upper leaves or aggregated into terminal bracteate or foliose (sometimes corymbiform) racemes; the tube of the corolla is neither fenestrate nor cleft dorsally and if the lobes are dimorphic, it is the two dorsal ones that are the larger. *Burmeistera* is distinguished from its allies by its combination of usually ebracteolate pedicels, green or yellow corolla often suffused with maroon or purple, large falcate or reflexed dorsal corolla lobes, the wide open orifice of the anther tube, baccate often inflated fruit, and oblong to fusiform seeds much longer than broad.

Most of the species of *Burmeistera* are found in montane areas from Costa Rica to Ecuador. At the southern limits of this range, two Ecuadorean species extend south into Peru (Stein 1987). At the northern end, a single species is known to occur north of Costa Rica: *Burmeistera virescens* (Benth.) Benth. & Hook. ex Hemsl. It has been reported (McVaugh 1943; Wimmer 1943; Nash 1976) only from Guatemalan, where it occurs in the departments of Alta Verapaz, Baja Verapaz, Huehuetenango, Quezaltenango, San Marcos, and Suchitepéquez. This is a disjunction from its congeners of nearly 700 km. That gap has been narrowed, however, by the discovery of this same species in central Honduras. This is the first report of any member of *Burmeistera* from that nation.

Voucher specimen: HONDURAS. Depto. Olancho: Parque Nacional la Muralla, trail above Visitors’ Center, ca. 14 km above La Union, 15°0'N 86°40'W, in dense high primary *Quercus* forest, 1400 m, 27 Oct 1996, P.J.M. Maas & H. Maas 8441 (U).

The new locality in Honduras is approximately 350 km east of the nearest conspecific populations in Guatemala. The *Quercus*-dominated primary forest there was quite rich in epiphytes, including *Pleurothallis tuerckheimii* Schlecht. (Orchidaceae), *Columna rubraeulid* Standl. (Gesneriaceae), and *Peperomia boffiannii C. DC.* (Piperaceae). Understory shrubs included *Besleria solanoides* Kunth (Gesneriaceae), *Momma inferleya* Taylor (Polygalaceae), *Tournfortia* sp. (Boraginaceae), scandent *Sphyrosernum maja* Griseb. (Ericaceae), and a treelet species of *Clethra* (Clethraceae). Species found in the herbaceous layer

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were *Psilochilus* *macrophyllus* (Lindl.) Ames (Orchidaceae), *Renealmia mexicana* Klotzsch ex Peterson (Zingiberaceae), *Smilacina* sp. (Asparagaceae), *Spigelia* sp. (Spigeliaceae), the saprophyte *Gymnosiphon* *suaveolens* (Karst.) Urb. (Burmanniaceae), and the root-parasite *Monotropa uniflora* L. (Monotropaceae). Adjacent patches of secondary forest contained small trees of *Saurania veraguensis* Seem. (Actinidiaceae), shrubs of *Triumfetta species* Seem. (Tiliaceae), and the herbs *Canna turckheimii* Kraenzl. (Cannaceae) and *Hydrocotyle mexicana* Cham. & Schlecht. (Apiaceae).

— Thomas G. Lammers, Department of Botany, Field Museum of Natural History, Chicago, IL 60605-2496, U.S.A.; and P.J.M. Maas, Department of Plant Ecology and Evolutionary Biology, Herbarium Division, Willem C. van Unnikgebouw, Heidelberglaan 2, 3584 CS Utrecht, Netherlands.

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**TRIRAPHIS MOLLIS** (POACEAE: ARUNDINEAE) A SPECIES REPORTED NEW TO THE UNITED STATES

Prior to this report the occurrence of *Triraphis* and *T. mollis* R. Br. (purple plumegrass) in naturalized populations was not documented in the United States (Chase 1951; Correll & Johnston 1970; Gould 1975; Hatch et al. 1990; Kartesz 1994; Jones et al. 1997). Specimens of this taxon were first collected in naturalized populations by William Godwin on 15 Mar 1993 in Dimmit County. Since the original U.S. collection, William E. Fox III collected the species in the same area on 1 May 1996.

Cultivated specimens collected from an experiment station in Biloxi, Mississippi were located in TAES. However, specimens have not been located that were from escaped or naturalized populations. TROPICOS has reported this species as being present in the U.S. because of a listing by the U.S. Department of Agriculture in their “National List of Scientific Plant Names” (U.S.D.A. 1982). In that U.S.D.A. publication, the distribution was not listed because the plant species was not naturalized.

The species was identified to genus using Clayton and Renvoize (1986) and to species using Simon (1993). The identification was then verified using the Tracy Herbarium (TAES) plant specimens from Australia and specimens from U.S. National Herbarium (US). Lazarides (1970) reported the grass to be grazed in Australia, but stated that it appeared to be less valuable than many short-lived perennials. Clayton and Renvoize (1986) reported the genus to be allied with *Neyraudia* because of gross morphology and the slender microhairs.

Superficially, *T. mollis* resembles *Aristida*. However, upon examination of the spikelets with a dissecting microscope the following observations become apparent. Spikelets have several florets with the reduced floret apical. Also the lemmas are 3-veined, 3-awned. The lemma awns are extensions of the 3-veins of the lemmas. In *T. mollis*, the central lemma awn originates from the lemma apex and lateral awns below and on both sides of the central awn, whereas in *Aristida* the lemma awns originate from a column or the lemma apex and branch from a common point of origin.

**Triraphis mollis** R.Br., Prodr. Fl. Nov. Holl. 185. 1810. (Fig. 1).

Caespitose perennial. Culms to 50 cm tall, erect to ascending, unbranched; nodes glabrous, purplish black; internodes solid. Leaves mostly basal; sheaths glabrous, rounded, margins free; auricles minute; ligules a fringe of hairs about 1 mm long; blades 6–17 cm long, 1–2 mm wide, flat becoming involute, glabrous. Panicles 7–20 cm long, 8–15 mm wide (excluding awns), contracted, somewhat interrupted, purplish tinged. Spikelets 4–12 mm long,
Fig. 1. *Triraphis mollis*. A. habit; B. spikelet, glumes separated from florets; C. floret, palea view with lemma margin and the associated hairs; and D. ligule.
crowded, pedicellate, laterally compressed, disarticulation above glumes and between florets; florets 4–10, callus bearded, reduced florets 1–2 and apical. Glumes subequal (not consistent in which glume is longer), 1-veined, hyaline, shorter than spikelets, awnless; first glumes 3.5–5 mm long; second glumes 4–5.5 mm long; lowermost lemmas 4–5 mm long, 3-veined and 3-awned, deeply bifid with teeth to 1 mm long, membranous, median vein awns 6–9 mm long from between teeth of bifid apex; lateral vein awns 5.5–7 mm long, divergent; lateral veins with long pilose hairs (hairs occasionally on the lemma body); lowermost paleas 2–2.5 mm long, 2-keeled, hyaline, glabrous to scaberulous. Stamens 3; anthers 0.2–0.3 mm long, yellow.

Collection localities were characterized by deep sandy soils of the Brystal Fine Sandy Loam (Stevens & Arriaga 1985). Historically, well drained sandy soils derived from Carrizo Sandstone were called Norfolk Fine Sand (Carter 1931). These soils are derived from parent material in the Carrizo Sands Formation. Carrizo Sand has been shown to have hygroscopic properties that ameliorate the effects of a xeric climate and consequently influence its plant formation (McBryde 1933).


UNITED STATES. Texas-Dimmit Co.: 14 mi NW of Carrizo Springs on Cometa Road, near sandy dirt road between Cometa and Hwy 277, 15 Mar 1993 W. Godwin s.n. (TAES); 13 mi W of Carrizo Springs, 2 mi W of FM 393 along Hwy 277, then 2 mi N on Cometa Road, along W side of road, 1 May 1996 W.E. Fox III, 548A (TAES). Associated with Pappophorum, Pennisetum, Setaria, Acacia and Prosopis.

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—Stephan L. Hatch, William E. Fox III, and John E. Dawson III, S.M. Tracy Herbarium, Department of Rangeland Ecology and Management, Texas A&M University, College Station, TX 77843-2126 U.S.A.; and William B. Godwin, Department of Entomology, Texas A&M University, College Station, TX 77843-2475 U.S.A.

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PRIORiTY oF THE NAME AGALINIS HARPERI (SCROPHULARIACEAE) OVER THE NAMES AGALINIS DELICATULA AND AGALINIS PINETORUM

This paper is part of an ongoing study by the author of the vascular plant genus Agalinis along the Gulf Coastal Plain. The objective of this note is to clarify one of the many nomenclatural difficulties associated with North American species of this genus.

Pennell (1913) described three species of Agalinis from Florida: A. delicatula, A. harperi, and A. pinetorum. These species have recently been shown to be conspecific (Canne-Hilliker and Kampny 1991). Later, in 1929, Pennell reduced A. delicatula to a variety of A. pinetorum as A. pinetorum var. delicatula (Pennell) Pennell, considering it to be a weak variety at best and stating in his description that it was “Of doubtful rank” (Pennell 1929). In their study, Canne-Hilliker and Kampny (1991) concluded that all three names represented one species and and chose A. harperi for this complex. Kartesz (1994), although apparently aware of the work of Canne-Hilliker and Kampny, chose instead to combine the two species under the name A. pinetorum. Although Pennell later recognized the name Agalinis pinetorum var. delicatula (Pennell) Pennell at the varietal rank, it must still be taken into account for nomenclatural purposes because the name A. delicatula has equal priority with A. pinetorum (Pennell 1913).

The name Agalinis harperi and a brief description of the species first appeared in the Flora of Miami, published in 1913 (Small 1913), in which Pennell prepared the treatment of Agalinis. On 13 August 1913, the August issue of Bulletin of the Torrey Botanical Club was published, and in this issue Pennell published for the first time the description of A. delicatula and A. pinetorum (Pennell 1913). It is clear that Pennell realized that Small’s flora had appeared (or would appear) before the August 1913 publication of the Bulletin, this is because he (p. 426) noted that A. harperi was first described in the Flora of Miami. But due to the fact that Small published the Flora of Miami himself, I have been unable to determine an exact publication date for it. However, in accordance with Art. 31.1 of the Code (Greuter et al. 1994), A. harperi was effectively published prior to publication of the 13 August 1913 issue of Bulletin of the Torrey Botanical Club. The valid publication date is fulfilled in two ways in accordance with Articles 29.1 and 31.1 of the Code:

1. The preface of Small’s Flora of Miami is dated 26 April 1913 (Small 1913); this is the only exact date found in the flora. According to Art. 31.1 of the Code, in the absence of any other evidence validating the date of a work, the earliest date indicating publication is to be accepted as the

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correct publication date.

2. In a 1997 communication with John F. Reed, Director of the LuEsther T. Mertz Library at the New York Botanical Garden, I was able to verify that the publication of Small’s Flora of Miami did in fact precede the 13 August 1913 publication date of Bulletin of the Torrey Botanical Club—a copy of Small’s Flora of Miami at the New York Botanical Garden’s library is date-stamped 21 June 1913. Thus, publication of Agalinis harperi in Small’s Flora of Miami obviously preceded the 13 August 1913 publication of A. delicatula and A. pinetorum in the Bulletin. The valid name for this species and its synonyms is as follows:

**Agalinis harperi** Pennell, in Small, Flora of Miami, 176. 1913.


**ACKNOWLEDGMENTS**

I thank John Thieret of Northern Kentucky University for reviewing the manuscript and John F. Reed of the LuEsther T. Mertz Library at the New York Botanical Garden for his assistance. I also thank Judith Canne-Hilliker of the University of Guelph in Ontario, Canada for sharing her unsurpassed knowledge of _Agalinis_ with me.—John F. Hays, Ozark Environmental Consulting, 3308 Keens Edge Drive, Columbia, MO 65201, U.S.A.

**REFERENCES**


Heinz (Harry) Dietrich Lubrecht, age 88, well known botanical and natural history bookseller, antiquarian book expert, appraiser, and former executive of the publishing company, Stechert-Hafner, died 12 November 1997, at the Columbia Presbyterian Hospital, New York City, after suffering a stroke. Harry, as he was affectionately known by friends, colleagues, and family, devoted nearly 70 years to the scholarly book trade, particularly in botany and natural history. In 1974 he established Lubrecht & Cramer, Booksellers and Publishers, currently located in Port Jervis, NY. His high standards of business, steadfast honesty, and breadth of knowledge of botanical literature earned him national and international respect as a bookman. With the passing of Harry Lubrecht the botanical and bookselling community has lost a faithful friend and serious scholar.

Born 2 December 1908, in Reutlinger, Germany, Harry was the son of Adolph August Karl Friederich Wilhelm and Sophie Amalie (Grueninger) Lubrecht. His father, an architect, was the son of Lutheran Pastor Adolph Lubrecht and Emma Karoline Kuebel. His mother, well-educated and adept in three foreign languages, was the daughter of Johann Matthis Grueninger, Professor of Mathematics in the Reutlinger Hochschule, and Sophie Kaemerer. When Harry was five, his parents separated. Subsequently, Harry, his mother, and two sisters moved to Stuttgart to live in an aunt’s apartment home. He attended Friedrich Eugens Oberrealschule and completed Hochschule in Stuttgart. Throughout his school years Harry was an avid reader. In order to ensure enrollment at his school, Harry secured an annual scholarship by placing in the top five of his class.

Upon graduation at age 17, Harry became an apprentice in Brueninger’s department store as part of his continued schooling. His flare for business was well recognized by the store’s management and in three years he earned the salary of a regular employee. Refusing to join the Nazi party, he was compelled to leave Germany. Harry emigrated to the United States where his Uncle Christian Grueninger, the mayor of Valhalla, NY, would sponsor him. Arriving in America on 15 May 1928, he soon found a job as a grave
digger at the local cemetery in Mt. Kensico, NY. When this seasonal work concluded that fall, Harry looked for employment in New York City. In October 1928, G.E. Stechert & Co.,1 well-known international book firm, hired him at a weekly salary of $14.00. The stage was thus set for a distinguished, life-long career in the book world, a profession practiced by ancestors on two sides of his family. Some of the Kuebels were medieval scribes, the book "publishers" of their time. In the early nineteenth century two Lubrecht brothers, Heinrich and August Adolph, separately developed careers as booksellers in Heilbronn and Blaubeuren, Germany. In the mid-nineteenth century August's son, Karl Theobold, emigrated from Blaubeuren to Brooklyn, NY. Here he Anglicized his name to Charles T. and founded with his cousin the publishing company Haasis and Lubrecht.

At Stechert Harry advanced from his initial position as billing clerk to assistant manager of the Antiquarian Department (April 1936). He was a natural for this job as he was familiar with German, French, Latin, and Greek. His facility for languages assisted him in compiling book catalogs and understanding the contents of many scientific books, especially those in German, acquired by the company. Since his immediate boss lacked significant experience in the antiquarian book market, Harry enjoyed the freedom and breadth to develop the antiquarian department about which topic he read widely. Under his supervision the process of searching for and supplying out-of-print books was significantly accelerated (Anonymous 1952). Among Harry's promotions were to: Chief of Reference and Customer Service, G.E. Stechert & Co. (spring 1945); Division Chief, Antiquarian and Out-of-Print Department, Stechert-Hafner, Inc. (fall 1951); Vice-President and Editor, Hafner Publishing Co. (January 1955); and Vice-President, Macmillan Publishing Co.-Hafner Publishing Division (1969).

After conducting a four-year study on subject publishing, Harry concluded that few firms published books on botany. Through Harry's efforts a new subsidiary called Stechert-Hafner Service Agency was established in 1960. Botanists and natural historians are fortunate to have had Harry's

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1A brief chronology of this book firm provides an historical perspective. Stechert & Wolff, founded on 1 September 1872, was renamed Gustav E. Stechert (1876), G.E. Stechert (1897), and G.E. Stechert & Co. (1904). On 1 October 1946, the G.E. Stechert partnership was dissolved and Stechert-Hafner, Inc. (SH) was created with its publishing and reprinting activities transferred to the newly established Hafner Publishing Co. In 1960 Stechert-Hafner Service Agency was established as a subsidiary of SH. Crowell Collier Macmillan, Inc. (now Macmillan, Inc.) acquired SH and its subsidiaries (1969). Beginning January 1974, the corporate name, Stechert Macmillan, Inc., became effective. By 1980 Macmillan, Inc. was divided into three parts of which Macmillan Publishing Co., Inc. contained the division now called Hafner Press.
wisdom in developing this subsidiary. This new division served scholarly, scientific and botanical societies by selling their publications and distributing scientific and botanical books for European publishers on a large scale. The Agency distributed publications for the New York Botanical Garden, Missouri Botanical Garden, Texas Research Foundation, and the Hunt Botanical Library (Anonymous 1972). During the 1960s and 1970s Harry also focussed attention on reprinting book classics in botany within the Hafner Publishing Co. Among the reprint series issued were the Classica Botanica Americana (CBA) titles by such eighteenth and nineteenth century luminaries as Humphry Marshall, John Torrey & Asa Gray, C. S. Rafinesque, Stephen Elliott, Thomas Nuttall, and William Darlington. Joseph Ewan, historian of botany, proposed this series and wrote a bibliographical commentary for each of the reprinted books (Ewan 1967). Ironically, these facsimile reprints, as well as many others produced by Hafner, have become as rare as the originals themselves. The rarity of these volumes was due in part
to their limited printing, high demand by scholars, and the destruction of remaining stock when Crowell Collier Macmillan, Inc. purchased Stechert-Hafner and its subsidiaries in May 1969.

After this corporate change Harry chose to direct the Publishing Division. He could not, however, abandon his interest in and passion for rare and out-of-print books. Using a substantial part of his lunch hour, he would work in the Antiquarian Department at noon time. Through his voluntary work, a veritable labor of love, Harry raised impressive revenues for the firm.

While at Stechert, Harry especially enjoyed appraising private collections for purchase. He was instrumental in acquiring an outstanding mathematics library in 1937, besides many other collections. Representing his company, Harry participated in the First Antiquarian Book Fair in the United States, sponsored by the Antiquarian Booksellers' Association of America and held in New York City (4–9 April 1960). Confident that the fair would be successful, he prepared an attractive catalog (#277) of rare books, the first ever issued from the Stechert-Hafner Antiquarian Department (Anonymous 1960). One of his career highlights was the discovery of 11 first editions of the works of Linnaeus in a Paris bookshop. These books had an additional historical value since they were annotated by the French botanist and explorer Michel Adanson (1727–1806), noted for his work on the natural classification of plants (Lubrecht 1986).


Harry retired from Stechert Macmillan on 30 November 1973 and then briefly compiled catalogs for Jack N. Bartfield, an antiquarian bookseller of New York City. In December 1974 Harry founded his own business, Lubrecht & Cramer, Booksellers and Publishers, which was later incorporated (Au-
gust 1983). Joerg Cramer (deceased 4 June 1985), a German publisher, specialized in reprinting classical botanical books, many of which Hafner had distributed in the United States. Harry’s wife Anne, and later his son Charles, assisted in the business, originally carried out from their country home in Forestburgh, NY, and dealing predominantly with new, scholarly books, mostly in botany and natural history. The company is also a distributor for Koeltz Scientific Books, Gustav Fischer Verlag, and J. Cramer. Although his bookselling company primarily was concerned with new titles, Harry continued his profound interests in rare books and the appraisal of libraries. Among the botanical collections that he appraised were those of Carroll W. Dodge, the New York Horticultural Society, Emanuel D. and Ann W. Rudolph, William C. Steere, and R. Gordon Wasson. The remarkable Rudolph Library of 53,000 volumes of botany and natural history books has since been donated to The Ohio State University Libraries (Stuessy et al. 1997).

For more than two decades Harry and Anne Lubrecht featured booksale tables at botanical and scientific meetings and regional mycological forays. Their service was known not only for the sale of books, typically sold at a special discount for meeting and foray attendees, but also for their congenial and knowledgeable conversations. Harry captivated customers with his storehouse of botanical and bibliographical knowledge. He and his wife regularly attended the annual meetings of the Council on Botanical and Horticultural Libraries, Inc., and national and international book fairs. Concerning the latter, he attended 49 annual exhibits of the Frankfurt Book Fair in Germany.

Harry was a modest and caring person, yet he forthrightly and candidly expressed his opinions. I remember him also for many reminiscences of his book trade career and the botanists with whom he associated. With a rich background of experience and strong sense of the book market, Harry successfully introduced the quality paperback, also known as the softbound, to the scholarly book trade. Among the first in his field, he adopted photo-offset printing as the process for producing reprints. Even when this was not widely practiced, Harry encouraged minority hiring and developed a staff fluent in numerous languages. He held membership in the American Antiquarian Booksellers’ Association, American Institute of Biological Sciences (AIBS), Council on Botanical and Horticultural Libraries, Inc., International Association for Plant Taxonomy, Mycological Society of America, New York Botanical Garden, North American Mycological Association, and Old Book Table (NY). Harry became a U.S. citizen on 14 December 1936. As a member of the Lutheran Church, he was a deacon during the 1960s and early 1970s. Among his honors was a Special Service Award from the Mycological Society of America presented at the annual meeting of the AIBS, San Antonio, TX, August 1991.
Harry's successful life was shared with his wife Anne (Johanne Marie Ficke) whom he married on 2 October 1937. Harry is survived by his wife Anne; two sons, Peter Thomas Lubrecht, Sr., a retired teacher of Drama and English and presently Artistic Director of Brundage Park Playhouse, of Randolph, N.J., and Charles Frederick Lubrecht, co-manager of Lubrecht & Cramer, of Montgomery, NY; three grandsons: Peter T. Lubrecht, Jr., Christopher C. Lubrecht, and Bryan Leone. Harry's two sisters, Ilse and Ruth Lubrecht, predeceased him. Funeral services were held 15 November 1997 in St. Peter's Lutheran Church, Port Jervis and cremation took place at the H. G. Smith Crematory, Stroudsburg, PA. Interment of his ashes will take place at the Forestburgh Cemetery. As a tribute to Harry, a memorial program in celebration of his life will be held at The New York Botanical Garden in the fall 1998. Memorial contributions may be sent to The LuEsther T. Mertz Library, New York Botanical Garden, 200th Street and Southern Boulevard, Bronx, NY 10458.

ACKNOWLEDGMENTS

I am grateful for information on Harry that Anne, Charles, and Peter Lubrecht provided. Ronald L. Stuckey suggested this biographical essay and supplied the photograph. The aforementioned individuals and Rogers McVaugh read the manuscript and made constructive suggestions for changes in the text. Additional information on Harry was obtained from a feature column on bookmen (Chernofsky 1986).

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ARNOGLOSSUM ALBUM (ASTERACEAE): NEW SPECIES FROM NORTHERN FLORIDA

LORAN C. ANDERSON

Department of Biological Science
Florida State University
Tallahassee, FL 32306-4370, U.S.A.

ABSTRACT

The new species Arnoglossum album is described. Its phyllaries have prominently winged keels—a feature shared with A. diversifolium, A. floridanum, A. plantagineum, and A. sulcatum. Comparisons among members of this closely knit assemblage include morphology, phenology, ecological setting, and range, and a key is provided to distinguish the species.

RESUMEN

Se describe una especie nueva Arnoglossum album. Sus filarios tienen quillas aladas prominentes—una característica que comparte con A. diversifolium, A. floridanum, A. plantagineum, y A. sulcatum. Las comparaciones entre miembros de este conjunto fuertemente reticulado incluye morfología, fenología, características ecológicas y areal. Se ofrece una clave para diferenciar las especies.

Species of the tusilaginoid Arnoglossum, commonly called “Indian Plantains,” were formerly placed in the heterogeneous “Cacalia” (Kral & Godfrey 1958; Cronquist 1978; Pippen 1978), but, because Cacalia is now typified by a species of the seneconid European genus “Adenostyles” and because generic circumscriptions are now more narrowly drawn, Arnoglossum is considered distinct by many recent authors (Robinson 1974, 1980; Jeffrey 1979, 1992; Godfrey & Wooten 1981; Wetter 1983; Funk 1985; Brummitt 1992). Arnoglossum has three species with extensive ranges in the eastern United States [A. atriplicifolium (L.) H. Robins. and A. reniforme (Hook.) H. Robins.] or southeastern United States [A. ovatum (Walt.) H. Robins.] and one from the central part of the country [A. plantagineum Raf.]. The remaining three species have more limited ranges, one as a Florida endemic [A. floridanum (A. Gray) H. Robins.] and the others with ranges barely extending from Florida into neighboring states [A. diversifolium (Torr. & A. Gray) H. Robins. and A. sulcatum (Fern.) H. Robins.]. The latter four species (i.e., A. plantagineum and “the Florida group”) are similar in having phyllaries with keels that are strongly winged. The new species described below is now added to this assemblage with winged phyllaries.

MATERIALS AND METHODS

Fresh and dried materials were processed as described by Anderson (1994). Heads from at least five different collections per species were dissected and measured for involucral and floral quantitative data. Living plants of the five species under study were propagated from seed or as transplants in a greenhouse or common garden in Tallahassee, Florida. Vouchers of seedlings, plants at various stages of development, and all cited specimens are deposited at FSU unless noted otherwise.

SPECIES DESCRIPTION


Herbae perennae plerumque 8–10 dm alta. Folia basalia 20–63 cm longa, 5–16 cm lata, longe petiolata, laminis late ovatis vel anguste oblongo-lanceolatis, vernis lateralis principalibus per 2–4 cm supra basin laminarum ad venam medium arcte parallelis dein divergentibus. Folia caulina paucia, 7–26 cm longa, petiolata, serrata, folis superioribus reductis sessilibusque. Capitula in cymis corymbosis disposita, involucris 10–13.4 mm longis, phyllariis albis carinis prominenter alatis. Corollae albae, 9–10.5 mm longae.

Essentially glabrous cespitose herbs. Stems (5-)8–10(–10.5) dm tall, light green, strongly ridged. Basal (radical) leaves (20–)30–55(–63) cm long overall, 5–10(–16) cm wide, long petiolate, (10–)15–18(–34) cm, blades broadly ovate to narrowly oblong-lanceolate, margins entire, shallowly sinuate, or rarely serrulate-denticulate, bases attenuate, apices rounded, mucronulate, basally disposed lateral veins appressed to the midrib 2–4 cm then abruptly extending toward the leaf margins; cauline leaves few, blades (7–)12–18(–26) cm long overall, (2.5–)4–5(–6) cm wide, petioles (1–)4–5(–12) cm long, ovate, bases cuneate, apices acuminate, serrately toothed, upper leaves reduced in size and sessile. Inflorescence compound, freely branched, ± flat-topped, with heads crowded in corymbose cymes. Heads 5-flowered; involucres 10–12.5(–13.4) mm long, cylindric, phyllaries 5, chalky white, margins hyaline, keels prominently winged (the wings rising 1–1.5(–2.0) mm from the phyllaries with margins sinuate to crosse and reduced apically). Receptacles with short central cusp. Corollas white, rarely tinged with pink, 9–10.5 mm long, veins 10, tube 5–6.4 mm, throat 0.2–1.0 mm, lobes 2.9–3.8 mm, lanceolate; anthers 2.5–2.6 mm long, collars cylindric; styles 11.8–12.5 mm long, style branches 1.5–1.7 mm long, stylodium immersed in nectary; achenes glabrous, 4.2–5 mm long, cylindric to narrowly clavate, carpopodium cells erect, pappus white, 6–7 mm long. n = 25.

Distribution.—Endemic to Bay and Gulf counties of Florida in poorly
Figs. 1–24. Representative leaves of selected *Arnoglossum* species, all at 1/6 full size. Figs. 1–5. Radical leaves showing major venation. Fig. 1. *A. album* with appressed lateral veins, *Anderson 15600*, Bay Co., FL. Fig. 2. *A. diversifolium*, *Anderson 13414*, Levy Co., FL. Fig. 3. *A. floridanum*, *Anderson 12165*, Taylor Co., FL. Fig. 4. *A. plantagineum*, *Anderson 12166*, Riley Co., KS. Fig. 5. *A. sulcatum*, *Anderson 16035*, Santa Rosa Co., FL. Figs. 6–24. Outlines of cauline leaves (major venation similar to respective radical leaves). Figs. 6–9. *A. album*. Fig. 6. *Anderson 12137*, Gulf Co., FL. Figs. 7–8. *Anderson 15600*, Bay Co., FL. Fig. 9. *Anderson 13432*, Gulf Co., FL. Figs. 10–13. *A. diversifolium*. Fig. 10. *Anderson 13475*, Levy Co., FL. Figs. 11, 13. *Anderson 13478*, Putnam Co., FL. Fig. 12. *McDaniel 9059*, Houston Co., AL. Figs. 14–15. *A. floridanum*. Fig. 14. *Anderson 12160*, Taylor Co., FL. Figs. 15–16. *Anderson 12077*, Clay Co., FL. Figs. 17–20. *A. plantagineum*. Fig. 17. *Mehrhoff 12299* (CONN), Bruce Co., Ontario Prov., Canada. Fig. 18. *Anderson 11991*, Loundes Co., AL. Fig. 19. *Bryson 9861*, Oktibbeha Co., MS. Fig. 20. *Anderson 11968*, Tangipahoa Par., LA. Figs. 21–24. *A. sulcatum*. Fig. 21. *McDaniel 7978*, Geneva Co., AL. Fig. 22. *Anderson 12342*, Leon Co., FL. Fig. 23. *Anderson 16058*, Walton Co., FL. Fig. 24. *Anderson 16057*, Walton Co., FL.
drained, acidic (pH 5–6), loamy sands (with 0.35–1.7% organic matter) of wet savannas, open pinewoods, and most frequently the ecotone between the two, often in close association with several of the following: *Aletris lutea, Aristida beyrichiana, Asclepias longifolia, A. michauxii, A. viridula, Aster eryngiifolius, Cleistes bifaria, Drosera capillaris, Eriocaulon compressum, Hypericum gymnanthum, Lachnanthes caroliniana, Lachenaulon anceps, Lobelia floridana, Ludwigia linifolia, L. microcarpa, L. virgata, Marshallia tenutifolia, Oxypolis greenmanii, Panicum rigidulum, Physostegia godfreyi, Platanthera nivea, Polygala baldunii, P. cruciata, P. ramosa, Rhexia lutea, Rhynechospora ciliaris, R. curtisi, R. fascicularis, R. filifolia, R. globularis, R. oligantha, R. pusilla, R. rariflora, R. wrightiana, Rudbeckia graminifolia, Ruellia noctiflora, Sabatia bartramii, S. campanulata, Sarracenia flava, Scutellaria floridanana, Tofieldia racemosa, Verbesina chapmanii, Xyris ambiguca, X. baldwiniana, and X. elliottii*. The woody associates (less frequent) include: *Cyrilla racemiflora, Hypericum cistifolium, H. exile, H. reductum, Ilex coriacea, I. vomitoria, Magnolia virginiana, Myrica cerifera, Nyssa ursina, and Pinus elliottii*. Flowers June to mid-July.

Representative specimens examined. U.S.A, FLORIDA, Bay Co.: type locality, L.C. Anderson 15529 (FSU), 20 Jun 1995, L.C. Anderson 15600 (FSU, MO, NY), 20 Jun 1995, L.C. Anderson 15601 (FSU), L.C. Anderson 15708 (FSU); S side County Rd 2300, 1.9 mi W of Rte 77, 1.5 air mi NW of Southport, 13 Jun 1995, L.C. Anderson 15577 (FSU); 0.5 mi E of Burnt Mills Creek bridge on S side of Rte 388, 1.9 mi W of Rte 77, 1.5 air mi WNW of Southport, 13 Jun 1995, L.C. Anderson 15581 (FSU), Gulf Co.; 5.3 mi S of Rte 22 on E side of Daniels Rd near Wetappo Creek, ca. 5.5 air mi WSW of Wewahitchka, L.C. Anderson 11642 (FSU), L.C. Anderson 11673 (2), L.C. Anderson 11934 (FSU), L.C. Anderson 12137 (BRIT, FSU, GH, MO, NY, US), L.C. Anderson 12138 (FSU), L.C. Anderson 13421 (FSU), 5.2 mi S of Rte 22 on W side Daniels Rd, L.C. Anderson 11950 (FSU), L.C. Anderson 12171 (FSU).

**DISCUSSION**

The Indian plantains with winged phyllaries form a closely related alli-
ance of species. They differ from each other in several floral features as summarized in Table 1. The longest involucres occur in *A. floridanum*, and the shortest in *A. sulcatum*. Phyllaries in *A. album* have prominent wings proximally that become highly reduced apically, whereas in all other species the wings are shorter in height but ± equally developed for the length of the bract (often broadest apically). *Arnoglossum album* also has the whitest phyllar-
aries; in the other species they are more greenish-white.

Corollas of *A. album* are white, rarely tinged with pink; in the other species they are white, light lavender, or ochroleucous (more greenish-white or yellowish-white in *A. floridanum* and sometimes more pinkish in *A. diversifolium*). Corollas are generally longest in *A. floridanum* and shortest in *A. sulcatum*, but not as short as reported by Pippen (1978) and Cronquist (1980). In all species the corolla tubes are relatively long and the throats below the lobes
very short. The tube widths are greatest in *A. album* and most slender in *A. sulcatum*. Carpopodial cells of the achenes in *A. album* are generally erect, whereas they are procumbent in *A. plantagineum*. Cell shape varies somewhat within a given population because of differing stages of achene maturity. Robinson and Brettell (1973) suggested carpopodial structure was an excellent character for distinguishing genera in the Senecioneae; they recorded procumbent carpopodial cells for *Mesadenia* (i.e., *Arnoglossum*). Wetter (1983) found considerable variation in this and other micromorphological characters and questioned their value as generic markers.

Vegetatively, *A. album* looks most like *A. plantagineum*, and that species is probably its closest relative. The two differ in seedling morphology. Cotyledons of *A. album* are 1–1.5 cm long and 9–12 mm wide (± orbicular), whereas they are 3–4.5 cm long and 8–9 mm wide (spatulate-oblanccolate) in *A. plantagineum*.

The five species differ more in leaf morphology than they do in floral features (Figs. 1–24). Basal leaves of *A. album* have distinctive venation. The principal lateral veins are appressed and closely parallel the midvein into the blade for a few centimeters and then spread abruptly toward the leaf margins (Fig. 1). This feature of appressed lateral veins is also found in the related *Yermo xanthocephalus* of Wyoming. In the other *Arnoglossum* species, the lateral veins spread immediately at the base of the blade (Figs. 2–5).

Relative length of the petiole on radical leaves is often used in keys to the species (Kral & Godfrey 1958; Pippen 1978; Cronquist 1980). This feature is correlated to habitat preferences of the species. Generally, *A. diversifolium* and *A. sulcatum* grow in deep shade, and their radical leaves have long petioles (Figs. 2, 5). *Arnoglossum floridanum* usually grows in full sun, and its radical leaves have short petioles (Fig. 3). Petiole lengths are more variable in radical leaves of *A. album* and *A. plantagineum*. These two species often grow in savannas or prairies. Their petiole lengths are related to the density of grass and other vegetation near the plants; plants from the same seed source that were grown in different shade or vegetation densities in my garden produced short-petioled leaves in sunnier or less crowded situations and longer petioles in shaded or crowded conditions.
Cauline leaves of *A. diversifolium* (Figs. 10–13) are petiolate and basally truncated or cordate; they are petiolate and rounded to broadly cuneate in *A. album* (Figs. 6–9), *A. floridanum* (Figs. 14–16), and *A. plantagineum* (Figs. 17–20), whereas they are ± sessile and more narrowly cuneate in *A. sulcatum* (Figs. 21–24). Cauline leaves of *A. diversifolium* are deltoid-hastate in outline and dentately toothed. They tend to be ovate, serrately lobed, and acute in *A. album*; ovate-oblong, crenulate, and obtuse or rounded in *A. floridanum*; ovate to lanceolate or narrowly spatulate, entire or serrulate, and acute in *A. plantagineum*; and ovate to rhombic or narrowly lanceolate, sparsely serrate-dentate, and acute to obtuse in *A. sulcatum*.

*Arnoglossum plantagineum* has the greatest geographical range among the five species (east Texas, Louisiana, and the black soil belt of Alabama north through Kansas and Ohio to southern Minnesota, Michigan, and Ontario, Canada); it occurs mainly in calcareous, tall-grass prairie (Pippen & Chapman 1986), but minor habitats include glades, fens, and pine-oak woodlands. *Arnoglossum floridanum* occurs in well-drained sands in open pine-scrub oak, dry flatwoods, and old fields from Duval and Madison through peninsular Florida south to Highlands and Manatee counties.

The other three species occur mainly in the Florida panhandle. *Arnoglossum diversifolium* occurs in river swamps and wet hammocks and is the most wide-ranging of these three; it has a few populations in southern Alabama and southwestern Georgia, ranges from Walton County to Leon County in the panhandle, and has disjunct populations in Putnam, Volusia, and Levy counties, Florida. *Arnoglossum sulcatum* occupies shaded acid bogs or swamps; it occurs sporadically in extreme southern Alabama and southwestern Georgia and from Escambia to Leon Counties of the Florida panhandle. *Arnoglossum album* is restricted to Bay and Gulf Counties of the Florida panhandle; the only other species of the group that occurs in those counties is *A. sulcatum*, but it has different habitat preferences and phenology.

Flowering time in *Arnoglossum plantagineum* is clinal from south to north; the plants blooming in late April in southern Louisiana to early August in Minnesota and Michigan (Pippen & Chapman 1986). A reverse cline exists for *A. diversifolium*; it blooms in the Florida panhandle from May to early July (same period for *A. floridanum*), whereas, to the south, in Levy County (where it is sympatric with *Hasteola robertiorum*) *A. diversifolium* blooms from mid-August through September. *Arnoglossum album* blooms from June to mid-July, and *A. sulcatum* is the latest to bloom (September to October).

The new species, *A. album*, is distinguished from all of its immediate relatives by the following features: it is geographically isolated from all other species except *A. sulcatum* and it is totally separated from *A. sulcatum* by
habitat and phenology; basal leaf venation is distinctive; cauline leaves are most similar to those of *A. sulcatum*, but they are generally narrower and sessile in *A. sulcatum*; its involucres and corollas appear whiter than those of the other species; the wings of the phyllaries are higher proximally and attenuated and distally, whereas wings are lower in height overall and evenly raised along the keel or somewhat higher distally in the others; the phyllary wings have erose margins distally in *A. album*, and wing margins are entire or sinuate in the other species; and the corolla tubes are wider than those in any other species in the group.

**KEY TO THE FIVE SPECIES OF ARNOGLOSSUM WITH WINGED PHYLLARIES**

Most keys to species of *Arnoglossum* include significant habitat and phenological data. The following key uses only morphological features.

1. Blades of radical leaves truncate, ovate to cordate-ovate, sparsely dentate; lower cauline leaves deltoid-hastate, dentately toothed........... *A. diversifolium*
2. Phyllaries with prominently winged keels, wings highest at base, erose; radical leaves with lateral veins appressed to midveins for 2–4 cm then spreading. ................................................................. *A. album*
3. Involucres and corollas mostly over 11 mm and 10 mm long, respectively; cauline leaves crenulate. .................................................. *A. floridanum*
4. Involucres mostly over 10 mm long, corollas over 9 mm; cauline leaves at midstem rounded to peltate base. ............................ *A. plantagineum*
5. Involucres less than 10 mm long, corollas 8–9(–9.6) mm; cauline leaves at midstem broadly cuneate and sessile................. *A. sulcatum*

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SEVEN NEW NOMENCLATURAL COMBINATIONS AND A NEW NAME IN PACKERA (ASTERACEAE: SENECIONEAE)

DEBRA K. TROCK and THEODORE M. BARKLEY

Herbarium, Division of Biology
Kansas State University
Manhattan, KS 66506, U.S.A.
dkwel@ksu.edu

ABSTRACT


RESUMEN


The genus Packera (Asteraceae: Senecioneae) has been known widely as the Aureoid group of Senecio, and the recognition of Packera necessitates many nomenclatural transfers. Preparation of the treatment of Packera for the Flora of North America project has drawn our attention to the transfers proposed here. Type specimens for the basionyms are provided by Barkley (1978). The combinations P. pseudaurae var. semicordata and P. dimorphophylla var. intermedia are proposed simply for consistency in the use of “varietas”

1Present address: Botanical Research Institute of Texas, 509 Pecan Street, Fort Worth, TX 76102-4060, U.S.A, e-mail: barkley@brit.org

as the infraspecific rank of choice in *Packera*. The two epithets are otherwise available as subspecies.


The situation with the epithet “*cymbalarioides*” is complicated. A single-headed plant of wet, open sites in western U.S. and adjacent Canada was long known as *Senecio subnudus* DC., a name that was introduced by A.P. de Candolle in 1837. Unfortunately, de Candolle used the epithet “subnudus” twice; the other time for an African plant. Heinrich W. Buek (1840) recognized the error in his index to the Prodromus and he chose the African plant to be the correct *Senecio subnudus*. He then called the American plant *Senecio cymbalarioides* H. Buek, and unfortunately, this name remained forgotten until the 1960s (Barkley 1962). In the meantime, a widespread plant of western North America was named *Senecio cymbalarioides* by Thomas Nuttall. It was necessary to change the name of the North American *S. subnudus* DC. to *S. cymbalarioides* H. Buck, and *S. cymbalarioides* Nutt. then became *S. streptanthifolius* Greene, which is the next oldest available name for that entity (Barkley 1962). Recognition of the genus *Packera* required
the transfer of many epithets into that genus and, unfortunately, *Senecio cymbalarioioides* Nutt. was transferred into *Packera* where it became *P. cymbalarioioides* (Nutt.) W.A. Weber & A. Löve, (Weber & Löve 1981). Shortly thereafter, Weber and Löve recognized that it was *S. cymbalarioioides* H. Buek that should have been transferred to *Packera*, so they made the combination: *P. cymbalarioioides* (H. Buek) W.A. Weber & A. Löve (Weber 1984). The transfer of the Nuttall epithet into *Packera* preoccupies that name in *Packera* so *Packera cymbalioides* (H. Buek) W.A. Weber & A. Love is illegitimate and must be rejected according the International Code of Botanical Nomenclature (Greuter et al. 1994). Thus, the American plant first known as *Senecio subnudus* DC. and then as *Senecio cymbalatroioides* Buek must have a new name. The new epithet that we chose for this distinctive plant commemorates Heinrich Wilhelm Buek, the 19th Century German botanist whose carefully prepared index to de Candolle’s *Prodromus* gave rise to the need for this new name.


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BOOK REVIEWS


These two volumes list the species of Orchidaceae known from Mexico, in alphabetical order by genus, then by species, from Acineta to Laelia (Orchidaceae 1) and from Lembogladium to Xylorhiza (Orchidaceae 2). There are also errata and additions to the first six parts (Agavaceae through Nolinaceae). For each species, there is a complete literature citation, followed by the basionym, along with all taxonomic and nomenclatural synonyms and respective type citations. It is clear that the authors have seen the vast majority of the type specimens involved. There are no lectotypes chosen in the work, but lectotypes chosen by other authors are cited clearly. Type specimens seen have the traditional "*" marking; otherwise, location of the holotype is cited as it appears in the protologue. Each species' distribution within Mexico is also given.

The list is a very handy reference for anyone interested in the Orchid flora of Mexico, or for that matter, Mesoamerica. It is printed on high quality paper and is clear and easy to read. The author abbreviations correspond to Authors of Plant Names, published by the Royal Botanic Gardens, Kew, and the literature citations correspond to the B-P-H and TI-2. I have seen no notable typographical errors.

Annotated checklists such as these are extremely useful, especially given the complete index to accepted names and synonyms in the back. This series is absolutely necessary for any curator dealing with Mexican monocotyledonous plants. We anxiously await the arrival of the other volumes, and unhesitatingly recommend them for everyone!—John J. Pipoly III
ARDISIA NIAMBIENSIS (MYRSINACEAE), A NEW SPECIES OF ARDISIA SUBGENUS ARDISIA FROM THE CHOCÓ FLORISTIC PROVINCE OF COLOMBIA

JOHN J. PIPOLY III
Botanical Research Institute of Texas
509 Pecan Street, Fort Worth, TX 76102-4060 U.S.A.
jpipoly@brit.org; clusia@latinmail.com

ALVARO COGOLLO P.
Fundación Jardín Botánico, Joaquín Antonio Uribe
Apartado Aéreo 51407, Medellín, Antioquia, COLOMBIA
acogollo@latinmail.com; jardinbo@epm.net.co

ABSTRACT

Documentation of the flora of the Natural Reserve Río Ñambí has resulted in the discovery of a heretofore undescribed species, Ardisia niambiensis. The species is described, illustrated and its salient morphological features are elucidated. Ardisia niambiensis is best placed in subgenus Ardisia because of its terminal, glandular-papillate, paniculate inflorescences with tripinnate branches, and the evenly divided, 5-lobed calyx, whose symmetric lobes have glandular-ciliolate margins. It is most closely related to Ardisia premontana, a taxon endemic to the eastern slopes of the Eastern Andean Cordillera of southern Ecuador and Peru.

INTRODUCTION

The pantropical genus Ardisia Swartz contains approximately 400–500 species (Chen Cheih & Pipoly 1996) with centers of high species diversity in Malesia and the Chocó Floristic Province from Panama through Colombia to Ecuador (Pipoly 1991, 1992, 1994, 1995, 1996). Within the Neotropics, approximately 300 species have been described, the majority

from Mesoamerica. There are relatively few South American taxa, perhaps not passing 40 total. During the course of an analysis of the vegetation of the Río Nambí Natural Reserve, located in western portion of Nariño corresponding to the Chocó Floristic Province, a new species of Ardisia was discovered, which is described herewith.

**Ardisia niambiensis** Pipoly & Cogollo, sp. nov. (Fig. 1). **Type**: COLOMBIA. **NARIÑO**: Mpio. Barbacoas; Corregimientos Ortiz y Zamora; Vereda El Barro; Reserva Natural Río Nambí, ca. 5 dm al W de Altaque, Faldas Occidentales de la Cordillera Occidental, 01° 15’N, 78° 08’W, 1,250–1,350 m, 9 Sep 1997 (stam. Fl). **J. Pipoly, A. Cogollo, M. López & M. Rodríguez 21572** (HOLOTYPE: PSO; ISOTYPES: BRIT, COL, FMB, GH, HUA, JAUM, K, MO, NY, TULV).

Ob inflorescentiam terminalem tripinnatipaniculatam, calycem aequaliter divisum, necnon lobos calycinos simetricis glandulari-ciliolaribusque subgeneri *Ardisia* pertinet. Propert laminas ad apice brevialaminatas, rachides inflorescentiae angulato-marginatae, margines sepalinos hyalinos carinatos subtomentos erosoque *A. premontano* valde arcte affinis, sed ab eo ramulis glabris (non furfuraceo-lepidotis), laminis coriaceis (non chartacccis), subter glabris dense punctatis puncctato-lineatis (nec furfuraceo-lepidotis), petioli 7–10 (non 15–25) mm longis, floribus pedicellatis (non sessilis), denique lobis calycinis deltatis vel late triangularibus (non ovatis) 2–2.2 (nec 1–1.2) mm longis statim distinguitor.

**Tree** to 10 m x 15 cm DBH. **Branchlets** terete, 4–8 mm glabrous. **Leaves** alternate; blades coniaceus, obovateolate to obovate, (14.1–)19–25.4 cm long, (6.8–)7.5–9.4 cm wide, apically abruptly acuminate, the acumen 5–8 mm long, basally acute, decurrent to petiole base, midrib canaliculate and prominently raised above, prominently raised and densely black punctate-lineate below, the secondary veins numerous, 39–47 pairs, prominentus above and below, drying dark above, pallid and densely perpuncticolose below, the punctations in the form of short lines, the margin slightly inrolled except revolute basally; petioles marginate to base, 7–10 mm long, glabrous. **Inflorescence** terminal, pyramidal, tripinnalement paniculate, 12.8–22.5 cm long, 11.5–33 cm wide, peduncle 1–2.5 cm long, the rachis prominently angulate, the secondary branches with smaller panicular units 12–16 cm long, 6–10 cm wide, the ultimate branches racemose, moderately rufous glandular-granulose and prominently and densely black punctate-lineate; floral bracts caducous, unknown; pedicels cylindrical, (1.0–)1.5–2.5(–3.0) mm long. **Flowers** unknown, but fruiting calyx 3–3.5 mm long, rufous glandular papillate and darkened at junction of lobe and tube, the lobes deltate to widely triangular, 2–2.2 mm long, 2.2–2.5 mm wide, apex acute to a minutely acuminate apex, minutely rufous-lepidote and carinate medially without, prominently punctate and punctate-lineate, the margin hyaline, somewhat erose and sparsely glandular-ciliolate apically. **Fruit** globose, 5–8(–10) mm long and wide when dried; when fresh, exocarp fleshy, bitter tasting.

**Distribution**.—Known only from Reserva Natural Río Nambí, Nariño, Colombia, at 1,250–1,350 m elevation.
Fig. 1. *Ardisia niambiensis* Pipoly, showing the pyramidal tripinnate inflorescence, densely and prominently black punctate leaf surfaces, short petioles marginate to base, and pedicellate flowers. Drawn from the holotype.
Ecology.—Ardisia niambiensis occurs in premontane pluvial forest, receiving approximately 7,800 to 8,200 mm rain per year. The species occurs in relatively low densities, in at the forest margin on ridgetops.

Etymology.—Ardisia niambiensis is named phoenetically for the Reserva Natural Río Ñambí, a private, nonprofit, integrated conservation and development area in the state of Nariño, Colombia, operated by FELCA, the Ecological Foundation of the Hummingbirds of Ataquer (Fundación Ecológica de los Colibríes de Ataquer).

ParaType. COLOMBIA. Nariño: Mpio. Barbacoas; Corregimientos Ortiz Zamora; Vereda El Barro, Reserva Natural Río Ñambí, ca. 5 km al W de Ataquer. Faldas Occidentales de la Cordillera Occidental, 01° 15’ N, 78° 08’ W; 1,350–1,450 m, 3 Sep 1997 (ster.), J. Pipoly, A Cogollo, M. López & M. Rodríguez 21227 (BRIT, FMB, JAUM, PSO).

On account of the shortly acuminate leaf apices, angulate inflorescence racises, carinate sepals with hyaline and subentire to erose margins, Ardisia niambiensis is most closely related to Ardisia premontana Pipoly. It is separated from A. premontana by its glabrous (not furfuraceous-lepidote) branchlets, the coriaceous (not chartaceous) leaf blades that are densely black punctate and punctate lineate (and not furfuraceous-lepidote) below, petioles 7–10 (not 15–25) mm long, pedicellate (not sessile) flowers and delamate or widely triangular (not ovate) sepals that are 2.0–2.2 (and not 1.0–1.2) mm long.

Ardisia subgenus Ardisia, to which A. niambensis belongs, is defined by the well-developed but early caducous floral and inflorescence bracts, race-mose or rarely spicate branchlets of the inflorescence, the anthers dehiscing by subapical pores opening into wide longitudinal slits, and symmetric sepals. Within that subgenus, the other species known from the Chocó include Ardisia colombiana Lundell, A. granatensis Mez, A. opaca Lundell, A. valida Mez (= A. perinsignis Lundell syn. nov.), A. monsalveae Pipoly, and A. cabrerae Pipoly (Forero & Gentry 1990; Pipoly 1991, 1995) Among these species, the only ones with inflorescence shape, pedicellate flowers and sepals similar to those of Ardisia niambiensis are A. cabrerae and A. monsalveae. However, the three species may be easily separated by the following key:

1. Calyx 2.4–2.9 mm long, apically obtuse, the margins glabrous, entire to subentire.
2. Leaf blades coriaceous, elliptic; sepals 3.4–3.5 mm wide, glabrous .......... A. cabrerae
2. Leaf blades chartaceous, widely oblanceolate to obovate; sepals 0.5–0.6 mm wide, densely and minutely rufous-puberulent ......................................... A. monsalveae
1. Calyx 3–3.5 mm long, apically acute to a minutely acuminate apex, minutely rufous-lepidote and carinate, the margin sparsely ciliolate .......... A. niambensis

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REFERENCES


BOOK REVIEW


This book purports to be a monograph, including both the basic botanical and applied agronomic aspects among the "Azuki" members of Vigna subgenus Cervatropis. The book is divided into nine chapters, including an introduction, botany, physiological characteristics, production, insects and nematodes, diseases, breeding characteristics, food chemistry and processing, and uses and marketing. The agronomic chapters contain a thorough review of the literature, but much of it refers only to the Azuki beans in general, and not to a specific taxon. As a plant systematist, I am most disappointed with Chapter 2, the Botany of Azuki. I find it superficial, and not useful for understanding the differences among the species, or the infraspecific taxa (subspecies, varieties and cultivars). A synopsis or taxonomic revision for this relatively small group could have been contributed by any one of a number of qualified taxonomists, but the authors chose to avoid a formal treatment. They state that in their Table 2.1, "No attempt has been made to correct the confusion of different classifications in the literature." That statement amounts to a fatal flaw for the work, because many of the subsequent chapters make frequent reference to various cultivar names, without link to a taxon described in the Botany chapter. For example, in the discussion of starch granules and processing (Chapter 8), reference is made to "azuki cv Takara," yet there is no mention of that or any other cultivar in the taxonomy chapter. Because the reader is most often unsure of the exact entity referred to, the rest of the book loses much of its usefulness, except in broad terms. I find the book hardly more than a literature review, and not a definitive monograph. Its extensive bibliography may be useful for agronomic investigators, but hardly justifies its hefty price. I would have preferred to have seen a comprehensive, well-executed systematic, agronomic and agricultural treatment, like the classic work of L. van der Maesen for Cicer arietinum, published in Meded. Landbouwhogeschool 72-10:1–342. 1972. I highly recommend that Maesen's monograph be used as a model (with phylogenetic systematics added) for economically critical and highly domesticated plant taxa. By following Maesen's model, we may better take advantage of wild relatives of currently cultivated plants, to bring useful characteristics into the cultivated from the wild. The book should be part of any major agricultural library, as a literature review source.—John Pipoly, III
CLUSIA NIAMBIENSIS (CLUSIACEAE),
A NEW SPECIES FROM THE CHOCÓ FLORISTIC PROVINCE OF COLOMBIA AND ECUADOR

JOHN J. PIPOLY III
Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060, U.S.A.
jpipoly@brit.org; clusia@latinmail.com

ALVARO COGOLLO P.
Fundación Jardín Botánico, Joaquín Antonio Uribe
Apartado Aéreo 51407, Medellín, Antioquia, COLOMBIA
acogollo@latinmail.com; jardinbo@epm.net.co

MARTA SOFÍA GONZÁLEZ
Departamento de Biología, Universidad de Nariño
Apartado Aéreo 1176, Pasto, Nariño, COLOMBIA

ABSTRACT

Documentation of the flora of the Natural Reserve Río Ñambí has resulted in the discovery of a heretofore undescribed species, Clusia niambiensis. The species is described, illustrated and its salient morphological features are elucidated. While its vegetative morphology is reminiscent of both Clusia laurifolia and C. venusta, the free, numerous, and subulate stamens with a central mass of staminodia producing a waxy resin indicate it is a member of section Chlamydocclusia rather than section Retinostemon, where the aforementioned congeners belong. At present, the relationships of Clusia niambiensis within section Chlamydocclusia, are unknown. It is anticipated that continuing studies of the genus, leading to a treatment of the family for Flora de Colombia, will resolve this problem.

RESUMEN

Al documentar la flora de la Reserva Natural Río Ñambí, se encuentra una nueva especie, Clusia niambiensis. Se describe, se ilustra y se discuten sus caracteres principales y sobresalientes. Mientras que sus caracteres vegetativos son muy semejantes a los de Clusia laurifolia y C. venusta, sus estambres libres, numerosos y subulados indican claramente que C. niambiensis pertenece a la sección Chlamydocclusia y no a la sección Retinostemon, donde se ubican las otras especies congeneres susodichas. En este momento, no se sabe exactamente la ubicación taxonómica de Clusia niambiensis dentro de la sección Chlamydocclusia. Esperamos que a través de los estudios en proceso para el tratamiento taxonómico de la familia para Flora de Colombia, se pueda resolver este problema.

Recent exploration of the Reserva Natural Río Ñambí, located on the

western slopes of the Western Cordillera of the Colombian Andes, has resulted in the discovery of this spectacular new species, described herewith.

**Clusia (§ Chlamydoclusia) niambiensis**, Pipoly, Cogollo et González, sp. nov. (Fig. 1). TYPE: COLOMBIA, NARINO: Mpio. Barbaconas; Corregimientos Ortúz y Zamora; Vereda El Barro; Reserva Natural Río Nambí, ca. 5 km al W de Altaguer, Faldas Occidentales de la Cordillera Occidental, 01° 15’ N, 78° 08’ W; 1,450–1,500 m, 8 Sep 1997 (stam. Fl), J. Pipoly, A. Cogollo, M. López & M. Rodriguez 21-489 (HOLOTYPE: PBO; ISOTYPES: BRIT, COL, FMB, JAUM, K, MO).

Quoad lamina bullata nerviosisque brochidodromos, resinam albam, *C. laurifolium* arcte similans sed ab ea petiolis profunde canaliculatisque marginatis (non aliquantum canaliculatis), ad bases laminas acutas decurrentesque (non obtusi haud decurrentes), denique fructibus ovoideis vel elipsoideis (non subglobosis) praecellit distat. Propter stamina inter se libera subulataque centraliter resinifera, stagnata conniventaque sectio *Chlamydoclusia* pertinet, inter species alis petiolis profunde canaliculatis marginatisque, laminis bullatis nerviosisque brochidodromis, fructibus longitudinaliter costatis statim distinguitur.

Glabrous, dioecious, shrubs or treelets to 2–3(–5) m tall, growth dynamics corresponding to Scarrone’s Model; latex white. *Branchlets* terete, appearing tetragonal when dried, 8–10(–15) mm diam., the bark reddish-brown, exfoliating transversely in the upper nodes, appearing furfuraceous at times. *Leaves* decussate; blades chartaceous, obovate, (19–)27–38.5 cm long, (14.5–)15.2–23 cm wide, apically rounded to obtuse, basally acute, decurrent to the petiole base, bullate, the midrib prominently raised or raised within a depression above, prominently raised below, the secondary veins brochidodromous, 28–46 pairs, ca. 7–10 mm apart, alternating so every other vein has twice the diameter of the others, deeply impressed above, prominently raised below, the submarginal connecting vein ca. 2–4 mm from margin, glabrous above and below, at times when dried with small linear latex canals oxidizing red, the margin scarious, entire; petioles deeply canaliculate and marginate, (1.0–)2.5–3.5 cm long, without adaxial marginal pit. *Staminate inflorescence* erect in bud, pendulous at maturity, a compound cyme, 20–25 cm long, 10–20 cm wide; peduncle appearing tetragonal when dried, 10.5–17 cm long, the bark transversely checked and exfoliating; primary inflorescence bract coriaceous, lanceolate, 18–21 mm long, 4–6 mm wide, apically acute, the midrib prominently raised above and below, the margin scarious, entire, glabrous; secondary inflorescence bracts cartilaginous, suborbicular, 3.5–4.0 mm long, 3.8–4.2 mm wide, apically broadly rounded, medially carinate, the margin scarious, entire; tertiary and floral bracts as in secondary but smaller acropetally, to the smallest that are rhomboid, 3 mm long and wide, apically acute; bracteoles 2, cartilaginous, ovate, .3.8–4.0 mm long, 2.5–3.0 mm wide, apically rounded, cucullate, the margin hyaline, not scarious, entire; pedicels 1–2.5(–5) mm long. *Staminate flowers* sepals 8, the lower 4 opposite, the upper 4 contorted, coriaceous, acro-
Fig. 1. *Clusia niambiensis* Pipoly, Cogollo & González. A. Habit. B. Opened pistillate flower, showing staminodes and stigmatic area. C. Opened staminate flower, showing stamens and central staminodial mass. D. Fruit, showing costae and mature stigmas. Figs. A–D, drawn from holotype.
petally larger, the lowermost oblate, 4.4–5.5 mm long, 5.5–6.5 mm wide, apically broadly rounded, translucent toward the margins, the linear latex canals black, conspicuous, the margins flat, scarios, irregularly notched, at times also appearing erose; uppermost sepal as in lowermost but oblong, 10–12 mm long, 7.5–8 mm wide, petals 12–16, contorted, membranaceous, oblong to oblongolate, acropetally larger, the largest 16–19 mm long, 10–12 mm wide, somewhat clawed, some appearing oblongolate-spathulate, apically broadly rounded to truncate, linear resin canals conspicuous, black, numerous, the margin undulate, somewhat irregular, minutely erose at tip; stamens numerous, linear 4–5 mm long, the filaments free, 2.0–2.2 mm long, the anther sacs linear, 2.0–3.0 mm long, the connective extending above the anthers ca. 0.5 mm long, subulate; central staminodes forming a mass agglutinated by orange waxy resin, the pistillode vestigial or absent. *Pistillate inflorescence* as in stamine but peduncle 7–20 cm long; secondary inflorescence bracts 11–13 mm long, 5.5–6.6 mm wide in lower portion of inflorescence, acropetally smaller to 3 mm long, 3 mm wide; pedicels accrescent to 2.8 cm in fruit. *Pistillate flowers* as in stamine but staminodes 4–5 mm long, devoid of pollen, the connectives 0.6–1 mm long, pistil ovoid, 7–8 mm long, 8–9 mm wide, carpels and stigmas 8, cuneiform at maturity, convex, 4.5–5.2 mm long, 2.0–2.5 mm wide. *Fruit* ovoid to oblong, 3.0–6.5 cm long, (1.8–2.7–2.9 cm diam., 7-ribbed, the fruit grenadine, the ribs white when fresh.

**Distribution.**—Endemic to the Chocó Floristic Province of Colombia and adjacent Ecuador, (17–)650–1,650 m elevation.

**Ecology and conservation status.**—*Clusia niambiensis* occurs in premontane and montane pluvial forest, where it is an understory treelet. The populations of this species are composed of approximately 20 individuals per hectare.

**Etymology.**—*Clusia niambiensis* is named for the Reserva Natural Río Ñambi, a private Wildlife Reserve in the state of Nariño, Colombia, operated by FELCA, the Ecological Foundation of the Hummingbirds of Altaquer, where the largest populations of this species have been found.

**Local names and uses.**—“Guandera” (Colombia & Ecuador, Spanish).

**Paratypes:** COLOMBIA, NARINO; Mpio. Barbacoas; Corregimientos Ortiz y Zamora; Vereda El Barro; Reserva Natural Río Ñambi, ca. 5 km al W de Altaquer, Faldas Occidentales de la Cordillera Occidental, 01° 15’ N, 78° 08’ W; 1,450–1,500 m, 1 Sep 1997 (pist. fl), J. Pipoly, A. Cogollo et al. 21044 (BRIT, JAUM, PSO), 8 Sep 1997 (stam. fl), J. Pipoly, A. Cogollo, M. Lopez & M. Rodriguez 21490 (BRIT, COl., JAUM, PSO), 1,250–1,350 m, 10 Sep 1997 (stam. fl), J. Pipoly, A. Cogollo et al. 21655 (BRIT, JAUM, PSO); Resguardo de El Sábalo, Río Cangapi, 01° 17’ N, 78° 14’ W, 580 m, 17 Aug 1995 (fr), B. Ramírez et al. 8049 (BRIT, PSO); Corregimiento El Diviso, near El Diviso, 25 Nov 1979 (pist. fl), O. de Benavides 2149 (PSO); Corregimiento de Junín, 1,200 m, 7 Oct 1988 (pist. fl bud), O. de Benavides 10246 (PSO); Locality between Junín and Divisio, 1,700 m, 15 Sep 1978.
(pist. fl), O. de Benavides 1565 (PSO); Espino to Tumaco Road, 84 km W of Espino, on pass between Altaquer and Junín, 01° 15’ N, 78° 09’ W, 1,300 m, 18 Nov 1986 (fr), B. Hammel & R. Bernal 15751 (COL, HUA, MO, PSO); El Espino to Tumaco Road, 30 km W of Ricaurte, 10 km W of Altaquer, El Mirador, Finca Sta. Lucía, in forest N of Río Nambi, 01° 17’ N, 78° 07’ W, 950 m, B. Hammel & A. Narváez 17178 (MO, PSO); Mpio. Ricaurte, Hacienda La Planada, 1,850 m, 26 Nov 1981 (fr), O. de Benavides 33338 (PSO); Resguardo Indigena Nulpe Medio, Andalucía- Nulpe Medio, 01° 05’ N, 78° 14’ W 01° 18’ N, 77° 54’ W, 800–1,100 m, 5 Jan 1996 (pist. fl), B. Ramírez et al. 9364 (BRIT, PSO); El Diverso, highway to Tumaco, 790 m, 20 Feb 1968 (fr), G. López 261 (PSO); Mpio. de Tumaco, 2 km from Tangareal, banks of Río Mira, 17 m, 8 Apr 1978 (pist. fl), O. de Benavides 1383 (PSO). ECUADOR. CARCHI: Cantón Tulcán, Reserva Indígena Awá, Gualpi Alto Community, Parroquia Chicál, 01° 02’ N, 78° 14’ W, 1,800 m, 15–28 Jul 1991 (stam. fl bud), D. Rubio et al. 1589 (BRIT, MO, QCNE), (fr), D. Rubio et al. 1590 (BRIT, MO, QCNE). LOS RÍOS: Cantón Quevedo, Parroquia Centinela-La Pirámide, via Sto. Dominto de los Colorados-Quevedo, entrando por Patricia Pilar, km 41, 01° 40’ S, 79° 20’ W, 650 m, 25 Feb 1992 (fr), C. Quetel & G. Típaz 160 (BRIT, MO, QCNE). PICHINCHA: Quito-Puerto Quito Road, 10 km N of main road, Km 113, 00° 05’ N, 79° 02’ W, Reserva Forestal ENDESA, Río Silancha, Cooperación Forestal Juan Manual Durini, voucher for NCI, 650–700 m, 17 May 1987 (pist. fl), P. Acevedo R., D. Daly & M. Ríos 1695 (BRIT, NY, QCA, US).

Clusia niambiensis is infrequent in the western slopes of the Cordillera Occidental of Colombia and adjacent Ecuador, where it has been frequently confused with its congeners, Clusia laurifolia Pl. & Tr., and Clusia venusta Little, all of them having bullate leaves with obviously brochidodromous venation. However, the free stamens with subulate apices, and Clusia venusta zone in the center of the androecium indicate it is a member of section Chlamydoclusia, and not section Retinostem, where the other two taxa belong. At this time, it is not known which member of subgenus Clusia is its closest relative.

ACKNOWLEDGMENTS

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BOOK REVIEW


This book is a collection of papers resulting from a symposium "Interactions of People and Forests in Kalimantan" held at the New York Botanical Garden in 1991. Despite being published some five years after the event, the 17 papers contained therein have not lost their timeliness, and are synthesized by an excellent introductory chapter by Padoch and Peluso. The book is composed of three sections: I) Introduction to Conservation and Development Issues and the Role of Research, II) Local Transformations in Forest Use and Forest Rights, and III) Case-Studies in Resource Management.

The first section contains five papers that explain the current development of Borneo within the context of Indonesia, Malesia as a whole, and SE Asia. Of these, the chapter by Potter on forest degradation is particularly illuminating and logically outlines what the conservation situation was on the island (prior to El Niño-1998), although the debt for nature swap, sensu Potter, is an extremely controversial concept.

The second section is focused to development on a local level and its effects on the forest, its people, and their sociology. It was interesting to note that Map 9.2 (p. 140) in Ngo's article, showing the migratory direction of the Kayan in Kalimantan, lies along the continental divide (and the Sarawak Border) and is immediately adjacent to (east of) and slightly overlapping with, the area surveyed by Burley in Chapter 5. Chapter 8, by Peluso and Padoch, is a cogent analysis of how two Dyak villages have changed with development, and contains a new hypothesis regarding changes in "distribution and economic importance of particular crops and technologies" as the impetus behind changes in resource management and rights. It includes extensive footnotes and a bibliography, with a conclusion's section that pinpoints the areas where further research is needed.

In the third part, Peters (Chapter 14), in his article on Illipe Nuts, has provided a model case (and I hope a rapidly adopted standard protocol) for the study of underexploited tropical crops. If data similar to that presented by Peters are combined with market data using the methodology in the following Chapter 14, by Leaman et al., a realistic estimation of a crop's potential can be calculated. Understanding the biology, and therefore, the likelihood of cultivation success for a given crop, combined with its relative "competitive fitness" against other crops simultaneously available in the market, would be a desirable formula to guide local communities in preferential resource allocations.

In summary, this book provides not only information pertinent to Borneo, but also contains papers with protocols worthy of becoming standards for their respective fields, concomitant with rich bibliographies. I think every conservationist, economic botanist, sustainable development specialist, and resource manager should have a copy. -John J. Pipoly III
NEW SPECIES AND NOMENCLATURAL NOTES IN CLUSIA (CLUSIACEAE) FROM ANDEAN COLOMBIA AND VENEZUELA

JOHN J. PIPOLY III
Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76126-3019, U.S.A.
jpipoly@brit.org; clusia@latinmail.com

ALVARO COGOLLO P.
Fundacion Jardin Botanico, Joaquin Antonio Uribe
Apartado Aereo 51407, Medellin, Antioquia, COLOMBIA
acogollo@latinmail.com; jardinbo@epm.net.co

ABSTRACT

Continuing studies on the Clusiaceae for Flora de Colombia, and fieldwork to document the phytodiversity of Río Ñambi Natural Reserve have revealed two new species, Clusia bernardoi Pipoly & Cogollo, and C. tetragona Pipoly & Cogollo. The new species are described, illustrated, and hypotheses of their phylogenetic positions are proposed. Corrections to bibliographic errors in citations for Clusia sect. Oedematopus and Clusia sect. Havetiopsis are provided. The new combination Clusia comans (Mart.) Pipoly is validated. Colombian and related Andean Venezuelan species formerly included in the genus Oedematopus are transferred to Clusia, necessitating the new combinations: C. aristeguietae (Maguire) Pipoly, C. divaricata (Cuatrec.) Pipoly, C. epiphytica (Cuatrec.) Pipoly, C. mirandensis (Cuatrec.) Pipoly.

RESUMEN

Estudios hacia un tratamiento taxonómico de la familia Clusiaceae para Flora de Colombia, y para documentar la fitodiversidad de la Reserva Natural Río Ñambi, revelaron dos especies nuevas para la ciencia, Clusia bernardoi Pipoly & Cogollo, y C. tetragona Pipoly & Cogollo. Se describen, se ilustran y se proponen hipótesis de parentesco para las nuevas especies. Errores bibliográficos previamente publicados para Clusia secciones Oedematopus y Havetiopsis se corrigen. La nueva combinación Clusia comans (Mart.) Pipoly se valida. Especies colombianas y venezolanas de la región Andina anteriormente consideradas como miembros del género Oedematopus se transfieren a Clusia, resultando en las nuevas combinaciones: C. aristeguietae (Maguire) Pipoly, C. divaricata (Cuatrec.) Pipoly, C. epiphytica (Cuatrec.) Pipoly, C. mirandensis (Cuatrec.) Pipoly.

INTRODUCTION

The genus Clusia contains approximately 300 species, of which nearly 17% remain undescribed. Fundamental taxonomic work by Panchon and
Triana (1860a, 1860b), Engler (1888, 1895), and Vesque (1892, 1893) form the basic framework which all modern studies have been based to date. Cuatrecasas (1949, 1950) was the first author of this century to critically reevaluate the Colombian members of the family, and in the two aforementioned papers, he described a total of 75 taxa. Most of the taxa described by Cuatrecasas belonged to the genus Clusia sensu stricto, but his work also included critical additions to the genera Oedematopus and Clusiella that left the circumscription of each significantly emended. Subsequently, Ewan (1951), Maguire (1951, 1977), Pipoly and Graff (1995a, 1995b), Pipoly (1997) and Pipoly and Graff (1995a, 1995b), described a number of new species. Pipoly et al. (1998), in their treatment of the family for Flora of the Venezuelan Guayana, relegated Quapoya, Havetiopsis, and Oedematopus (among other genera) to synonymy under Clusia. This paper is intended to describe novelties in Clusia, correct bibliographic errors in citation for sections Havetiopsis and Oedematopus, validate the new combination Clusia comans, and to complete the transferal of Oedematopus species to Clusia.

NOVELTIES IN Clusia

In the course of identification of herbarium materials for an analysis of the family for Flora de Colombia, the following new species were encountered.

Clusia (§ Anandrogyne) bernardoi Pipoly & Cogollo, sp. nov. (Fig. 1).


Quoad filamenta numerosa omnino libera, ad apices emarginata, adque bases cordata, androphoros paniculipracta C. sectio Anandrogyne pertinet, sed ab species illis laminis oblongis vel perangustae oblanceolatis, nervis secundariis numerosis ad apices truncatis vel late rotundatis hydropoditique induritis, securis margines revolutis acuon sepals petalisque 4 perficile cognoscitur.

Glabrous treelet to 5 m tall; latex unknown. Branchlets terete, 5–8 mm diam., swollen at the nodes 7–10 mm diam., the nodes short, 1.3–2 cm long, glabrous. Leaves sessile; blades coriaceous, oblong to narrowly oblanceolate, 17–23 cm long, 4.6–6.0 cm wide, apically truncate to broadly rounded, basally cuneate, midrib prominently raised above and below, the secondary veins brochidodromous, numerous, 70–80 pairs, prominentus above, scarcely visible below, the submarginal collecting vein like the secondaries, 1–2 mm from margin, drying smooth and dark green above, palloid below, the linear resin canals visible in the lower 1/3, and with scattered, minute rubiginous hydropotes, the margin slightly revolute except prominently revolute in the basal 1/4 of leaf. Staminate inflorescence a terminal panicle of cymes, thrice-branched, and each subsequent branch divided 3 times; peduncle 3.7–4.7 cm long; inflorescence bracts cartilaginous, ovate, 7–10 mm long,
Fig. 1. *Clusia bernardoi* Pipoly & Cogollo. A. Branchlet, showing oblong to narrowly ob lanceolate leaf blades. B. Androecium, showing poorly developed androphore and oblongoid anthers with emarginate apices. C. Sepal, showing asymmetry, and conspicuous venation. D. Petal, showing asymmetry and conspicuous venation. E. Abaxial leaf surface, showing hydropote. A–D, drawn from holotype.
4.5–6.5 mm wide, apically obtuse, medially thickened but not carinate, the linear resin canals drying black, conspicuous, the margin entire; floral bracts 2, as in secondary inflorescence branch bracts except oblate, 1.8–2.2 mm long, 2.1–4.1 mm wide, apex widely rounded; bracteoles 2, chartaceous, oblate to deltate, 2.0–2.2 mm long, 3.8–4.2 mm wide, apex obtuse to acutish, medially keeled, the margin entire; pedicels obsolete. **Staminate flowers** 3 per cymule, whitish-green; sepals 4, decussate, membranaceous, oblong, 5.5–6.5 mm long, 3.1–3.5 mm wide, asymmetric, apically obtuse, cucullate, hyaline, the venation conspicuous, the margin entire; petals 4, decussate, oblong, 5.5–7.0 mm long, apically broadly rounded and asymmetrically notched, hyaline, the venation conspicuous, the margin irregular, entire; androphore poorly developed or obsolete, stamens 22–28, 2.0–3.5 mm long, free to the base, the filaments 1–1.5 mm long, the anthers oblongoid, 0.5–0.9 mm long, 0.5–0.7 mm wide, apically emarginate, basally subcordate, as wide as the filaments, dehiscent by wide longitudinal slits throughout their length; pistillode absent. **Pistillate inflorescence, flowers, and fruit** unknown.

**Distribution.**—Known only from the type.

**Ecology and conservation status.**—The type locality lies in a transitional zone between premontane pluvial forest and cloud forest, but no further details are known. While the species is known from Munchique National Park, encroachment is common and poses a threat to this species.

**Etymology.**—It gives me great pleasure to dedicate this striking new species to Biól. Bernardo Ramiro Ramírez Padilla, Herbarium Technician of the University of Nariño in Pasto, Colombia. Bernardo has worked indefatigably for over twenty years, documenting the complex, species-rich and biogeographically important flora of the Department of Nariño and adjacent areas, such as Cauca and Putumayo.

**Clusia bernardoi** is unique among members of C. section *Anandrogyne* because of its oblong to narrowly oblanceolate leaf blades bearing rubiginous hydropotes, and 4-merous perianth. Four-merous flowers are otherwise frequent among members of C. section *Criuva* (Pipoly, 1996), but the oblongoid anthers with emarginate apices and cordate bases, dehiscent by wide longitudinal slits leave no doubt that **Clusia bernardoi** is a member of C. section *Anandrogyne*, the largest and most complicated section of the genus.

**Clusia (§ Criuva) tetrakona** Pipoly & Cogollo, sp. nov. (Fig. 2), COLOMBIA. NARIÑO: Mpio. Barbaconas; Corregimiento Ortíz y Zamora; Vereda El Barro; Reserva Natural Río Nambí; ca. 5 km W de Altaquén, faldas occidentales de la Cordillera Occidental; 01° 18' N, 78° 08' W, 1,350–1,400 m. 3 Sep 1997 (bud, fr.), *J. Pipoly, A. Cogollo, M. López, & M. Rodriguez 21198* (HOLOTYPE: PSO; ISOTYPES: BRIT, COL, FMB, JAUM, K, MO, NY, TULV).
Fig. 2. *Clusia tetragona* Pipoly & Cogollo. A. Branchlet, showing tetragonal shape appearing alate, and subsessile leaves. B. Androecium, showing poorly developed androphore, free filaments, and muticous anthers. C. Flower buds, showing secondary inflorescence bracts and two of the four bracteoles. D. Fruit, showing rostrate apex. A–C, drawn from holotype. D, drawn from *J. Pipoly et al. 21157.*
Propert lamina obovata vel elliptica coriaceaque nervio submarginale prominente, inflorescentiam terminalem pyramido-paniculatum, petiilos marginatos necnon fructu rostrato, *C. garciabarrigae* valde arcte affinis, sed ab ea ramulis tetragonis (non teretibus), petiilos obsoletis vel usque ad 1.5 (non 2.5–4) cm longis, bracteis florinis 4 (non 2), sepalis suborbicularibus (non oblongis), denique fructibus 8–10(–13) (non 5–7) mm longis statim distinguitur.

Terrestrial tree to 25 m tall, and to 45 cm DBH; latex white. *Branchlets* tetragonal, subolate, (4–)5–7 mm diam., glabrous. *Leaves* decussate; blades coriaceous, obovate to elliptic, (9.5–)14.2–19 cm long, 4.5–6(–9.5) cm wide, apically broadly rounded to truncate, basally acute, midrib prominently raised above and below, the secondary veins numerous, 50–52 pairs, connected by a submarginal collecting vein ca. 2 mm from margin; linear latex canals not visible from above, rubiginous and conspicuous below, the margin entire, flat; petiolo obsolete to broadly marginate, to 1(–1.5) cm long. *Staminate inflorescence* a bipinnate panicle, ca. 12 cm long, 10 cm wide; peduncle 4–4.5 cm long, tetragonal except drying flat in the upper portion; primary inflorescence bracts 2, cartilaginous, 11–13 mm long, 5.5–6.5 mm wide, apically obtuse, medially keeled, the margin scarious, entire; secondary inflorescence bracts acropetally smaller and similar, except the uppermost suborbicular, ca. 3 mm long and wide; pedicels obsolete to 0.5 mm long. *Staminate flowers* greenish white; bracteoles 4, cartilaginous, obolate, 2.5–3 mm long, 3–3.5 mm wide, apically acute to rarely subobtuse, prominently carinate medially, the margin entire, opaque, glabrous; sepals 4, membranous, hyaline, decussate, the outer suborbicular, 4.5–5.5 mm long, 3.5–4 mm wide, the inner oblong, 7–8 mm long, 3.5–4 mm wide, apically cuculate and broadly rounded, the linear latex canals conspicuous, the margin entire; petals 4, decussate, membranaceous, obovate-spathulate, 8–9 mm long, 4–5 mm wide, linear latex canals conspicuous, the margin entire; androphore poorly developed, to 1 mm high; stamens 32–36, 3–4.5 mm long, the filaments free, angulate 1–2 mm long, the anthers linear, each theca half the diameter of the connective, apically muticous, tapering basally into filament, dehiscent by narrow longitudinal slits 2–2.5 mm long; pistillode absent. *Pistillate flowers* similar to staminate except somewhat smaller (in bud); staminodes obsolete; pistil oblongoid, 3.5–4 mm long, ca. 2 mm wide, the stigmas 4, sessile, cuneiform, concave, 0.9–1.3 mm long, 0.9–1.1 mm wide, appearing to be borne on connivent styles at maturity, the apparent styles 1–1.2 mm long. *Fruit* ellipsoid, 8–10(–13) mm long, 4.5–6 mm wide, abruptly constricted to a small “beak” apically (rostrate).

*Distribution.*—Apparently endemic to the Barbacoas area, on the western slopes of the Cordillera Occidental, in the Department of Nariño, Colombia, at 1,325–1,900 m elevation.

*Ecology and conservation status.*—*Clusia tetragona* is restricted to premontane pluvial and cloud forests, where it is found along forest margins.

*Etymology.*—The specific epithet, ‘tetragona’ refers to the tetragonal na-
ture of the branchlets when seen in transverse section.

Common names.—“Guanderá” (Spanish).

Paratypes. COLOMBIA. NARÍNÔ: Mpio. Barbacoas, Corregimiento Altaquer, Vereda El Barro, Reserva Natural Río Nambi, left bank of Río Nambi, 01° 18’ N, 78° 04’ W, 1,325 m, 11 Dec 1993 (fr), P. Franco et al. 5145 (COL, PSO); Corregimiento Ortiz y Zamora; Vereda El Barro: Reserva Natural Río Nambi; ca. 5 km W de Altaquer, faldas occidentales de la Cordillera Occidental; 01° 18’ N, 78° 08’ W, 1,350–1,400 m, 2 Sep 1997 (bud, fr), J. Pipoly, A. Cogollo, M. López & M. Rodríguez 21157 (BRIT, COL, FMB, JAUM, K, MO, PSO, TULV); Mpio. Ricaurte, La Planada, 1,900 m, 28 Nov 76 (stam. fl), O. de Benavides 730 (PSO), La Planada, 5 km S of Altaquer, 01° 10’ N, 78° 00’ W, 1,750 m, 22 Nov 1986 (fr), B. Hammel & R. Bernal 15802 (COL, MO, PSO); La Planada, 7 km de Chucunès, 01° 10’ N, 77° 58’ W, 1,800 m, 25 Sep 1989 (fr), O. de Benavides 10803 (MO, PSO), 18 Jan 1990 (fr), O. de Benavides 11337 (MO, PSO), 01° 05’ N, 78° 01’ W, 1,800 m, 22 Dec 1987 (fr), A. Gentry & P. Keating 59721 (MO, PSO); Trail to El Hondón, 5–12 km SW of La Planada, 01° 04’ N, 78° 02’ W, 1,750–1,800 m, 6 Jan 1988 (fr), A. Gentry & P. Keating 60474 (MO, PSO); Camino Las Cruces-Curucel, 01° 08’ N, 77° 51’ W, 1,700–1,800 m, 5 Nov 1995 (fr), B. Ramirez, M. González & A. Muñoz 8692 (BRIT, PSO).

Because of its obovate to elliptic, coriaceous leaves, with a prominent submarginal collecting vein, terminal pyramidal-paniculate inflorescence, and rostrate fruit, Clusia tetragona is most closely related to C. garciabarrigae Cuatrecasas. However, Clusia tetragona is immediately separated from that species by the tetragonal branches, appearing alate when dried, sessile to short-petiolate leaves, more numerous floral bracteoles, suborbiculate sepals and much longer fruits. While Clusia tetragona is apparently sympatric with C. garciabarrigae, it is notable that C. tetragona is restricted to more open habitats than C. garciabarrigae. Clearly, more fieldwork is needed to understand the population biology of these species.

NOTES ON CLUSIA SECTIONS OEDEMATOPSIS AND HAVETIOPSIS

In our recent treatment of this section for the Venezuelan Guayana (Pipoly et al. 1998), we inadvertently missed the first publication of the basionyms, Oedematopus Planch. & Triana, and Havetiopsis Planch. & Triana, and cited them as “Ann. Sci. Nat., Bot. ser. 4, 14:249. 1860,” for Oedematopus and “Ann. Sci. Nat., Bot. ser. 4, 14:246. 1860” for Havetiopsis, where complete descriptions of the genera were presented, followed by descriptions of all infrageneric taxa. However, Planchon and Triana had first published the two generic names, with diagnoses inside a synoptic key, for the first time in the previous volume, published in the same year. For my relegation of Pilosperma Planch. & Triana to synonymy under Clusia, I (Pipoly 1997) cited “Ann. Sci. Nat., Bot ser. 4, 13:315. 1860,” which was correct. Because the citations for Oedematopus and Havetiopsis only involve bibliographic errors (ICBN, Art. 33.3), the combinations are valid, but should be cited as follows:


When relegating Rennggeria to synonymy under Clusia, we (Pipoly et al. 1998), cited the basionym “Rennggeria comans Meisn., Pl. Vasc. Gen., Commentarius 42. 1837.” However, Meisner did not make a new combination on that page; he merely published the name of a new genus there, without listing any species. Therefore, the correct basionym was not cited and according to ICBN Art. 33.2, the combination is invalid. The new combination, citing the correct basionym is made herewith:


Even though the generic name Schweiggeria Mart. (non Spreng.) is a later homonym, the binomial is legitimate, as per ICBN Art. 55.1.

In the treatment of the genus Clusia for Flora of the Venezuelan Guayana, (Pipoly et al. 1998), and subsequently (Pipoly 1997), we transferred a number of Andean species from Oedematopus to Clusia, but did not transfer the Andean species from Colombia and Venezuela, pending review of available material. Now that I have seen types and other material of these species, here I transfer the remainder of the species formerly in Oedematopus, to Clusia sect. Oedematopus, herewith.


Acknowledgments

This work results from studies supported by a generous grant from the
National Geographic Society, 5575-95, for exploration of the Parque Nacional Natural Las Orquídeas, followed by the same at Reserva Natural Río Ñambí. We thank Bernardo Ramírez (PSO) for his technical assistance, as well as the administration of FELCA (Fundación Ecológica de los Colibríes de Altaquer), Marcial Bisbiczuz, and Maruricio Flores. Ramiro Fonnegra, Director of HUA, graciously made the services of Gloria Mora and Consuelo García available to us to prepare the line illustrations, for which we are most grateful. Logistical help from Juan Guillermo Ramírez and Adriana Gómez (JAUM) greatly facilitated our work.

We are also very grateful to K. Gandhi (GH) for bringing the bibliographic errors in the Flora of the Venezuelan Guayana treatment to the attention of Pipoly. Gandhi’s thorough and meticulous work is most appreciated. The additional comments by D. Nicolson (US) did much to improve the quality of the paper, for which we are most thankful.

REFERENCES


BOOK REVIEW


This book's format is extremely similar to the classic Textbook of Dendrology, by W. Harlow & E. Harrar, published in 1958. Although I found no direct reference to that work mentioned in the text, the 7th edition of Harlow and Harrar, published in 1991, is cited in the Bibliography section. The author states that this book evolved from the Native Trees of Canada, first published in 1917. Clearly, there are only so many ways to present multiple dendrological characteristics graphically, clearly, yet with high technical accuracy, and this, like the other aforementioned books, does just that. For each "native" species, the "preferred" English common name, latin name, French common name, its distribution, and brief descriptions of the: leaves, buds, twigs, "seed cones" (in the case of gymnosperms), or flowers and fruit (for angiosperms), seeds, vegetative reproduction, bark, wood, size and form of bole and canopy, habitat and notes. The distribution map, habit profile, twig profile, leaf profile, and fruit drawing are on a page facing color photos of the cones or flowers, fruits, seeds, young bark, and old bark, for most species. The entire work is divided into 12 groups, the first six of which are gymnosperms (needle and scale characters) and the second of which are angiosperms, separated by leaf morphology. While I believe the section entitled, "Tree names" contains several important conceptual errors, they do not comprise any meaningful pitfall. I would have also liked an explanation for determination of "native" species. In summary, it is one of those guides that every professional conservationist, forester and botanist should have, along with anyone who enjoys hiking, camping, nature walks, and other outdoor activities in the geographic area covered. The price is more than reasonable for such an absolutely practical work, that is easy to use, richly illustrated on acid-free paper, and with an extra-heavy-duty binding. I am not sure how the book would withstand a rainstorm or two, but I am anxious to find out, as should everyone.—John Pipoly III
DOS NUEVAS ADICIONES A LA ORQUIDEOFLORA MEXICANA

ADOLFO ESPEJO SERNA Y ANA ROSA LÓPEZ-FERRARI

Herbario Metropolitano
Departamento de Biología, C.B.S.
Universidad Autónoma Metropolitana-Iztapalapa
Apdo. Postal 55-535
09340 MÉXICO, D. F.
aes@xanum.uam.mx

JAVIER GARCÍA CRUZ, ROLANDO JIMÉNEZ MACHORRO y LUIS SÁNCHEZ SALDAÑA

Herbario AMO
Apdo. Postal 53-123
11520 MÉXICO, D.F.
eric@internet.com.mx

RESUMEN

Se describen e ilustran dos nuevas especies del género *Malaxis* (Malaxideae, Orchidaceae) para México, *Malaxis palustris* y *Malaxis alvaroi*. La primera crece en el estado de Morelos y la segunda se conoce de los estados de Morelos y Guanajuato.

ABSTRACT

*Malaxis palustris* and *Malaxis alvaroi* (Malaxideae, Orchidaceae), two new species from Mexico, are described and illustrated. The former grows in Morelos and the latter is known from Morelos and Guanajuato.

INTRODUCCIÓN

El género *Malaxis* fue propuesto por Swartz en 1800 y comprende un grupo de orquídeas terrestres, bulbosas, ocasionalmente epífitas, que se caracterizan por presentar una o dos hojas (ocasionalmente tres) envainadoras y flores pequeñas, verdes a verde-amarillentas, raramente purpúreas dispuestas en inflorescencias racemosas a corimbosas. El género cuenta con cerca de 300 especies de distribución cosmopolita. Williams (1951) cita 24 especies para México, Soto Arenas (1988) reporta 32 taxa, en tanto que Espejo & López-Ferrari (1998) registran 47. Aunque los listados mencionados nos dan una idea del número de representantes mexicanos del género, aun está lejos de completarse la revisión del mismo para el país. En los últimos 15 años han sido descritos más de 10 taxa (McVaugh 1985; Catling 1990; Salazar


Por otra parte, la distribución de las especies de Malaxis en México es poco conocida o en algunos casos mal entendida, debido a que la delimitación específica se basa en buena medida en los caracteres florales, los cuales son difíciles de observar o interpretar en el material herborizado. Además, la falta de claves recientes para la identificación de las especies conduce a que los ejemplares, o bien no se identifiquen, o bien se determinen erróneamente.

En recientes salidas al campo a los estados de Morelos y Guanajuato, se recolectó material de dos especies del género Malaxis, que no pudieron asignárse a ninguno de los taxa conocidos. La revisión bibliográfica pertinente, así como el estudio de las colecciones del género, incluyendo material tipo, depositadas en los herbarios AMES, AMO, ENCB, GH, MEXU, MICH, NY, UAMIZ, VT y W nos llevaron a la conclusión de que se trata de dos novedades para la ciencia, que aquí proponemos.

**Malaxis palustris** Espejo & López-Ferrari, sp. nov. (Fig. 1). TIPO: MÉXICO. Morelos, municipio de Huitzilac, 1–2 km al W de la Laguna Zempoala, sobre el arroyo Las Trancas, Parque Nacional Lagunas de Zempoala, 19° 02’ 37” N, 99° 19’ 20” W, 2800 m, 12 jul 1997, Espejo, 5714, López-Ferrari, García-Cruz y Jiménez M. (HOLOTIPO: UAMIZ; ISOTIPOS: AMO, AMES).


**Hierba** paludícola de 12–33 cm de alto. Raíces pocas, originadas en la base del pseudobulbo, de 0.2–0.5 mm de diámetro, pilosas, blanquecinas. Rizoma conspicuo, de 0.5–2.5 cm de largo por 2–3 mm de diámetro, cubierto por las vainas. Seudobulbo hipógeo, ovoide a oblongo, inconspicuo, blanco, de 5–10 mm de largo por 5–7 mm de ancho. Vainas dos, tubulares, estrechas, verdosas hacia el ápice, obtusas a agudas, de 3–4.5 cm de largo. Hoja única con una vaina tubular de 3–9.5 cm de largo que envuelve la porción inferior del escapo; lámina de 3.5–5.5 cm de largo por 1.3–2 cm de ancho, angostamente elíptica a elíptica, obtusa a redondeada, la base decurrente, el margen entero, con una quilla prominente en el envés. Inflorescencia erecta, originada de la parte apical del pseudobulbo en desarrollo, racemosa, más larga que la hoja, con 10–30 flores sucesivas; pedúnculo de 8–16 cm de largo por 1–1.5 mm de diámetro, alado, pentagonal en corte transversal, racimo denso, de 2–4.5 cm de largo por ca. 1 cm de diámetro. Brácteas florales ascendentes, verdes, triangulares, agudas, de 1–1.5 mm de largo por ca. 1 mm de ancho. Flores ascendentes, de 5–6 mm de largo, amarillo-verdosas, no resupinadas. Ovario subcilíndrico, de 2–2.5 mm de largo por ca. 1 mm
Fig. 1. *Malaxis palustris* Espejo & López-Ferrari. A. Hábito de la planta; B. Detalle de la inflorescencia; C. Flor disecada; D. Flor tres cuartos; E. Flor vista lateral; F. Flor vista frontal; G. Columna vista dorsal; H. Columna vista lateral; I. Columna vista ventral; J. polinios.
de diámetro. Sépalo dorsal extendido, con los márgenes deflexos a revolutos, angostamente triangular, obtuso, trinervado, de 2.5–3 mm de largo por 1.8 mm de ancho. Sépalos laterales extendidos, con los márgenes deflexos a revolutos, angostamente triangulares, ligeramente oblicuos, obtusos, trinervados, de 2.5–3 mm de largo por 1.8 mm de ancho. Pétalos extendidos a recurvados, oblongo-lineares, uninervados, de 2.5–3 mm de largo por ca. 0.3 mm de ancho, el ápice redondeado. Labelo depreso-ovado, abruptamente acuminado, cóncavo, abrazando a la columna en posición natural, con una quilla media longitudinal evidente de color verde oscuro, de 2.5 mm de largo por 2.2 mm de ancho, la base truncada. Columna corta, cuadrada, comprimida dorsiventralmente, truncada, de 0.7 mm de largo por 0.7 mm de ancho. Antera transversalmente oblonga, bilocular, de 0.2 mm de largo por 0.6 mm de ancho. Polinarios dos, separados, divergentes, cada polinario formado por dos polinios fusionados entre sí; cada par de polinios obpiriforme, obcuso, comprimido dorsiventralmente, amarillo, de 0.3 mm de largo con un viscidio apical, formado por una gota viscosa, de color ámbar. Estigma ventral, semicircular, cóncavo. Cápsula elipsóide, de 4–5 mm de largo por 2 mm de diámetro.


Etimología.—el nombre de la especie hace alusión a su hábito paludícola ya que crece en llanos permanentemente inundados rodeados por bosques de Abies.

Malaxis palustris se conoce hasta el momento sólo de la localidad tipo, en el estado de Morelos, sin embargo, es de esperarse su presencia en el vecino municipio de Ocuilan, en el Estado de México. La preferencia de las plantas de esta especie por los lugares abiertos y anegados, hábito poco común en el género, la distinguen del resto de las especies mexicanas. Otros caracteres peculiares de M. palustris son el rizoma evidente, las flores no resupinadas y el labelo depreso-ovado, abruptamente acuminado en el ápice y truncado en la base. El conjunto de todas estas características distinguen inconfundiblemente a M. palustris de cualquier otra especie mexicana conocida. Cabe señalar que en los alrededores de la localidad tipo de M. palustris, crecen también M. ehrenbergii (Rchb. f.) Kuntze, M. myurus (Lindl.) Kuntze, M. salazarrii Catling, M. sourei L. O. Williams, M. streptopeata (B.L. Rob. & Greenm.) Ames y M. tenuis (S. Watson) Ames, sin embargo ninguna de ellas se encuentra en lugares pantanosos, sino que prefieren sitios elevados y secos dentro de los bosques de pino y/o Abies.

Malaxis alvaroi García-Cruz, R. Jiménez & L. Sánchez, sp. nov. (Fig. 2).

Tipo: MÉXICO. MORELOS: municipio de Tepoztlán, sobre la vía del ferrocarril México

Hierba terrestre de 12–23 cm de alto. Raíces pocas, originadas de la base del seudobulbo, de 0.3–0.6 mm de diámetro, pilosas, blanquecinas. Rizoma ausente. Seudobulbo hipogeo, ovoide, suculento, blanco, de 7 mm de largo por 4.3–8 mm de ancho. Vaina una, tubular, estrecha, verdosa, obtusa a redondeada, de 2–4 cm de largo. Hoja única con una vaina tubular, de 2.5–3.5 cm de largo, ligeramente comprimida, con cuatro quillas evidentes que envuelve la porción inferior del escapo; lámina de 3–4.5 cm de largo por 1.8–2.5 cm de ancho, ovada, obtusa a redondeada, la base ligeramente cordada, el margen levemente ondulado, sobre todo hacia la base, con cinco venas ligeramente hundidas en el haz y prominentes en el envés, la vena media marcadamente quillada, de color verde oscuro. Inflorescencia erecta, originada de la parte apical del seudobulbo, racemosa a corimbosa, más larga que la hoja, con 20–45 flores sucesivas; pedúnculo de 4–10 cm de largo por 0.8–1.5 mm de diámetro, con diez alas diminutamente aserradas a erosas, racimo denso, de 1.5–2.5 cm de largo por 0.8–1.5 cm de diámetro; raquis alado, las alas diminutamente aserradas a erosas. Brácteas florales extendidas, verdes, triangulares, agudas, de 0.5 mm de largo por 0.5 mm de ancho. Flores ascendentes, de 3–4.2 mm de largo, verde oscuras, resupinadas. Ovario torcido, quillado, subcilíndrico, de 1.7–4 mm de largo por 0.3–0.5 mm de diámetro. Sépalo dorsal extendido, aplanado, ovado a lanceolado, obtuso, trinervado, de 1.5–2.2 mm de largo por 1–1.3 mm de ancho. Sépalos laterales extendidos, brevemente connatos en la base, aplanados, ligeramente oblicuos, ovados a lanceolados, obtusos, trinervados, de 1.6–2.2 mm de largo por 1–1.3 mm de ancho. Pétalos recurvados, lineares, uninervados, de 1.5–2 mm de largo por ca. 0.2 mm de ancho, el ápice redondeado. Labelo delgado sagitado, ligeramente cónico, pentanervado, de 1.7–2.5 mm de largo por 2.1–2.3 mm de ancho, agudo, la base con dos lóbulos laterales triangulares con el ápice en ocasiones falcado. Columna corta, subcuadrada, comprimida dorsiventralmente, truncada, de ca. 0.5 mm de largo por ca. 0.5 mm de ancho. Antera dorsal, bilocular, reniforme, de 0.2 mm de largo por 0.4 mm de ancho. Polínarios dos, separados, divergentes, cada polinario formado por dos polínios fusionados entre sí, cada par de polínios obovoide, oblicuo, comprimido dorsiventralmente, amarillo, de 0.3 mm de largo con un viscidio apical, formado por una gota viscosa de color ámbar. Estigma ventral, subcuadrado, cóncavo. Cápsula obovoide, ascendente, de 5 mm de largo por 2 mm de diámetro.
Fig. 2. *Malaxis alvaroi* García-Cruz, R. Jiménez & L. Sánchez. A. Hábito de la planta; B. Detalle de la inflorescencia; C. Flor disecada; D. Flor vista lateral; E. Flor vista frontal; F. Columna vista dorsal; G. Columna vista lateral; H. Columna vista ventral; I. Polinios.

Etimología.—el epíteto asignado a este taxon se dedica al biólogo Alvaro Flores Castorena, amigo y colega con quien hemos recorrido gran parte del estado de Morelos recolectando orquídeas y otras plantas.

Esta especie crece en los bosques de encino secos y generalmente forma colonias pequeñas difíciles de encontrar.

*Malaxis alvaroi* se reconoce por sus flores pequeñas de menos de 4,3 mm de largo y de color verde obscuro, dispuestas apretadamente en una inflorescencia racemosa a corimbosa, que se va alargando por la permanencia de las flores marchitas en la parte inferior de la misma. Otros caracteres distintivos son el labelo deltado sagitado, con los lóbulos basales agudos y las alas aserradas a erosas del pedúnculo y el rúquis.

Por sus caracteres vegetativos y florales, como son la hoja única y cordada, la inflorescencia racemoso-cóimbosa y el labelo triangular y sin ornamentaciones, *Malaxis alvaroi* puede ubicarse dentro del grupo de especies formado por *M. brachystachys* y *M. corymbosa*. En el cuadro 1 pueden apreciarse las características comparativas entre éstas (Tabla 1).

<table>
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<tr>
<th>Características</th>
<th><em>M. alvaroi</em></th>
<th><em>M. brachystachys</em></th>
<th><em>M. corymbosa</em></th>
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<td>3-7</td>
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<td>corímbo alargado</td>
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<td>longitud de las flores (mm)</td>
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<th><em>M. brachystachys</em></th>
<th><em>M. corymbosa</em></th>
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<td>color de las flores</td>
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<tr>
<td>longitud del ovario (mm)</td>
<td>1.7-4</td>
<td>10-12</td>
<td>6-7</td>
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</table>

![Imagen de Malaxis alvaroi]

![Imagen de Malaxis alvaroi]

![Imagen de Malaxis alvaroi]
AGRADECIMIENTOS

Este trabajo fue patrocinado parcialmente por la Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO) a través de los proyectos G016, H1043 y H098. Deseamos hacer patente nuestro agradecimiento a Victoria Sosa, Kerry A. Barringer, Lawrence K. Magrath, Eric Hágsater y Gerardo Salazar por la revisión crítica del manuscrito. Asimismo agradecemos a los curadores de los herbarios consultados por las facilidades brindadas para la revisión del material. Los dibujos fueron elaborados por Rolando Jiménez Machorro.

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SEEDLING DEVELOPMENT IN SPECIES OF CHAMAESYCE (EUPHORBIACEAE) WITH ERECT GROWTH HABITS

W. JOHN HAYDEN and OLGA TROYANSKAYA

Department of Biology
University of Richmond
Richmond, VA 23173, U.S.A.

ABSTRACT

Seedling development is described for Chamaesyce hirsuta, C. hypericifolia, and C. mesembrianthemifolia as discerned by light microscopy and scanning electron microscopy. Although these species ultimately develop erect to ascending growth habits, epicotyl development is limited to the production of a single pair of leaves located immediately superjacent to and decussate with the cotyledons. The shoot system develops from one or more buds located in the axils of the cotyledons. In all respects, seedling ontogeny is very similar to that of previously studied prostrate species of Chamaesyce. Evidence from seedling ontogeny thus contradicts a hypothesis concerning homologies of plant form pertinent to the origin of Chamaesyce from Euphorbia that was first articulated by Roeper in 1824. These results support an alternative hypothesis based on proliferation of branches from the cotyledonary node in hypothetical ancestral elements within Euphorbia where this morphology can be found in perennial hemicryptophytes as well as certain annual species.

RESUMEN

Se describe el desarrollo de la semilla de Chamaesyce hirsuta, C. hypericifolia, y C. mesembrianthemifolia al microscopio óptico y microscopio electrónico de barrido. Aunque estas especies desarrollan finalmente hábitos de crecimiento de erectos a ascendentes, el desarrollo del epicotilo se limita únicamente a la producción de un par de hojas localizadas inmediatamente encima y decussadas con los cotiledones. El sistema de ramas se desarrolla a partir de una o más yemas localizadas en las axilas de los cotiledones. La ontogenia de la semilla es en todos los aspectos muy semejante a la de las especies de Chamaesyce postradas estudiadas previamente. Esta evidencia de la ontogenia de la semilla contradice la hipótesis relativa a las homologías, de la forma de la planta, relativas al origen de Chamaesyce a partir de Euphorbia emitida por Roeper en 1824. Estos resultados apoyan la hipótesis alternativa basada en la proliferación de ramas a partir del nudo de los cotiledones en los hipórticos elementos ancestrales de Euphorbia donde puede encontrarse esta morfología en hemicriptófitos perennes así como en algunas especies anuales.

The genus Chamaesyce Gray can be distinguished from its close relatives in Euphorbia L. by a series of morphological, physiological, and developmental characters (Webster 1967, 1994; Koutnik 1984). The peculiar features of seedling ontogeny in Chamaesyce are often asserted to be characteristic for the genus (Degener & Croizat 1938; Koutnik 1987). However,
seedlings of only a few species have been studied anatomically (Veh 1928; Mangaly et al. 1979; Rosengarten & Hayden 1983; Hayden 1988). Moreover, these few anatomical studies have generally focused on species of section *Chamaesyce*, a group characterized by radiating, prostrate branches. This paper describes seedling development in species with erect to ascending growth habits for comparison with the known structures and developmental events of prostrate species. Further, this paper critically assesses the interpretation of Mangaly et al. (1979) who described extra-axillary origin of lateral branching in seedlings of *Chamaesyce* and it is the first study to examine *Chamaesyce* seedlings with the scanning electron microscope (SEM).

We document and describe seedling development for three species representing two sections of the genus characterized by erect to ascending stems. *Chamaesyce hypericifolia* (L.) Millsp., the type species of section *Hypericifoliae* (Boiss.) Hurus., is a widely distributed weed (Holm et al. 1979) thought originally to be native to warm regions of the Americas (Webster 1967; Koutnik & Huft 1990). *Chamaesyce hirta* (L.) Millsp. is also classified in section *Hypericifoliae* and has similar present day status as a pantropical weed (Cardenas et al. 1972; Holm et al. 1979); however, it may be native to both the New and the Old World tropics (Koutnik & Huft 1990). *Chamaesyce mesembrianthemia* (Jacq.) Dugand is a shrubby plant classified in section *Sclerophyllae* (Boiss.) Hurusawa and found near seashores of the Caribbean and northern South America (Long & Lakela 1976; Acevedo-Rodríguez 1996). Although *C. hypericifolia* is often characterized as an herb, under favorable conditions it can produce weakly woody stems approaching a meter in height and 1 cm in basal diameter; thus, it can attain a stature comparable to that of *C. mesembrianthemia*. In contrast, *C. hirta* is smaller, and somewhat intermediate between the prostrate growth habit typical of section *Chamaesyce* and the erect growth habits of sections *Hypericifoliae* and *Sclerophyllae*. In *C. hirta*, each plant produces multiple stems, but seldom as many as found in species of section *Chamaesyce*, and while these stems are sometimes more or less prostrate, they more frequently ascend, but seldom to heights exceeding 15 or 20 cm.

**MATERIALS AND METHODS**

Specimens of *C. hirta* were collected in 1982 from weeds among nursery stock in a Richmond, VA, garden center. Plants of *C. mesembrianthemia* were collected at West Summerland Key, Florida, in 1983 and plants and seeds of *C. hypericifolia* were collected from Big Pine Key, Florida, in 1986. All three species have been maintained subsequently in greenhouse cultivation at the University of Richmond. Adult plants were prolific in cultivation; over several years *C. hypericifolia* produced many thousands of seedlings whereas *C. hirta* and *C. mesembrianthemia* each produced several hun-
dred. Preparations of *C. hirta* and *C. hypericifolia* were derived from seedlings obtained spontaneously from containers of sterile soil placed in the vicinity of mature greenhouse-grown plants. Preparations of *C. mesembrianthemifolia* were derived largely from a dense mass of seedlings collected in the wild from the surface of a small anthill and supplemented with greenhouse materials. Herbarium vouchers at URV for materials studied include: *C. hirta*—Hayden 614; *C. mesembrianthemifolia*—Hayden 709; and *C. hypericifolia*—Hayden 1433, 3252 and 3281. All specimens were preserved in FAA (formalin—acetic acid—70% alcohol). Numbers of seedlings studied for each species are as follows: *C. hirta*—30 for light microscopy (LM); *C. hypericifolia*—30 for LM and 42 for SEM; *C. mesembrianthemifolia*—17 for LM and 14 for SEM.

For light microscopy, fixed seedlings were trimmed to remove structures more than 5 mm below or above the cotyledonalary node (if present), dehydrated in a tert-butanol series, embedded in paraffin, sectioned at 10 μm, affixed to slides with Bissing’s adhesive (Bissing 1974), and stained in a combination of safranin and hematoxylin (Johansen 1940). Photomicrographs were prepared from Kodak Technical Pan film developed in Kodak HC110 developer at dilution F. For SEM, fixed seedlings were trimmed, dehydrated in ethanol, subjected to critical point-drying with CO₂ as the intermediate solvent, affixed to stubs with aluminum tape, sputter-coated with a gold-palladium mixture to a thickness of 40 nm, and observed with a Hitachi S-2300 SEM. Scanning electron micrographs were prepared from Kodak Tri-X film developed in Kodak HC110 developer at dilution B.

**RESULTS**

**External morphology**

In the seed and during initial stages of germination, the cotyledons are tightly appressed. Upon germination, blades of the cotyledons diverge first, leaving their petioles in close contact. Soon, however, petioles also diverge, revealing primordia for the first pair of true leaves (Figs. 1–3). Following Hayden (1988), these first leaves are referred to as v-leaves to indicate their supposed homology with leaves on the vegetative axis of *Euphorbia* species classified in subgenus *Agaloma* (Raf.) House and subgenus *Esula* Pers. Upon their full expansion, v-leaves are inserted directly superjacent to and decussate with the cotyledons (Fig. 3). There is no residue of meristematically active cells at the epicotyl apex following v-leaf formation (Figs. 4, 9, 10, 15–17). Seedling growth continues via lateral branches that arise from buds axillary to the cotyledons (Figs. 4–8, 10–12, 15, 17, 20).

Although multiple buds routinely develop in the axils of each cotyledon (Figs. 11, 20), just a single lateral branch dominates early growth in *C. hypericifolia* and *C. mesembrianthemifolia* (Figs. 5, 6). This first, dominant branch is

erect or slightly inclined from vertical. Growth of additional lateral branches at the cotyledonary node as plants grow older is highly variable in these two species. Vigorous specimens with sparse or no competing nearby vegetation tend to produce one or two additional basal branches, but these remain smaller than the first branch unless the latter is removed or dam-
aged. It is not unusual for nearly the entire aerial system in these species to develop from the first dominant branch that arises at the cotyledonal node.

Initially, seedlings of C. hirta are similar to those of C. hypericifolia and C. mesembrianthemifolia. However, in C. hirta, multiple lateral branches develop from the cotyledonal node. The first two branches arise one each from the axils of the cotyledons and, frequently, two additional branches develop from buds located at the bases of the first two branches.

**Anatomical structure**

*Cotyledon stage.*—The hypocotyl is traversed by four vascular bundles that ascend from the radicle to the cotyledonal node. Two of these bundles, each located on opposite sides of the axis, constitute the median traces to the cotyledons; each passes directly from the hypocotyl into the petiole of its respective cotyledon. The other two bundles form four lateral traces to the cotyledons; each splits into two bundles at the cotyledonal node and the resultant pair of traces diverge towards cotyledons on opposite sides of the stem. Cotyledonal node vasculature is thus trilacunar with split laterals (Fig. 19). The system of non-articulated branched laticifers that ultimately permeates the plant body arises from initials located external to the vascular tissue at the cotyledonal node.

*V-leaves.*—V-leaves arise on the flanks of the epicotyl apex (Figs. 1, 9). As soon as v-leaf primordia can be detected, cells of the epicotyl apex are larger and more vacuolate than those of the v-leaf primordia (Fig. 9). Thus, the only meristematically active cells of the epicotyl apex are fully consumed in formation of the v-leaves. Each v-leaf is vascularized by three traces that differentiate from procambium near the split lateral traces to the cotyledons; of the three traces for a given v-leaf, two traces insert on one side of the cotyledonal split lateral and one trace inserts on the opposite side. General
Figs. 7, 8. Seedlings of Chamaesyce birta, Hayden 614, LM. 7. Cotyledons, their lateral buds, and portions of one v-leaf, longitudinal section in the cotyledonary plane; bar = 50 μm. 8. Cotyledon petioles, their lateral buds, and v-leaf petioles; bar = 100 μm. c = cotyledon; v = v-leaf.

vascular development of the seedling continues as the v-leaves develop. Once the v-leaves are fully expanded, the hypocotyl contains four well-defined vascular strands that supply the first four leaves of the seedling.

Branch development.—SEM micrographs of intact seedling apices and LM sections reveal branch primordia in the axils of the cotyledons (Figs. 4, 7, 8, 12, 15, 17, 20). Lateral branches arise from ordinary lateral buds located at the cotyledonary node. The densely-stained and meristematically active lateral buds (or the subsequent active branch apex, e.g., Fig. 13) contrast sharply with the inert epicotyl apex (Figs. 7, 8, 10, 12, 17). Each axillary bud is also associated with a non-vascularized, persistent stipule-like flap of tissue (Figs. 10, 11, 18). Whereas stipules located on subsequent nodes (i.e., nodes of the lateral branch) generally consist of a planar interpetiolar sheath, stipules at the cotyledonary node are elongate and bear a distinct curve that conforms with the curved surface of its associated bud primordium.

At their initiation, the buds that produce lateral branches are clearly not aligned with the axis defined by the hypocotyl and truncated epicotyl. In time however, the first, dominant, branch of fully erect species assumes an apparent axial position (Fig. 14), a consequence of its growth and expansion concomitant with that of the hypocotyl.
Based on previous literature (Veh 1928; Mangaly et al. 1979; Rosengarten & Hayden 1983; Hayden 1988) and the species described above, early stages of seedling development in Chamaesyce appear to be similar in sections Chamaesyce, Hypericifoliae, and Sclerophyllae. Common features include the vascular architecture of the cotyledonary node, the development of v-leaves and their vascular supply, and the origin of lateral branches from the axils of the cotyledons. The potential for multiple branches from the cotyledonary node is also uniform throughout the species for which seedling ontogeny is known. The chief differences between previously studied prostrate species and the erect or semi-erect species documented here involves the number of lateral branches that develop from the axils of the cotyledons and their orientation with respect to gravity. Thus, species of section Chamaesyce routinely produce multiple branches that radiate at ground level, whereas most species of sections Hypericifoliae and Sclerophyllae produce one dominant, erect branch and, sometimes, another small, subsidiary branch. Chamaesyce hirta appears somewhat intermediate in that it produces a limited number of semi-erect branches.

Mangaly et al. (1979) reported on seedling development in Chamaesyce hirta and C. thymifolia (L.) Millsp. We find their illustrations consistent with the anatomy and morphology of the species reported here and in Hayden (1988). We differ, however, in the interpretation of certain aspects of seedling structure and developmental processes. For example, Mangaly et al. (1979) failed to notice the absence of an epicotylar apical meristem upon development of the v-leaves. Thus, they interpreted the first lateral branch, which actually develops from the axil of a cotyledon, to be the “main axis” and they also described the second lateral branch, which develops from the axil of the other cotyledon, as “extra-axillary.” On the basis of gross external morphology, numerous authors have expounded on the significance of the absence of true epicotyl development (main axis) in Chamaesyce (e.g., Wheeler 1941; Degener & Croizat 1938; Webster 1967). Both the absence of epicotyl and the axillary origin of the first two branches are clearly indicated by the LM and SEM evidence presented here. Hayden (1988) earlier refuted other evidently erroneous ontogenetic interpretations of seedling structure in Chamaesyce found in Veh (1928) and Degener and Croizat (1938).

We hypothesize that seedling form in Chamaesyce is derived from plants with growth habits that are widespread in Euphorbia subgenus Agaloma and subgenus Esula. Such plants produce ordinary, vegetative stems from the seedling epicotyl that eventually terminate in a single cyathium followed by a pleiochasial and dichasial pattern of cyathium production; they also produce additional vegetative axes from the cotyledonary node which also become pleiochasial or dichasial (Fig. 21-A). Euphorbia helioscopa L., as
illustrated in Korsmo (1954; fig. 111) or Holm et al. (1997; fig. 41-2), provides a good example of this growth habit in an annual species. Reduction of the epicotyl to the first pair of leaves and accelerated proliferation of branches from the cotyledonary node (Fig. 21-C) would result in the growth habit found in Chamaesyce. By this interpretation, the majority of the shoot system in Chamaesyce would be homologous with proliferative cotyledonary branches in species of Euphorbia.

The hypothesis of homology at the cotyledonary node described above stands in partial contradiction to the oft-cited hypothesis of Roeper (1824) (Fig. 21-A, B, D) who said that foreshortening of the epicotyl results in development of pleiochaisal branches (inflorescence axes) at ground level (see, for example, Wheeler 1941; Webster 1967). Pleiochiasal branches in Euphorbia arise individually from the axils of a whorl of leaves at the apex of the epicotyl-derived main axis of the plant (Hayden 1988). If lateral branches in seedlings of Chamaesyce developed also from the axils of the v-leaves, then Roeper’s hypothesis could be supported. However, this paper provides additional confirmation of the fact that lateral branches in Chamaesyce are strictly axillary to the cotyledons and never arise from axils of the v-leaves (Hayden 1988).

Plants with well-developed epicotyls and proliferative branches from the cotyledonary node, the hypothesized condition in ancestors of Chamaesyce, are common in Euphorbia. This growth habit occurs in both hemicryptophytic perennials and annuals. Among the hemicryptophytic forms, some familiar garden examples from subgenus Esula include Euphorbia myrsinites L. and E. epithymoides L. (E. polychroma A. Kern.): Euphorbia corollata L., widespread in eastern North America, and its close relatives in subgenus Agaloma section Titthymalopsis (Klotzsch & Garcke) Boiss., also proliferate from the cotyledonary node. Examples of annual species with proliferative branches from the cotyledonary node include E. helioscopia from subgenus Esula, E. extipulata Engelm. from subgenus Agaloma, and E. dentata Michx. from subgenus Poinsettia (Graham) House. In Chamaesyce, species with proliferative cotyledonary nodes include hemicryptophytic perennials (Simmons & Hayden 1997), prostrate annuals (Hayden 1988), erect to ascending annuals (present study), sub-shrubs (present study), and small trees (Koutnik 1987). In contrast to the situation in Chamaesyce, Euphorbia species possess well-developed epicotyls.

Despite the uniformity of form and development that seems to be emerging from studies of Chamaesyce seedlings, examination of a few additional critical taxa appears warranted. Based on our unpublished observations of very limited material, seedlings of C. acuta (Engelm.) Millsp. appear to possess a relatively normal pattern of seedling development, with well-developed epicotyls. Chamaesyce acuta also lacks C4 photosynthesis (Webster et al. 1975) and its inclusion within Chamaesyce might thus be doubted. Confirmation
Figs. 9–14. Seedlings of *Chamaesyce hypericifolia*, LM; 9, 13, Hayden 3252; 10–12, 14, Hayden 3281. 9. Petioles of cotyledons and v-leaf primordia, cross section at the epicotyl apex; bar = 50 μm. 10. Petioles of cotyledons, their lateral buds, and petioles of fully expanded v-leaves, cross section at the epicotyl apex; bar = 200 μm. 11. Same seedling as Fig. 10, cross section just above insertion of cotyledons; bar = 200 μm. 12. Petioles of cotyledons and their axillary buds, longitudinal section in the cotyledonary plane; bar = 200 μm. 13. Apex of lateral branch, longitudinal section; bar = 100 μm. 14. Cotyledonary node of seedling dominated by one lateral branch, longitudinal section in the intercotyledonary plane; bar = 200 μm. b = branch from axil of cotyledon, c = cotyledon, h = hypocotyl, s = stipule-like flap, v = v-leaf.
Figs. 15–20. Seedlings of *Chamaesyce mesembrionifolia*, Hayden 709, LM. 15. Petioles of cotyledons, their lateral buds, and petioles of v-leaves, cross section below the epicotyl apex; bar = 50 μm. 16. v-leaf primordia, longitudinal section in the intercotyledonary plane; bar = 100 μm. 17. Petioles of cotyledons and their lateral buds, longitudinal section in the cotyledonary plane; bar = 200 μm. 18. Base of lateral branch arising from cotyledon axial and adjacent petiole bases of cotyledons and v-leaves, cross section at the epicotyl apex; bar = 200 μm. 19. Cotyledonary node from seedling with expanded v-leaves, note median traces (single arrows) and split lateral traces (double-headed arrows) to the cotyledons; bar = 100 μm. 20. Petioles of cotyledons, their lateral buds, and petioles of v-leaves; bar = 100 μm. b = branch from axil of cotyledon, c = cotyledon, s = stipule-like flap, v = v-leaf.
of seedling development in this and supposedly related species of section Acutae (Boiss.) Webster (see discussion in Mayfield 1991) would thus prove useful. Also, seedling development in *C. potentilloides* (Boiss.) Croizat [= *C. caecorum* (Mart. ex Boiss.) Croizat] of southern Brazil and adjacent regions is completely unknown; because this is a hemicryptophyte species that routinely produces pleiochasial inflorescences reminiscent of the reproductive branches in subgenus Agaloma and Esula of *Euphorbia* (Simmons & Hayden 1997), a developmental study of its seedlings may provide useful phylogenetic insight for the genus as a whole. Finally, certain Hawaiian *Chamaesyce* species endemic to the island of Kauai appear to have ordinary seedling development with well-developed epicotyls (Koutnik 1987); anatomical comparisons between these epicotyl-present and epicotyl-absent species of *Chamaesyce* should prove critical in assessing relationships among the Hawaiian species of *Chamaesyce*.

A developmental mutant known in *Arabidopsis* Heynh. (Brassicaceae) results in a pattern of epicotyl deletion reminiscent of this hallmark feature
of seedling ontogeny in *Chamaesyce*. In *Arabidopsis*, plants homozygous for the *WUSCHEL* (*WUS*) allele form a pair of leaves above the cotyledons but fail to develop any other ordinary epicotylar structure (Clark 1997). In *WUS* mutants, the epicotyl apex remains somewhat flattened and essentially non-meristematic, although it can initiate adventitious meristems that reiterate the abruptly terminated structure of these mutant seedlings (Clark 1997). Evidently, ordinary branches do not form at the cotyledonary node in these *WUS* mutants of *Arabidopsis*, so the analogy with developmental events in *Chamaesyce* is only approximate.

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**REFERENCES**


Hayden and Troyanskaya, Seedling development in Chamaesyce


This book is a popular field picture guide to the wildflowers of New York State, based principally on Dick Mitchell and Gordon Tucker’s *The Revised Checklist of New York State Plants*. It is arranged so that one first must identify the color and structure (symmetry) of the flowers, then look to habitat (terrestrial vs. aquatic), then to determine if there are leaves, and if they are present, whether they are basal, alternate, opposite or whorled. The common name, Latin name and authority, family, flowering season, floral description, plant description, habitat, and comments are given for each of 350 of the most common wildflowers found in the state, as well as some of the rare and endangered taxa. The table of contents, visual glossary, glossary of terms, index to common names, and index to genera and species, makes finding one’s way around the book extremely easy. The chapter “how to use this guide” will allow anyone to use the book right away, with virtually no instruction needed. The photographs are superb, with excellent depth-of-field and vibrant colors. The high quality, alkaline paper is also a plus, as is the sturdy, yet flexible cover on the paperback. I have seen few other wildflower books of this caliber made for the general public. The authors are to be congratulated for their fine work and no botanist traveling through New York State, or from the Northeast, should be without it.—*Johu J. Pipoly III*
A REVISION OF THE GENUS ARDISIA SUBGENUS

GRAPHARDISIA (MYRSINACEAE)

JOHN J. PIPOLY III

Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060, U.S.A.
jpipoly@brit.org; clusia@latinmail.com

JON M. RICKETSON
Missouri Botanical Garden
P. O. Box 299
St. Louis, MO 63166-0299, U.S.A.
jricketson@leumann.mobot.org

ABSTRACT

A taxonomic revision of Ardisia subgenus Graphardisia is presented, including an emended description of the subgenus, a key to the species and subspecies, along with updated descriptions and new illustrations for each taxon. Six taxa are recognized, including three new combinations: Ardisia opegrapha subsp. paquitensis (Lundell) Pipoly & Ricketson, A. opegrapha subsp. wagneri (Mez) Pipoly & Ricketson, and A. bartlettii subsp. lilacina (Lundell) Pipoly & Ricketson. Four binomials, Ardisia weberbaueri, A. opegrapha, A. wagneri and A. albovirens, are lectotypified and twenty-one are newly relegated to synonymy. Ardisia nigrovirens J. F. Macbr. is relegated to synonymy under A. albovirens Mez, and both are excluded from subgenus Graphardisia.

RESUMEN

Se presenta una revisión taxonómica del género Ardisia subgénero Graphardisia. Se provee una descripción actualizada del subgénero junto con una clave para identificar las especies y subespecies, descripciones actualizadas y nuevas ilustraciones para cada taxon. Se reconoce seis taxa, incluyendo tres combinaciones nuevas: Ardisia opegrapha subsp. paquitensis (Lundell) Pipoly & Ricketson, A. opegrapha subsp. wagneri (Mez) Pipoly & Ricketson, y A. bartlettii subsp. lilacina (Lundell) Pipoly & Ricketson. Se lectotipifican cuatro binomiales: Ardisia weberbaueri, A. opegrapha, A. wagneri y A. albovirens y se relega veintiuno a la sinonimia. También, Ardisia nigrovirens se relega bajo sinonimia de A. albovirens, y ambas se excluyen del subgénero Graphardisia.

INTRODUCTION

The pantropical genus Ardisia Sw. is the largest within the Myrsinaceae, containing perhaps as many as 500 species (Chen & Pipoly 1996). The genus has been separated from all others in the Myrsinaceae by the free filaments and pluriseriate ovules (Mez 1902). While only a few groups within Ardisia sensu latissimo have been segregated as separate genera in the Paleotropics...
SinAl8(2), Ardisia dular (1834), Parardisia Nayar & Git (1986)), there has been an enormous increase in separation of species groups from Ardisia to new genera in the Neotropics, starting with those who recognize Aublet's (1775), Iacorea (against which Ardisia is conserved), followed by Alphonse de Candolle (1841), Ducke (1930), and finally Cyrus Lundell (1963, 1964, 1981a, 1981b, 1981c, 1981d, 1982). Lundell's contribution was clearly the most extensive, consisting of the segregation of Amatania Lundell, Auriculardisa Lundell, Chontalesia Lundell, Yunckeria Lundell (=Ctenardisia Ducke), Gentlea Lundell, Graphardisia (Mez) Lundell, Ibarrea Lundell, Oerstedianthus Lundell, Synardisia (Mez) Lundell, Valerioanthus (Mez) Lundell, and Zunil Lundell. Because the group is comprised of over 800 names, it will be some time before each species has been reviewed and the entire group is revised. In the meantime, we suggest using the key to the Mesoamerican genera we published (Ricketson & Pipoly 1997) to identify specimens to generic level (Ardisia versus Synardisia, Ctenardisia or Gentlea). For groups within Ardisia, the use of Flora of Guatemala (Lundell 1966a) and Flora of Panama (Lundell 1971) will permit rough identification, at least to species groups, until our review of the entire complex is complete. While most of the taxa described in the remaining segregated groups are best placed in Ardisia, it appears that some currently placed in Iacorea and Chontalesia may prove to be problematic. Treatment of those taxa is now underway (Pipoly & Ricketson, in prep.).

Ardisia subgenus Graphardisia (1902) was described in the Das Pflanzenreich treatment of the Myrsinaceae and was comprised of only two species, Ardisia opegrapha Oerst. and A. wagneri Mez. Mez considered subgenus Graphardisia allied to Ardisia subg. Synardisia Mez [=Synardisia (Mez) Lundell] by its imbricate or contorted (but not valvate) corolla lobes and the included (rather than exserted) stamens. Subgenus Graphardisia was separated from subg. Synardisia by the rotate (not infundibuliform) corolla, with lobes connate to only 1/3 (not 3/4) their length. He also considered Ardisia subg. Graphardisia closely related to A. subg. Ardisia, because of the often persistent inflorescence bracts and floral bud shape, and contrasted these two subgenera with A. subg. Iacorea (Aubl.) Mez, known for its very inconspicuous inflorescence bracts.

Lundell (1966b) treated subgenus Graphardisia, but later raised Graphardisia to generic rank (Lundell 1981c). He (Lundell 1981c) stated that it was most closely related to Oerstedianthus Lundell, because both groups of species have linear-lanceolate anthers deshiscent by apical pores. Oerstedianthus (Lundell 1981c) is comprised of a group including Ardisia nigrescens Oerst., A. tuerckheimii Donn. Sm., and eight other taxa, formerly placed by Mez (1902) in subgenus Iacorea, but segregated from Iacorea by Lundell because of its glandular trichomes of the branchlets, inflorescence and perianth parts. Lundell
(1981c) separated *Graphardisia* from *Oerstedianthus* by the following key:

"1. Filaments strictly glabrous; stems and inflorescence glabrous; punctation of all parts dense and blackish; bracts and bractlets usually foliaceous and often persistent; sepals and petals large, accrescent, usually blackened, usually ribbed or with dense elevated black glands. ............ *Graphardisia*

1. Filaments pubescent with gland-ripped hairs; stems and inflorescence rarely glabrous, usually pubertulent, hirtellous or densely hirsute-tomentose; bractlets and sepals small, not accrescent; sepals not ribbed with glands. ........ *Oerstedianthus*

Upon examination of the six taxa we recognize in *Ardisia* subgenus *Graphardisia*, 4 taxa (comprising two species in our classification) have either stalked glandular papillae or sessile glandular granules on the filaments near the base, thus invalidating the first part of Lundell's lead couplet. While members of the *Oerstedianthus* species group have anthers very similar to that of *A.* subg. *Graphardisia*, the unique glandular tomentum, and small, corymbose inflorescences are much different than the panicles of corymbs, and essentially glabrous plants of subgenus *Graphardisia*. Our studies indicate that *Ardisia* subg. *Graphardisia* is most closely related to *A.* subg. *Icacorea* based on its well-developed panicles with flowers in terminal corymbs; apiculate, subapically poricidal, concolorous anthers, and style two to three times longer than the ovary. The two subgenera may be separated by the following key:

1. Branchlets and inflorescence rachises glabrous or rarely, sparsely glandular-granulose; leaf blades, inflorescence and floral bracts, and perianth densely and prominently black or red punctate and/or punctate-lineate; sepals accrescent, usually clasping the developing fruit. ............ *Ardisia* subg. *Graphardisia*

1. Branchlets and inflorescence rachis furfuraceous-lepidote; leaf blades rarely conspicuously but never prominently punctate-lineate; the inflorescence and floral bracts mostly orange, rarely black, punctate, the perianth mostly orange, rarely black punctate; sepals not accrescent, never clasping the developing fruit. .................................................. *Ardisia* subg. *Icacorea*

While preparing a treatment of *Ardisia* subg. *Graphardisia* as part of the Myrsinaceae for *Flora Mesoamericana*, we treated the entire subgenus so that it might serve as a precursor to our treatment of the tribe Ardisieae for *Flora Neotropica*, that is now in preparation. The revision here presented provides a nomenclator for *Ardisia* subg. *Graphardisia*, that is beyond the format limitations of the *Flora Mesoamericana*.

**NOTES ON KEYS, TAXONOMIC CONCEPTS, TERMINOLOGY**

The keys are artificial and designed to expedite identification of herbarium specimens. An attempt has been made to emphasize vegetative characters to increase the keys' usefulness with sterile material. The numbers appearing before the taxa refer to their respective position in the key; any correlations with phylogenetic relationships are coincidental. Quantitative and
qualitative data presented in keys and descriptions for floral parts and bracts were taken from organs rehydrated from herbarium specimens by boiling in water. Measurements from these range from 10% to 15% greater than those measurements taken directly from dried material. Data regarding stem diameters, inflorescence rachises, pedicels, leaf and fruit shape and size were taken from dried herbarium specimens.

Our concept of subspecies follows that of Pipoly (1987) who defined subspecies as: "groups of populations within a single lineage of ancestor-descendant populations that show variation by unique combinations of plesiomorphies, or homoplastic apomorphies, correlated with biogeography and/or ecology. This rank is primarily used to convey information regarding variation in the life histories of these populations and character state differences hypothesized to be the result of this variation. The subspecific rank in no way attempts to predict speciation events."


**TAXONOMIC TREATMENT**


Mez (1902) included both *Ardisia ogegrapha* as well as *A. wageneri* in his new subgenus. Subsequently, Lundell (1966b) did not designate a lectotype. Therefore, we have chosen *A. ogegrapha* because it most closely fits the original circumscription of the subgenus.

**Subshrubs** to trees. **Branchlets** mostly terete, glabrous or rarely, glandular-granulose. **Leaves** petiolate; blades membranaceous to subcoriaceous, densely and prominently black (rarely pellucid-) punctate and punctate-lineate, the margins entire to crenulate, rarely sharply and irregularly dentate. **Inflorescence** terminal, un- to tripinnately paniculate, pyramidal to obpyramidal rarely globose, the ultimate branches corymbose, at times in high anthotactic spirals and thus appearing umbellate, the rachis often densely and prominently black punctate and punctate-lineate; inflorescence and floral bracts foliaceous, mostly persistent, resembling the vegetative leaves but acropetally reduced in size. **Flowers** white, pink, lavender or purple, densely and prominently black punctate and punctate-lineate; calyx with sepals free or nearly free; large, accrescent and clasping fruits at maturity; corolla rotate, the lobes imbricate in bud, basally short-connate and sparsely to densely yellow glandular-
granulose within, densely and prominently black punctate-lineate, stamens inserted at corolla tube base, the filaments basally connate to form an inconspicuous tube, the tube free from the corolla tube, the apically free portions of the filaments glandular-granulose or glandular-papillate, less than half the length of the anthers, the anthers ovoid-lanceoloid, linear or lanceoloid, prominently apiculate, dehiscent by subapical pores; ovary globose, the style slender, equaling the sepals, 2–3 times longer than the ovary, the placenta apiculate, the ovules pluriseriate, biseriate, or apparently uniseriate (few in number and in a very high anthotactic spiral). Fruit globose or oblongoid, densely punctate and punctate-lineate, basally surrounded by persistent, clasping sepals.

**Distribution.**—A small distinctive subgenus of three species with five subspecies found from Nicaragua to Bolivia and adjacent Brazil.

**Ecology.**—Members of the subgenus occur in diverse vegetation types, including wet and pluvial lowland, premontane, montane, and cloud forests.

The subgenus is defined by: 1) glabrous branchlets and inflorescence rachises; 2) dense and prominently raised black, or rarely, reddish-black, punctations or punctate-lineations on all leaf and floral parts; 3) sepals often accrescent and usually clasping the developing fruit; 5) linear-lanceolate, concolorous, apiculate anthers with subapically poricidal dehiscence; and 6) style 2–3 times longer than the ovary. Species of the subgenus are often used for home decoration and for use in Christian churches for religious holidays (Pipoly, pers. obs.).

**KEY TO TAXA OF ARDISIA SUBGENUS GRAPHARDISIA**

1. Stoloniferous subshrubs mostly less than 1(–2) m tall; leaf blade margins sharply and irregularly dentate; corolla tube and filaments yellow glandular-granulose; Ecuador to Bolivia and adjacent Brazil........ 1. A. weberbaueri

1. Shrubs to small trees (0.5–)2–6(–10) m tall without stolons; leaf blade margins entire, undulate or crenulate; corolla tube yellow glandular-granulose; filaments glabrous or sessile to stalked glandular-papillate; Nicaragua to Colombia.

2. Sepals membranaceous, oblong, 4.2–8 mm long, apically broadly rounded to obtuse, hyaline throughout, the margins entire; filaments sessile to stalked-glandular-papillate; .......................................................... 2. A. opegrapha

3. Inflorescence obpyramidal; leaf blades oblanceolate or rarely obovate, 3.5–7.5(–8) cm wide, 2 or more times longer than wide.

4. Floral bracts caducous; stamens 5.2–6.5 mm long; filaments 2.5–3 mm long; sepals 5–8 mm long. ...2a. A. opegrapha subsp. opegrapha

4. Floral bracts persistent; stamens 3.8–5 mm long; filaments 1.5–2 mm long; sepals 4.2–5.2 mm long. ......2b. A. opegrapha subsp. wagneri

3. Inflorescence globose; leaf blades elliptic to broadly elliptic (7.5–) 8–14.5 cm wide, 2–2.5 times longer than wide. .................. ..............

........................................................................ 2c. A. opegrapha subsp. paquitensis
2. Sepals chartaceous, ovate, 1.5–2.5 mm long, apically acute, opaque except at margin, the margins subentire to erose; filaments glabrous.

3. *A. bartlettii*

5. Sepals 1.5–1.8 mm long; petal lobes 6–6.5 mm long; stamens 3.5–4.8 mm long; style base tapering; tall wet forests.

3a. *A. bartlettii subsp. bartlettii*

5. Sepals 2–2.5 mm long; petal lobes 7–8 mm long; stamens 4.5–5.7 mm long; style base stylodic; strand vegetation and beach forests.

3b. *A. bartlettii subsp. lilacina*


The holotype of *Ardisia weberbaueri* was destroyed in Berlin (B) in 1943 during WWII. According to Index Herbariorum (Holmgren et al. 1990), other institutions housing duplicate *A. Weberbauer* collections are: F, MOL, USM and WRSL. Through the kindness of Carlos Reynel (MOL), Asunción Cano (USM), and Krzysztof Swierkosz (WRSL), thorough searches were conducted at their respective institutions, all failing to locate isotypes of *A. Weberbauer 1809*. A fragment of the holotype, including a mature flower and leaf fragment, was taken from B in 1926, and is available at F (a "clastotype"—see Pipoly 1983), and is here selected as the lectotype.


![Fig. 1. Comparison of sepal size, shape and punctations among the taxa of Ardisia subgen. Graphardisia. See individual taxon descriptions for details. A. Ardisia opegrapha subsp. opegrapha, drawn from G. Webster 16867. B. Ardisia opegrapha subsp. wagneri, drawn from I.D. Gomez 24093. C. Ardisia opegrapha subsp. paquitensis, drawn from Araquistain 3007. D. Ardisia weberbaueri, drawn from R. Vásquez 5924. E. Ardisia bartlettii subsp. bartlettii, drawn from H. Bartlett & T. Lasser 16720. F. Ardisia bartlettii subsp. lilacina, drawn from J. Dwyer 4354.](image)
Fig. 2. *Ardisia weberbaueri* Mez. A. Habit, flowering branch. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower, showing calyx and pistil. E. Detail of flower, showing corolla and stamens. F. Detail of stamen, showing adaxial and abaxial surfaces. G. Fruit. A-G drawn from *R. Vasquez 5924.*
Stoloniferous subshrubs to shrubs, 0.75–1.0(–2.0) m tall. Branchlets slender, terete, 2–4 mm in diam., glabrous to scattered glandular-granulose. Leaves alternate; blades membranaceous to chartaceous, oblong to elliptic, 8.2–19.4 cm long, 1.9–6.6 cm wide apically acuminate, the acumen 5–9 mm long, basally acute to acuminate, decurrent on the petiole, the midrib impressed above, prominently raised below, the secondary veins 22–26 pairs, obscure above, prominent below, conspicuously punctate and punctate-lineate, glabrous, the margins irregularly dentate, the teeth 0.4–0.8 mm long, mostly flat; petioles slender, canaliculate. 0.7–2.1 cm long, glabrous. Inflorescence terminal, 2.5–7 cm long. 2.5–8 cm wide, usually shorter than the leaves, the rachis conspicuously punctate and punctate-lineate, glabrous to sparsely scattered glandular-grandulose; peduncle 2–5 mm long; inflorescence branch bracts foliaceous, membranaceous, oblong or elliptic, 1.4–2.5 cm long, 0.5–0.8 cm wide, apically acute to rounded, the midrib impressed above, prominently raised below, the secondary veins obscure above and below, conspicuously punctate and punctate-lineate, glabrous, the margins entire to undulate; petioles 0.8–1.2 mm long, glabrous; inflorescence branches 2–9 mm long, conspicuously punctate and punctate-lineate, glabrous to scattered glandular-grandulose, bearing terminal corymbbs; floral bracts resembling secondary inflorescence branch bracts, but 7.2–8.1 mm long, 1.7–2.2 mm wide, sessile or nearly so; pedicels 11.6–13.5 mm long, slender, mostly accessent in fruit, glabrous to scattered glandular-grandulose. Flowers 5-merous (occasionally with sepals 6–7), membranaceous, 4.5–5.5 mm long; calyx with sepals free, oblong, 3.2–4.2 mm long, 1.4–1.6 mm wide, apically broadly obtuse to rounded, densely and prominently punctate and punctate-lineate, glabrous, except densely glandular-grandulose within basally, the margins hyaline, subentire, glandular-ciliolate; corolla rotate, 4.3–5.3 mm long, the tube 0.4–0.5 mm long, densely yellow glandular-grandulose within apically above staminal tube and below corolla tube and lobe junction, the lobes ovate, 4.1–4.8 mm long, 2.3–2.5 mm wide, apically rounded to obtuse, prominently punctate and punctate-lineate, glabrous, the margins entire; stamens 3.2–3.8 mm long, connate by their bases and adnate to corolla to form a tube 0.4–0.5 mm long, the free portion 2.8–3.3 mm long, the filaments 1.2–1.4 mm long, 0.5–0.7 mm wide at base, conspicuously punctate, glabrous except scattered sessile glandular-papillate basally, the anthers linear-lanceoloid, 2.0–2.2 mm long, 0.9–1.0 mm wide at base, apically apiculate, basally sagittate, dehiscent by subapical pores, the connective prominently black punctate dorsally; pistil obturbinato, the ovary glabrous, the style 1.9–2.7 mm long, slender, tapering, punctate, glabrous, the ovules 13–14, plurislicate. Fruit globose, 6.1–6.8 mm in diam., densely and prominently punctate and punctate-lineate, the style base persistent, glabrous.

Distribution.—Ardisia weberbaueri is endemic to the junction of the Andes
and Western Amazonia, from Napo and Pastaza Provinces, Ecuador, southward through the Departments of Loreto, San Martín, Junín and Madre de Dios, Peru, to the Departments of Beni, La Paz and Santa Cruz, Bolivia and the adjacent state of Acre, Brazil. It grows from 180–1,100 m in elevation. This is the first report of the species for Ecuador.

Ecology and conservation status.—Ardisia weberbaueri is restricted to tall, lowland and premontane tropical moist and wet forests, where it is an understory subshrub, growing in loose detritus in sheltered areas near rocks and tree buttresses. While it is certainly not common, at this time, there are no data to suggest the species is threatened.

Etymology.—Ardisia weberbaueri is named in honor of August Weberbauer (1871–1948), a German botanist and phytogeographer who collected in Peru from 1901–1905 and again from 1908–1948 (Stafleu & Cowan 1988). During the 1920s, he was sponsored by the Field Museum of Natural History (F), under J. Francis MacBride’s Flora of Peru project. Many of Weberbauer’s collections are type specimens today. Ardisia weberbaueri’s taxonomic synonym, Ardisia vigoi Lundell, was named in honor of José Schunke Vigo, who had a long collaborative history with the Missouri Botanical Garden (MO), Field Museum of Natural History (F) and Peruvian Herbaria’s revived Flora of Peru project. José is the son of Carlos Schunke, who was guide and field assistant to J. Francis MacBride of the Field Museum and G.S. Bryan of the University of Wisconsin, during their 1923 botanical expedition to Peru (Dahlgren 1936). Unfortunately, Lundell (1979), confused José’s second surname (maternal) with his legal (paternal) one, hence the epithet “vigoi” instead of “schunkei.”

bank of Río Huallaga, without elev., 17 May 1970 (fr), *J. Schunke* V. 3983 (F), 8 Jun 1970 (fr), *J. Schunke* V. 4039 (F); Puerto Pizana, right bank of Río Huallaga, without elev., 3 Sep 1971 (fr), *J. Schunke* V. 4983 (F, MO); Quebrada de Cachiyacu de Lopuna, Progreso Hwy., 500–850 m, 21 Jul 1974 (fl, fr), *J. Schunke* V. 7647 (MO); Quebrada Paraído, 5 km below Tocache, 400 m, 27 Nov 1974 (fl, fr), *J. Schunke* V. 8133 (MO), BOLIVIA. Beni: Prov. Ballivián, lower slopes of Serranía Pilón Lajas, 14.3 km N of the bridge over the Río Quichibey, 15°19' S, 67°03' W, 700 m, 10 Jun 1985 (fr), *J. Solomon* 13940 (MO); Misión Fátima, S of San Borja, near Río Chimán, on alluvial of Río Chimán, behind the Misión, 240 m, 20 May 1988 (fr), S. Beck 16323 (MO); E slopes, 21 km from Yucumo, 15°17' S, 67°04' O, 1035 m, 17 May 1989 (fr), *D. Smith* et al. 13188 (MO). La Paz: Prov. Nor Yungas, Alto Madidi, ridge top ca. 7 km NE of camp, 13°35' S, 68°46' W, 300 m, 27 May 1990 (fr), A. Gentry & S. Estensore 70712 (MO); Alto Beni, trail from bridge toward San Antonio, 570 m, 3 Jan 1988 (fr), R. Seidel & M. Schulte 2316 (MO); Prov. Sud Yungas, Alto Beni, Sapecho Concession, Yungas, 15°30' S, 67°20' W, 550 m, 3 Apr 1989 (fr), R. Seidel et al. 2671 (MO), 3 Feb 1990, R. Seidel & V. Baptista 2824 (MO), Santa Cruz: Prov. Ichilo, Parque Nacional Amboro, 3 km SW of Estancia San Rafael de Amboró, 17 km by air, SSF of Buena Vista, forest near Río Surutú, 17°36' S, 63°37' W, 350 m, 29 Jul 1987 (fr), M. Nee et al. 35424 (MO, TEx); ca. 15 km (SE) up the Río Pitasama from the Río Surutú, 17°44' S, 63°40' W, 700 m, 28 Aug 1985 (fr), *J. Solomon* 14104 (MO), BRAZIL. Acre: Río Acre, Seringal, São Francisco, without elev., Oct 1911 (fl), *E. Ule* 9641 (K).

*Ardisia weberbaueri* appears to be most closely related to *A. bartlettii*, based on its sepals that are opposite except along the margin, relatively small inflorescences with early caducous floral bracts, and non-entire margined leaf blades. However, *Ardisia weberbaueri* may be easily separated from *A. bartlettii* by its diminutive, stoloniferous habit, sharp and irregular teeth of the leaf blades, and the glandular-granulose filaments.

Detailed study of the lectotype of *A. weberbaueri* and the type of *A. vigoi* revealed no quantitative or qualitative difference between the two respective type specimens.

2. *Ardisia opegrapha* Oerst.

*Shrubs or small trees* (0.6–)2–10 m tall. *Branchlets* (2–)3–5–7 mm in diam., glabrous throughout. *Leaves* alternate or pseudoverticillate; blades membranaceous, elliptic, broadly elliptic, oblongate, or obovate, 10–30 cm long, 3.5–14.5 cm wide, apically acuminate, base acute or attenuate, decurrent on the petiole; midvein impressed above, prominently raised below, the secondary veins prominent above, inconspicuous below, densely and conspicuously punctate and punctate-lineate, glabrous, the margins entire or irregular; petioles canaliculate and usually marginate, 0.2–3.5 cm long, glabrous. *Inflorescence* terminal, a bipinnate, radially symmetrical (globose) or obpyramidal panicle of corymb, 2–12 cm long, 2–15 cm wide, usually shorter than the leaves; peduncle obsolete to 3.5 cm long, conspicuously punctate and punctate-lineate, glabrous, inflorescence branch bracts membranaceous, widely ovate, 7.2–26 mm long, 1.4–8 mm wide, apically broadly...
rounded, densely and prominently punctate and punctate-lineate, glabrous, caducous or persistent in fruit, the margins entire; floral bracts as in secondary branch bracts except oblong, 3.7–12 mm long, 0.8–5.5 mm wide; pedicels 6–23 mm long, slender, conspicuously punctate and punctate lineate, sparsely glandular-glandulose. Flowers 5-merous, membranaceous, 7.5–10 mm long; calyx with sepals free, linear, oblong or broadly elliptic, 4.2–8 mm long, 2.2–3.1 mm wide; apically rounded, emarginate, densely and prominently punctate and punctate-lineate, very sparsely glandular-granulose without, densely glandular-granulose at base within, the margins entire, sparsely glandular-ciliolate or not; corolla rotate, 6.5–9.5 mm long, the tube 0.3–0.7 mm densely yellow glandular-granulose within apically above staminal tube as well as below corolla tube and lobe junction, the lobes ovate to elliptic, 6.5–9 mm long, 3.8–5.7 mm wide, apically rounded, densely and prominently punctate and punctate-lineate, glabrous, the margins entire; stamens 3.8–6.5 mm long, the staminal tube 0.3–0.8 mm long, the filaments 1–3 mm long, 0.5–0.8 mm wide, epunctate, scattered glandular-papillate, the anthers linear-lanceoloid, 2.3–3.6 mm long, 0.9–1.1 mm wide at base, apiculate, basally sagittate, concolorous, dehiscent by subapical pores, the connective inconspicuously punctate dorsally; pistil obtrubinate, the ovary glabrous, the style 3.5–5 mm long, slender, punctate and punctate-lineate, glabrous, the ovules 11–13, pluriseriate. Fruit globose, 4.2–8 mm in diam., densely and prominently punctate, glabrous.

_Ardisia opegrapha_, as here circumscribed, includes three newly recognized subspecies for which combinations are made herewith.


In the Botanical Museum, University of Copenhagen Herbarium (C), there are two different collections that were cited in the protologue by Oersted, two duplicates of _A.S. Oersted 29_ from Jaris, and one of _A. Oersted 29A_ from Aguacate, of which only _A. Oersted 29A_ is duplicated in the Field Museum of Natural History (F). The collection from Jaris was made in November 1846, and that from Aguacate in November 1847. In Oersted’s original description he states “Crescit in montibus costaricencibus Aguacate et Jaris (1500–2000), ubi florentem et fructificantem Novembris legi,” without further specifying the location. Mez (1902) and subsequent authors have not designated a lectotype. We here select the collection from Aguacate at C as the lectotype because it contains the greatest number of dissections in the original fragment packet, indicating it was a more critical element in the description of the species.

W 3-sheets).


*Ardisia skutchii* C. V. Morton, J. Wash. Acad. Sci. 27:309. 1937. **Syn. nov. Graphardisia skutchii** (Morton) Lundell, Phytologia 59:432. 1986. **Type:** COSTA RICA. **San José:** Vicinity of El General, 1,070 m, Jun 1936 (fl), A.F. Skutch 2660 (holotype: US (CM Neg. # 49641, LL-TEX Neg. # 71-104, US Neg. # 2386); isotype: MO (LL-TEX Neg. # 71-104)).

*Ardisia subcoriacea* Lundell, Wrightia 3:193. 1966. **Syn. nov. Graphardisia subcoriacea** (Lundell) Lundell, Phytologia 48:140. 1981. **Type:** PANAMA. **Coclé:** El Valle de Antón, vicinity of La Mesa, ca. 1,000 m, 22 Jun 1941 (fl), P.H. Allen 2571 (holotype: US, (LL-TEX Neg. # 71-111); isotypes: A, F (F Neg. # 68253)).


*Graphardisia obtusata* Lundell, Phytologia 59:430. 1986. **Syn. nov. Ardisia obtusata** (Lundell) Lundell, Phytologia 61:66. 1986, nomen invalidum. **Type:** PANAMA. **Darién:** Río Tuquesa, at middle Tuquesa Mining Company camp called Charco Peje, ca. 250 m, 8 Jul 1975 (fr), S. Mori 7034 (holotype: LL-TEX; isotype: MO).

*Graphardisia oxyphylla* Lundell, Phytologia 59:430. 1986. **Syn. nov. Ardisia riamonteanana** Lundell, Phytologia 61:66. 1986, nomen novum invalidum, non *Ardisia oxyphylla* Wäll., Numer. List 2291. 1830. **Type:** PANAMA. **Chiriquí:** 2.5 km from Questa Piedra along Río Monte Road, at stream, without elev., 27 Jun 1977 (fl), J.P. Folsom 3975 (holotype: LL-TEX; isotypes: CR n.v., MEXU n.v., MO, NY, PMA n.v.).


*Graphardisia serenoana* [serenoana] Lundell, Phytologia 59:431. 1986. **Syn. nov. Ardisia serenoana** (Lundell) Lundell, Phytologia 61:66. 1986, nomen invalidum. **Type:** PANAMA. **Chiriquí:** road from Volcán to Río Sereno [Serano], road that turns E 7.2 km from Río Serano, 3.2 km along side road, without elev., 29 Jun 1977 (fl), J.P. Folsom 4029 (holotype: LL-TEX; isotypes: MEXU n.v., MO, PMA n.v.).
Shrubs or small trees (1–)2–10 m tall, 2–5 cm in diam. Branchlets 3–5 mm in diam. Leaves with blades elliptic to lanceolate, broadly elliptic or oblanceolate, 12–25 cm long, 3.5–7.5 cm wide; petioles canaliculate, usually marginate, 0.2–1.5 cm long. Inflorescence obpyramidal, bipinnately paniculate, 2–12 cm long, 4–15 cm wide; peduncle 0.5–1.5 cm long; inflorescence branch bracts widely ovate, 16–18 mm long, 14–16 mm wide, caducous; floral bracts 7–12 mm long, 3–5.5 mm wide, oblong, caducous; pedicels 10–23 mm long. Flowers 9–10 mm long; sepals linear, oblong to broadly elliptic, 5–8 mm long, 2.2–2.5 mm wide; corolla 8–9.5 mm long, the tube 0.4–0.6 mm long, the lobes oblong to broadly elliptic 7.6–8.9 mm long, 4.5–5.5 mm wide; stamens 5.2–6.5 mm long, the staminode tube 0.4–0.7 mm long, the filaments 2.5–3 mm long, 0.6–0.8 mm wide, the anthers 2.7–3 mm long, 0.9–1 mm wide at base; ovary with style 4–5 mm long, the ovules 12–many. Fruit 5–8 mm in diam.

Distribution.—Nicaragua (Jinotega, Matagalpa, Zelaya, Río San Juan), Costa Rica (Alajuela, Puntarenas, San José), Panama (Chiriquí, Veraguas, Herrera, Los Santos, Colón, Panamá, San Blas, Darién) and Colombia (Chocó); sea level–2,500 m elevation. It is notable that the subspecies principally inhabits areas facing the Pacific coast of Central and adjacent South America.

Ecology and conservation status.—Ardisia opegrapha subsp. opegrapha inhabits a wide range of habitats, including beach thickets; gallery forests in deciduous woodlands and dry oak forests; moist, wet, lower montane, montane, cloud and elfin forests. Because it is mostly found at forest margins, and along watercourses, subsp. opegrapha may be found in primary and disturbed or remnant sites.

Etymology.—The epithet ‘opegrapha’ comes from the Greek, ‘opsis’, resembling, and ‘graphe’, meaning drawing, picture or writing. This refers to the densely and prominently punctate and punctate-lineate vegetative and floral parts.

Additional specimens examined. NICARAGUA. Jinotega: Cerro San Pedro, Comarca Kichwa, 13° 36′ N, 85° 38′–39′ W, 820 m, 21 Jul 1980 (fr), F. Sandino 192 (MO). Matagalpa: Las Brisas, 15 km W of Waslala, road to El Tuma, 13° 15′ N, 85° 28′ W, 250–300 m, 23 Dec 1982 (fr), P. Moreno 19225 (MO). Río San Juan: Buenos Aires, 1 km al N de Caserio Sábalito, along Río Sábalito, 11° 02′ N, 84° 28′ W, 70 m, 10 Sep 1985 (fr), P. Moreno 26297 (MO); between Río Santa Cruz and Caño Santa Crucita, La Palma, 11° 02′–04′ N, 84° 24′–26′ W, 40–60 m, 30 Nov–2 Dec 1984 (fr), W. Stevens et al. 23470 (MO). Zelaya: El Achiote, 11° 47′ N, 84° 26′ W, 200 m, 25 Aug 1982 (fr), M. Araquistain 3130 (MO); San Antonio, 200 m, 29 Aug 1982 (fr), A. Laguna 27 (MO); along Río El Zapote, W of Nueva Guinea, 11° 42′ N, 84° 26′ W, 130 m, 21 Aug 1983 (fr), J. Miller & J. Sandino 1257 (MO); 4.4 km N of base camp, base camp 3.6 km SE of Cerro San Isidro, Río Kama, Río Escondido, 12° 05′–15′ N, 83° 45′–48′ W, sea level–65 m, 16 Mar 1966 (fr), G. Proctor et al. 27751 (NY, LL-TEX); 5 km SE of La Providencia, along Caño Chiquito, without elev., 21 Aug 1983 (fr), J. Sandino 4353 (MO); Comarca de El Cabo, 40–45 km SW of Waspam, 10–100 m, 21 Jan 1970 (fr), F. Seymour 3783 (MO); Esquipulas and Alemán,
Río Alemán drainage, 150 m, 27–29 Nov 1951 (fr), P. Shank & A. Molina R. 4783 (FL, LL-TEX, MO). **COSTA RICA.** Alajuela: toward center of Cerro de San Isidro, San Ramón, 1,150 m, 10 Jul 1925 (fr), A. Breses 4313 (FL, LL-TEX); between Santiago and San José de San Ramón, without elev., 17 Oct 1928 (fr), A. Breses 6349 (F); San Miguel de San Ramón, without elev., 21 Jul 1934 (fl), A. Breses 19242 (F); Río Grande, San Isidro, San Ramón-Alajuela, 1,000 m, 10 Jun 1982 (fr), A. Carvaljal 2849 (LL-TEX, MO); 3 km E of San Ramón, 1,025 m, 22 Jun 1969 (fl), R. Lent 17165 (F); Los Angeles de La Gancia, 1,100 m, 21 Dec 1936 (fl), F. Solís R. 495 (LL-TEX, MO). **Puntarenas:** Cantón Coto Brus, Las Cruces Botanical Garden, Cordillera de Talamanca, 08° 47' 10" N, 82° 58' 30" W, 1,200–1,300 m, 30 Jun 1995 (fr), L. Angulo 388 (BRIT, MO); "Hort. Eisigm, Cht. Lauche," without elev., 1895 (fl), C. Beck s.n. (W); Cerro Pando, ridges above the Río Cotón and the Río Negro, near La Lucha, Río Cotón, 08° 55' N, 82° 45' W, 1,000–1,800 m, 19–21 Feb 1982 (fr), K. Barringer & L. Diego G. 1652 (F); Puerto Quepos, along stream in shady woods on W side of National Park, 16 mi E of town, without elev., 28 Feb 1982 (fr), J. Churchill 82022 (F); foothills of the Cordillera de Talamanca, directly N of the Alturas, 08° 57' N, 82° 50' W, 1,400–1,500 m, 28 Aug 1983 (fr), G. Davide 24159 (MO); Fila El Tigre, SE of Las Alturas, 08° 56' N, 82° 51' W, 1,350–1,450 m, 29 Aug 1983 (fr), G. Davide 24176 (MO); foothills of Cordillera de Talamanca, forested valley of the Río Cotón between Sitio Cotón (Cotontico), and Sitio Tablas, 08° 57' N, 82° 46' W, 1,500–1,600 m, 2 Sep 1983 (fl), G. Davide 24428 (MO); Parque Bolívar, without elev., 10 Jul 1945 (fl), J. Echeverria 4147 (F); La Tigra-Las Mellizas, 1,280 m, Aug 1983 (fl, fr), L. Gómez et al. 21982 (LL-TEX, MO); Cantón Coto Brus, NE slopes of Fila de Cal, between San Vito de Coto Brus and Ciudad Neily, 08° 41' N, 82° 56' 50" W, 500–620 m, 12 Jul 1985 (fr), M. Grunyam & B. Hammel 5638 (MO); Alturas of Coto Brus, ca. 20 km NE of San Vito, 1–3 km S of Las Alturas, 08° 56' N, 82° 50' W, 1,300–1,400 m, 13 Jul 1985 (fl), B. Hammel & M. Grunam 14201 (MO); Las Cruces Botanical Garden, San Vito, jungle track, 08° 47' 08" N, 82° 57' 29" W, 1,250 m, 4 Jul 1994 (fl), W. Kress & T. Prinzke 4572 (MO, US); Amistad Biosphere Reserve, near Las Alturas of Cotón Biological Station, 08° 57' 00.3" N, 82° 49' 56.8" W, 1,455–2,100 m, 8 Jul 1994 (fl), W. Kress & T. Flores 4266 (MO, US), 1,475–1,750 m, 8 Jul 1994 (fl), W. Kress & T. Prinzke 4582 (BRIT, MO, US); above La Tigra, Talamanca Range, near Panamanian border, 1,600–1,800 m, 20 Mar 1982 (fr), D. Hazlett 5064 (F); between Sitio Tigra and Sitio Las Tablas picnic area, near Cerro Chivo, S of Cotón river, 1,600–1,800 m, 17 Jul 1983 (fl), D. Hazlett 5229 (F); beside Río Bella Vista near Las Alturas, 08° 56' N, 82° 51' W, 1,300 m, 8 Jul 1972 (fl), R. Lent 2693 (F, MO); Cañas Gordas, 1,100 m, Feb 1897 (fr), H. Pittier 11190 (LL-TEX); 1 mi S of San Vito de Java, 3,500 ft [1,067 m], 18 Aug 1967 (fr), P. Raven 21889 (F, MO); Piedra Blanca de Villa Colón, 1,200 m, 17 Abr 1935 (fl), M. Valerio 1268 (F); 7.5 km NE of Sabalito, 08° 51' N, 82° 53' W, 1,021 m, 7 Jul 1977 (fl), G. Webster 21876 (F); Finca Loma Linda, SW of Cañas Gordas, 08° 44' N, 82° 56' W, 3,600 ft [1,097 m], 17 Jul 1977 (fl), G. Webster 21937 (F); 4 km S of Las Alturas, 1,400 m, 15 Jul 1977 (fl), R. Wilbur et al. 22713 (MO). **San José:** forest along Quebrada de los Micos, ca. 8.5 km by road, W of Ciudad Colón, 09° 55' 50" N, 83° 17' 50" W, 600 m, 16 Jan 1986 (fr), M. Grunyam & P. Sleeper 6103 (MO); Zona Protectora La Cangreja, along Río Negro, ca. 1.5 km E of Santa Rosa de Puriscal, 09° 42' N, 84° 23' 05" W, 320 m, 14 May 1987 (fl), M. Grunyam et al. 8325 (MO); between Pedernal and Candelaria, 900 m, 29 May 1966 (fl), A. Jiménez 3966 (F, MO); road from Santiago to Patrícia, 600 m, 24 Sep 1967 (fl), R. Lent 1321 (F, NY); Zona Protectora La Cangreja, Santa Rosa de Puriscal, in the márgenes del Río Negro, 09° 42' 24" N, 84° 23' 35" W, 400 m, 10 Aug 1992 (fr), J. Morales 318 (BRIT, MO); “Cultivé, Jardin Monte Alegre á San José”, without elev., without date (fl), H. Pittier 2298 (BR); vicinity of El General, 1,190 m, Nov 1936 (fl, fr), A. Skutch 2890 (GH, MO), 670 m, Jun 1939 (fl), A. Skutch 4371 (A, F. K. LL-TEX, MO); Cantón Turruaraces, flank of Cerro
Pelón, Zona Protectora Cerros de Turrubares, 09° 48' 50" N, 84° 28' 00" W, 1,500 m, 7 Nov 1990 (fr), R. Zúñiga et al. 392 (BRIT, MO). PANAMA. Chiriquí: Cerro Colorado, mining road 15.6 mi above bridge over Río San Félix, 1,330 m, 21 Nov 1979 (fr), T. Antonio 2573 (LL-TEX, MO). Cerro Colorado, 8.5 km from Escopeta, along stream, 800–1,000 m, 17 Aug 1977 (fr), J. Folsom 4925 (LL-TEX, MO). Coclé: vicinity of El Valle, 800–1,000 m, 22 Dec 1936 (fl), P. Allen 72 (LL-TEX, MO); vicinity of El Valle, 800–1,000 m, 5 Sep 1938 (fl, fr), P. Allen 786 (LL-TEX, MO); N rim of El Valle, without elev., 4 Jun 1939 (fl), P. Allen & A. Alston 1846 (MO); El Valle de Antón, 750 m, 2 Jul 1941 (fl), P. Allen 2577 (A, LL-TEX, MO), 1,000 m, 16 Jun 1946 (fl), P. Allen 3535 (BM, MO); El Valle de Antón, N hills, without elev., 29 Jun 1946 (fl), P. Allen 3561 (F-3-sheets, C, LL-TEX -2 sheets, MO, MU); El Valle, without elev., 20 Jun 1966 (fl) K. Blum et al. 2382 (MO); 5 km E of El Valle on dirt road to top of grassy ridge, 3,000 ft [914 m], 26 Feb 1978 (fl), B. Hammel 1764 (LL-TEX, MO); hills NE of El Valle de Antón, 2,000 ft [610 m], 27–29 May 1967 (fl), W. Lewis et al. 1803 (LL-TEX, MO); El Valle, on mountain slope near hotel, without elev., 30 Nov 1975 (fl), R. Mendez 26 (MO); ca.15–20 km NE of La Pintada towards Toberá, largest peak in vicinity, 600–1,000 ft [183–305 m], 15 Feb 1981 (fl), K. Systma & W. D'Arcy 3610 (MO); border Cocle-Panama Prov., N slopes of Cerro Guacamayo, SE of El Valle, 08° 36' N, 80° 07' W, 1,800 ft [549 m], 3 Jul 1971 (fl), G. Webster 16867 (MO); between Las Margaritas and El Valle, without elev., 15–Jul–8 Aug 1938 (fl), R. Woodson et al. 1239 (A, LL-TEX, MO), 1746 (MO). Herrera: hill above Chepo de Las Minas, 700 m, 19 Dec 1977 (fr), J. Folsom et al. 6991 (LL-TEX, MO); W of Las Minas, on Montosa de Chepo, vicinity of Chepo, 07° 42' N, 80° 51' W, 900 m, 20 May 1987 (fl), G. McPherson 10933 (MO, PMA). Los Santos: Río Guanico Valley, 07° 18' N, 80° 30' W, 600 m, 25 May 1986 (fl), G. McPherson 9248 (BRIT, LL-TEX, MO, PMA); above Guanico River, on hills W of river, 07° 20' N, 80° 30' W, 550–650 m, 5 Jan 1989 (fr). G. McPherson 13513 (BRIT, MO, PMA). PANAMA: Camino de Plantación, 09° 04' N, 79° 39' W, 80 m, 1 Jun 1995 (stcr). S. Aguilar & A. Castillo 2116 (fl); Summit of Cerro Campana, 800–1,000 m, 1 Sep 1940 (fl), P. Allen 2226 (F, LL-TEX); Cerro Campana, trail Campana to Chica, 600–800 m, 10 Aug 1941 (fl), P. Allen 2661 (LL-TEX, Interpretation Trail, 1 km E of INRENARE Forest Ranger Camp, 8° 40' N, 79° 55' W, 800–900 m, 2 Aug 1989 (fl), M. Correa et al. 5139 (BRIT, MO, PMA); Cerro Campana above Su Lin Motel, without elev., 25 May 1971 (fl), T. Croat 14746 (MO); Cerro Campana at turnoff to FSU cabin, without elev., 20 Jul 1974 (fl), T. Croat 25189 (MO); Cerro Campana, 2,500 ft [762 m], 17 Aug 1982 (fr), W. D'Arcy & C. Hamilton 14976 (LL-TEX, MO); Cerro Campana, upper slopes in National Park, 207 m, 13 May 1980 (fl), D. LeDoux 2630 (MO); Cerro Campana, beyond Su-Lin, 2,700–3,000 ft [823–914 m], 8 Sep 1966 (stcr), J. Duke 8650A (MO); Cerro Azul, 1 mi below Goofy Lake, 2,000 ft [610 m], 21 Jul 1972 (fl), A. Geersy & J. Dwyer 5512 (F, MO); Cerro Campana, slopes S of radio tower, 2,500 ft [762 m], 1 Jul 1978 (fl), B. Hammel 3761 (LL-TEX, MO); between peaks of Cerro Trinidad, saddle on SE slope, without elev., 5 May 1968 (fl), J. Kirkbride & J. Duke 1642 (MO); Cerro Campana, without elev., 10 Dec 1967 (fl), W. Lewis et al. 3038 (LL-TEX, MO); Altos de Campana, 285 m from Motel Su Lin, 951 m, 25 Jun 1977 (fl), R. Méndez 45 (MO), without elev., 25 Jun 1977 (fl), R. Méndez 47 (MO), 3,045 ft [928 m], 3 Dec 1977 (fr), R. Méndez 80 (F, MO); Cerro Campana, 2,800 ft [853 m], 29 Aug 1965 (fl), S. McDaniel 6912 (MO); W of Inter-American Hwy. near Capira, Cerro Campana, 08° 40' N, 79° 50' W, 900 m, 11 Nov 1985 (fl, fr), G. McPherson 7458 (BRIT, F, LL-TEX, MEXU, MO, PMA, US); Parque Nacional Altos de Campana, Interpretation Trail, 1 km E of forest INRENARE forest ranger cabin, Tree No. S2158. 08° 40' N, 79° 55' W, 800-900 m, 8 Jul 1988 (fl), M. Ruiz et al. 165 (BRIT, PMA), 30 Sep 1988 (fr), M. Ruiz et al. 210 (BRIT, PMA), 2 Aug 1989 (fl), M. Ruiz et al. 5139 (BRIT, PMA), 23 Aug 1990 (fl), M. Ruiz et al. 7320 (BRIT, PMA), 23 May 1991 (fl), M. Ruiz et al. 7800 (BRIT,}
PMA), 13 Jun 1991 M. Ruiz et al. 7865 (BRIT, PMA); Goody Lake, SW facing slope, 500 m, 5 Jul 1976 (fl), G. Sullivan 58 (MO); Cerro Campana, 08° 40' N, 79° 55' W, 2,700–2,800 ft [823–853 m], 11–12 Jun 1971 (fl), G. Webster & G. Breckon 16516 (MO, TEX).

Veraguas: Vicinity Santa Fé, forested slopes of Cerro Tute, 2,500 ft [762 m], 25 Mar 1947 (fl), P. Allen 4404 (F, G, MO); vicinity of Escuela Agricultura Alto Piedra, near Santa Fé, along trail to top of Cerro Tute, 3,600–4,000 ft [1,097–1,219 m], 29 Jun 1980 (fl), T. Antonio 4961 (LL-TEX, MO); Islas Contreras, Isla Uva, 08° 48' N, 81° 45' W, 50 m, 18 Jul 1984 (fr), H. Churchill 5687 (LL-TEX, MO); along road on Pacific slope 1–3 km above Escuela Agricola Alto Piedra, 700–800 m, 26 Jul 1974 (fl), T. Croat 25995 (LL-TEX, MO); between Santa Fé and Escuela Agricola Alto de Piedras, without elev., 29 Aug 1974 (fr), T. Croat 27350 (LL-TEX, MO); 0.2 mi beyond fork in road at Escuela Agricola Alto de Piedra on road to Río Calovebora, 750 m, 3 Apr 1976 (fl, fr), T. Croat & J. Folsom 33865 (LL-TEX, MO); above Santa Fé beyond Escuela Agricola Inter-Americana, 1.8 mi beyond fork in road on Pacific slope, on side of Cerro Tute, without elev., 5 Apr 1976 (fr), T. Croat 34205 (LL-TEX, MO); along road between Santa Fé and Río Calovebora, 1.8 mi beyond Escuela Agricola Alto de Piedra, 735 m, 5 Apr 1976 (fr), T. Croat & J. Folsom 34267 (MO); vicinity of Santa Fé, along dirt road past Escuela Circolo Alto de Piedra, formerly Escuela Agricola Alto de Piedra, to Río Luis, along Río Primero Brazo, first stream below school, on Atlantic Coast, 08° 33' N, 81° 08' W, 490 m, 28 Jun 1987 (fl), T. Croat 66873 (BRIT, LL-TEX, MO, PMA); Parque Nacional, Cerro Tute, vicinity of Santa Fé, along road between Alto Piedra, on slopes of Cerro Tute, 800–1,030 m, 15 Jul 1994 (fl), T. Croat & G. Zhu 76926 (MO); 7 km NW on road to Santa Fé, without elev., 5 Dec 1975 (fr), W. D'Arcy 10274 (MO); SW side of Cerro Tute, La Cuchilla, 2,500 m, 10 Sep 1982 (fl), W. D'Arcy 15019 (MO); Isla de Coiba, without elev., 18 Aug 1961 (fl, fr), J. Dwyer 1612 (fr); along beach of Isla de Coiba, without elev., 25 Jul 1962 (fr), J. Dwyer 2363 (MEXU, NY); traditional campsite, 1 km past Ag School, forest slope to the rear, road from Santa Fé, 1,000–1,200 m, 5 Feb 1977 (fr), J. Folsom & L. Collins 1613 (MO); shoulder of Cerro Tuti, without elev., 25 May 1977 (fl), J. Folsom et al. 3375 (MO); Cerro Tute ridge up from former Escuela Agricola, Santa Fé, 08° 35' N, 81° 05' W, 800–1,100 m, 15 Jul 1983 (fl), C. Hamilton & K. Krager 3973 (LL-TEX, MO); trail on ridge to summit of Cerro Tute, Cordillera de Tute, 1 km past Escuela Agricola Altos de Piedras, W of Santa Fé, 08° 36' N, 81° 06' W, 750–950 m, 15 Dec 1981 (fl), S. Knapp & K. Sysma 2498 (LL-TEX, MO); (fr), S. Knapp & K. Sysma 2518 (LL-TEX, MO); above Escuela Agricola Alto de Piedra, just W of Santa Fé, 3,200 ft [975 m], 7 Jun 1973 (fl), J. Luteyn 4012 (LL-TEX); N of Santa Fé, on property of Escuela Agricola Alto de Piedra, woods near cattle shelter at Girasol, 16 Oct 1974 (fl), S. Mori & J. Kallunki 2520 (LL-TEX, MO); Cerro Tute, ca. 10 km NW of Santa Fé, on lower slopes, 750–1,000 m, 19 Jun 1975 (fl), S. Mori 6738 (LL-TEX, MO), 2 Aug 1975 (fl), S. Mori et al. 7545 (LL-TEX, MO); Cerro Tute, along ridge-trial towards summit, 08° 30' N, 81° 07' W, 1,000–1,250 m, 21 Mar 1987 (fr), G. McPherson 10744 (MO); vicinity of Cerro Tute-Arizona, along trail to summit beyond Altos de Piedra, above Santa Fé, 08° 30' N, 81° 10' W, 850–1,100 m, 27 Jul 1988 (fl), G. McPherson 12797 (BRIT, F, LL-TEX, MO, PMA); along trail to summit of Cerro Tute, ca. 3 km above Escuela Agricultura Alto Piedra near Santa Fé, 2600–2800 ft [792–853 m], 4 Jan 1981 (fr), K. Sysma & T. Antonio 2997 (BRIT, MO). COLOMBIA. Chocó: Quebrada Changamé to the mouth of the Río Jurubidá, 06° 05' N, 77° 10' W, sea level–100 m, 5 May 1990 (fl), C. Barbosa 6412 (BRIT, MO); trail between Curiche and Alto de Curiche, 10–1,000 m, 22 Jun 1968 (fl, fr), J. Duke 15799 (MO, OS).

It is notable that Ardisia coibana (Lundell) Lundell, A. esquipulasana Lundell, A. obtusata (Lundell) Lundell, A. riomonteanana Lundell, and A. ustupoana (Lundell) Lundell, are all invalid names because Lundell (1986) made the
transfers “to obviate the incentive of workers to undertake such unnecessary reductions [of *Icacorea* (Aubl.) Mez, * Auriculardisia* Lundell, *Gentlea* Lundell, * Graphardisia* (Mez) Lundell, *Oerstedianthus* Lundell, *Ibarrea* Lundell, *Amatlania* Lundell, and *Zunilia* Lundell] to subgenera.” Therefore, according to ICBN 34.1, we feel that the names are invalidly published because both clauses, “(a) when it is not accepted by the author in the original publication, and (b) when it is merely proposed in anticipation of the future acceptance of the group concerned, or of a particular circumscription, position or rank of the group,” are clearly fulfilled. However, this is not the case for *Ardisia murphyae* (Lundell) Lundell because the transfer (Lundell 1987) was effected with no commentary on the part of the author. We have not validated Lundell’s combinations in *Ardisia* here because we consider these names taxonomic synonyms and to do so would require that we recognize them as distinct taxa.

*Ardisia opegrapha* subsp. *opegrapha* exhibits great quantitative variation among relative size of its organs within individuals and among populations within its somewhat restricted geographic range. Repeated sampling from one individual at Parque Nacional Altos de Campana, Panama ([*M. Ruiz et al.* 165, 210, 5139, 7320, 7800, 7865] over a three year period revealed that relative size of leaves to inflorescence is highly variable even within the same individual. Given that the inflorescences are terminal, the branches are pseudoverticillate and growth is rythmic, *Ardisia opegrapha* exhibits Scarrone’s Model ([Halle et al. 1978]). Repeated collections would amount to a pruning experiment and while the tree grew from 1.5 m tall when first collected in July of 1988 ([*M. Ruiz et al.* 165]) and reached a height of three meters in June of 1991 ([*M. Ruiz et al.* 7865]), some of the radical size difference among the leaves on the specimens may be consequent to reiteration phenomena previously discussed by Pipoly (1992, 1998). Unfortunately, no data is available to determine whether successive specimens were taken from normal sympodial (by substitution) branches of the tree, or from reiterative (bayonet type) shoots as a direct result of pruning effected during specimen collection. Morphological variation among populations is much greater than that observed within individuals, and this plasticity has led to overdescription, because species circumscription has been reliant on relative size of inflorescences to leaves, bracts to pedicels, relative crowding of the flowers in the corymbs, length of floral parts, and plant height. The rationale for relegating 12 species to synonymy is explained below; relative terms (larger, smaller, thinner, and thicker) refer to comparisons with populations with features of the type of *Ardisia opegrapha*.

*Ardisia oliveri* was collected from populations whose inflorescences are larger than average, large relative to the leaves, and whose flowers were in full anthesis. *Ardisia seibertii* also has inflorescences that are large relative
to the size of the leaves; the inflorescence branches bear pedicels in high anthotactic spirals, giving the impression that the flowers are in umbels rather than true corymbbs. The type of *Ardisia skutchii* is notable only for its sepals that are slightly shorter and wider than the average, short petioles and flowers white with only a slight pink tinge. *Ardisia subcoriacea* was described because it has relatively smaller, subcoriaceous leaves, petioles not marginate to the base, smaller flowers, elliptic sepals with hyaline margins and short stamens. *Graphardisia coibana*, whose type is a fruiting collection, was separated by its thick leaves with abruptly caudate-acuminate apices and long-attenuate bases. However, both of these features lie well within the range of quantitative variation for the subspecies.

*Ardisia picturata*’s type represents populations with extremely thin leaves, but otherwise identical to “typical” subspecies *opegrapha*. It is interesting to note that the type (Dwyer & Kirkbride 7818) is a specimen that amply demonstrates the range of variation in size and shape of the leaves within the taxon; the LL-TEX isotype has small nearly elliptic leaves, while the isotypes at MO and NY have leaves nearly twice as large as the LL-TEX sheet, and are elliptic to widely ob lanceolate (essentially obovate). Clearly, there is no practical way to separate the *A. picturata* morphotype. Other taxa segregated principally because of thin leaves include *Graphardisia nicaraguensis* and *G. obtusata*, both of which are otherwise notable for their ob lanceolate and obl ong leaves, the former with obovate or elliptic sepals and the latter with narrowly obtuse sepal apices. Recognition of these various taxa amounts to describing plants different in overall aspect rather than unique characters.

Other examples of minor variations used to separate species include the sparsely ciliolate sepals found on the type of *Graphardisia ustypoana*, and the pellucid rather than black punctate leaves found on the type of *Graphardisia murphyae*. In addition, *Graphardisia oxypylla* has reddish instead of black punctate-lineate sepals, relatively thick petioles and flower size at the smaller end of the continuum for the subspecies. The description of *Graphardisia seranoana* was based primarily on its subsessile anthers, but reexamination of the type reveals that the measurements were taken from very young floral buds. The duplicate collection at MO contained more mature buds, and open floral remnants with stamens well within the size range of variation found in subsp. *opegrapha*. Therefore the mistake was owing to the holotype specimen's condition rather than to a biological characteristic.

*Ardisia opegrapha* is most closely related to *A. bartletti* based on its yellow glandular-granulose corolla tube, but can easily be separated from it by the membranaceous, oblong apically broadly rounded to obtuse sepal with entire margins, and sessile- to stalked glandular-papillate filaments. Among the subspecies of *Ardisia opegrapha*, subspecies *opegrapha* is most
easily recognized by a combination of the obpyramidal inflorescence, caducous floral bracts and floral parts larger than the other two subspecies. It appears to be more closely related to subsp. wagneri than it is to subsp. paquitensis because of the obpyramidal inflorescence shape and leaves 3 or more times longer than wide.


Mez (1902) listed collections from Volcán Barú, including M. Wagner 623 and F. Lehmann s.n., and cited herbaria at GOET, M. and W. Without reference as to which specimen was deposited where. Searches of the collections at M and W failed to discover any material of either M. Wagner 623 or F. Lehmann s.n. A misidentfied collection of Lehmann s.n. was located at W, bearing a determination by Mez in 1901 as Ardisia opegrapha. Therefore, we assume it does not fit Mez’s original concept of A. wagneri. The Wagner collection at GOET most closely fits the description of A. wagneri and we therefore designate it as the lectotype.


Shrubs to small trees (0.5–2)–6 m tall, 2–5 cm in diam. Branchlets 2–4 mm in diam. Leaves with blades elliptic or oblanceolate 10–23 cm long, 4–7.5(–8) cm wide; petioles canaliculate, 0.7–2 cm long. Inflorescence obpyramidal, a pinnate panicle of corymbs, 2–8.5 cm long, 4–15 cm wide; peduncle obsolete to 3.5 cm long; inflorescence branch bracts numerous, oblong, 10–26 mm long, 3.5–8 mm wide, persistent; floral bracts linear to oblong, 6–9.2 mm long, 1–3.1 mm wide, persistent; pedicels 6–23 mm long. Flowers 8–9.2 mm long; sepals oblong or widely oblong, 4.2–5.2 mm

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long, 2.2–3.1 mm wide; corolla 7.1–9 mm long, the tube 0.3–0.5 mm, the lobes ovate, 7.0–8.5 mm long, 3.8–4.5 mm wide; stamens 3.8–5 mm long, the staminal tube 0.3–0.6 mm long, the filaments (0.5–)1.5–2 mm long, 0.5–0.7 mm wide, the anthers 2.3–3.2 mm long, 0.9–1.1 mm wide at base; ovary with style 3.5–5 mm long; ovules 12–13, pluriseriate. Fruit 4.2–5.5 mm in diam.

Distribution.—Central America, primarily in areas with drainage toward the Caribbean, subsp. paquitensis is found from Nicaragua (Jinotega, Matagalpa, Chontales, Zelaya and Río San Juan) southward through Costa Rica (Guancaste, Alajuela, Heredia, Puntarenas and Limón) to Panama (Chiriquí and Bocas del Toro) from sea level–1450 m elevation.

Ecology and conservation status.—Primary, remnant and secondary forests in lower montane, premontane, evergreen tropical wet forests and cloud forests.

Etymology.—The specific epithet commemorates Moritz Friedrich Wagner (1813–1887), Bavarian botanist and zoologist, who traveled to Panama and Ecuador between 1857–1860.

Additional specimens examined. NICARAGUA. Chontales: Santo Domingo, 500–1000 m, 13 Jan 1970 (fl, fr). J. Atwood 3346 (MO); Cerro Oluma, near top of Cordillera Americana, 12° 18’ N, 85° 24’ W, 840 m, 3 Jan 1984 (fr), A. Gentry et al. 43897 (MO); Cerro Oluma, ca. 3 km SW de Ciudad Cuapa, 12° 18’ N, 85° 20’ W, 700–740 m, 3 Jan 1984 (fl), A. Grijalva et al. 33808 (MO); Cerro Las Nubes, El Tamagis and Loma San Gregorio, ca. 2 km N of Santo Domingo, 600 m, 20 Jan 1984 (fr), A. Grijalva & D. Ríos 3493 (MO); 4 km NNW of Cuapa, ridgetops and summits of Cerro Oluma, 12° 18’ N, 85° 23’ 30” W, 700–775 m, 23 Sep 1983 (fl), M. Nee 28425 (MO). Jinotega: Comarca Santa Cruz, El Calvario, al SW del Cerro Kilambé, 13° 34’ N, 85° 40’ W, 900–1,000 m, 27 Mar 1981 (fr), P. Moreno 7730 (MO); Las Brisas, Comarca Kilambé, 13° 35–36’ N, 85° 39’ W, 930 m, 13 Jul 1980 (fl), J. Sandino 160 (MO); Cerro San Pedro, Comarca Kilambé, 13° 30’ N, 85° 38–39’ W, 820 m, 21 Jul 1980 (fl), J. Sandino 186 (MO). Matagalpa: 78 km from Matagalpa, along Matagalpa-Siuna Hwy, La Gloria, 13° 15’ N, 85° 35’ W, 600 m, 13 Sep 1982 (fr), P. Moreno 17227 (MO); El Comején, 1 km W of Hwy. to Waslala, 13° 15’ N, 85° 34’ W, 600 m, 23 Feb 1983 (fr), P. Moreno 20597 (MO), Río San Juan: Along Río Sábalo, 11° 03’ N, 84° 28’ W, 40 m, 07–08 Jul 1984 (fl), P. Moreno & W. Robleto 25981 (MO); La Lupe near Río Santa Cruz, 11° 08’ N, 84° 22’ W, without elev., 7 Oct 1990 (fr), J. Salick 7880 (MO). Zelaya: Nueva Guiria, 11° 46’ N, 84° 26’ 30” W, 200 m, 11 Ago 1982 (fl), M. Araquistain 3007 (MO); Nueva Guiria, Colonia Yolaina, 11° 40’ N, 84° 22’ 30” W, without elev., 13 Ago 1982 (fl), M. Araquistain 3087 (MO); El Achiote, 11° 47’ N, 84° 26’ W, 200 m, 25 Ago 1982 (fl), M. Araquistain 3132 (MO); Cerro El Naranjito, ca. 15 km SW of Waní, without elev., 14 Sep 1982 (fl), A. Grijalva & P. Moreno 1134 (MO), (fr), A. Grijalva & P. Moreno 1153 (MO); Río Punta Gorda, Atlanta, La Richard, Loma San Jorge, 11° 31’ N, 84° 04’ W, 150–160 m, 13 Nov 1981 (fr), P. Moreno & J. Sandino 13039 (MO); Río Punta Gorda, Atlanta, al SE de La Richard, 11° 32’ N, 84° 05’ W, 30 m, 14 Nov 1981 (fr), P. Moreno & J. Sandino 13100 (MO); Comarca Waslala, 6.5 km al SE de Waslala, 13° 16’ N, 85° 24’ W, 520–560 m, 14 Sep 1982 (fr), P. Moreno 17273 (MO); El Naranjito, a 50 km de Siuna, along Matagalpa-Siuna Hwy., 10 km al W de la cuesta El Guayabo, 13° 34’ N, 85° 10’ W, 300 m, 14 Sep 1982 (fr), P. Moreno 17312 (MO); La Posolera, 5 km al W de Waslala, carretera El Tuma a Waslala, 13° 17’ N, 85° 24’
W, 700 m, 22 Dic 1982 (fr), P. Moreno 19119 (MO); El Guásimo, camino a El Dos, NE de Siuna, 13° 48' N, 84° 39' W, 360–380 m, 25 Feb 1983 (fr), P. Moreno & W. Robleto 20745 (MO); Mpio. de Siuna, Wani, without elev., 27 Ago 1982 (fr), F. Ortiz 49 (MO); Mpio. de Siuna, Comarca Santa Rosa, without elev., 6 Sep 1982 (fr), F. Ortiz 112 (MO); Mpio. de Siuna, Comarca Danlí, 100–130 m, 31 Sep 1982 (fl), F. Ortiz 201 (MO); Mpio. de Siuna, Waspadó, 100–120 m, 6 Oct 1982 (fr), F. Ortiz 281 (MO); Mpio. de Siuna, El Torno, 120 m, 10 Oct 1982 (fr), F. Ortiz 324 (MO); Sector Mina Nueva América, 13° 45' N, 84° 30' W, 500 m, 22 Sep 1984 (fr), F. Ortiz 2130 (MO); Bonanza, on ground of Neptune Mining Co, 14° 02' N, 84° 35' W, 350–450 m, 26 Feb 1979 (fr), J. Pipoly 3516 (MO); Lagua Santa Rosita on road from Bonanza to El Salto Grande, 14° 03' N, 84° 37' W, 140–160 m, 27 Feb 1979 (fl), J. Pipoly 3670 (MO); Finca Waylayás, 13° 39' N, 84° 48' W, 80 m, 12 Mar 1979 (fl), J. Pipoly 4420 (MO); Risco de Oro, 40 m, 22 Mar 1979 (fl), J. Pipoly 5010 (MO); Estación Experimental El Recreo, 12° 09' N, 84° 17' W, 15 m, 10 Jan 1985 (fr), D. Ríos 232 (MO); 1 km S de Colónia Verdún, en Nueva Guinea, 11° 38' N, 84° 26' W, 200–250 m, 17 Jul 1982 (fl), J. Sandino 3260 (MO); Cerro El Escobín, 4 km de Colónia Serrano, 11° 33–34' N, 84° 21–22' W, 120–130 m, 30 Jul 1982 (fl), J. Sandino 3369 (MO); 1 km de Colónia Serrano, Río Serrano, 11° 34' N, 84° 21–22' W, 70–80 m, 31 Jul 1982 (fl), J. Sandino 3427 (MO); Toro Bayo and Esquíupilas, drainage of Ríos Jicaro and Esquíupilas, 130 m, 20 Nov 1951 (fr), P. Shank & A. Molina R. 4610 (F); Esquíupilas Mountains, 130 m, 22 Nov 1951 (fr), P. Shank & A. Molina R. 4696 (F); Esquíupilas Mountains and Alemán, Río Alemán Drainage Basin, 150 m, 27–29 Nov 1951 (fr), P. Shank & A. Molina R. 4766 (F), (ster), P. Shank & A. Molina R. 4850 (F); Ríos Punta Gorda, Alemán, and Zapote Drainage Basins, 30 m, 5 Dic 1951 (fl), P. Shank & A. Molina R. 4966 (F); Estación Experimental El Recreo, ca. 1.5 km SE of the station, 100 m, 10 Ene 1985 (fr), D. Soza et al. 378 (MO), along new road from Río Blanco to Río Copalar, ca. 31 km E of Río Blanco, 12° 50–55' N, 85° 00–05' W, 200–400 m, 13 Feb 1979 (fl), W. Stevens 12153 (MO, NY); along road from Bonanza to Constancia, 13° 58–14° 01' N, 84° 37–40' W, 160–360 m, 21 Feb 1979 (fl), W. Stevens 12493 (MO); along road between El Empalme and Limbaika, ca. 1.5 km SE of Palmera, 13° 35' N, 84° 20' W, 60 m, 24 Feb 1979 (fr), W. Stevens 12836 (MO); along Río Waspáka ca. 1 km upstream from confluence of Ríos Pis-Pis, 14° 15' N, 84° 36 W, 75–100 m, 1 Mar 1979 (fr), W. Stevens 13083 (MO), Without Department: 1867 (fl), B. Seemann s.n. (BM). COSTA RICA. Alajuela: Cantón San Ramón, R.F. San Ramón, Cordillera de Tilarán, trail to Volcán Muerto, 10° 12' 55" N, 84° 36' 25" W, 1,100–1,200 m, 11 May 1993 (fr), F. Araya et al. 306 (BRIT, MO, NY); Reserva Biológica Monte Verde Río Peñas Blancas, Parcela de Manuel Rojas, 850 m, 8 Aug 1988 (fl), E. Bello 291 (MO); Cantón Upala, ca. 3 km NNE of Bijagua along new road to Upala, 10° 45' N, 85° 03' W, 450 m, 7–8 Nov 1975 (fr), W. Burger & R. Baker 9847 (F); E slopes of Volcan Miravalles, W of Bijagua, near el Río Zapote, 10° 44' N, 85° 05' W, 600 m, 11–12 Feb 1982 (fr), W. Burger et al. 11684 (BM, F, LL-TEX); along road between Canas (Guancaste) and Upala, near el Río Zapote, 1.8–2.7 km S of Río Canalete, 100 m, 25 Jun 1976 (fl), T. Croatt 36349 (BRIT, MO); along Hwy. 15, between Naranjo and Aguas Zarcas, 8 km NE of Quesada, 600 m, 3 Feb 1979 (fr), T. Croatt 46928 (MO); without further locality, without elev., without date (fl), E. Friedrichsblad 1296 (W); Cantón Upala, P.N. Guanacaste, Cordillera de Guanacaste, Estación San Ramón, La Campana, Dos Ríos, 10° 52' 50" N, 85° 24' 05" W, 550 m, 23 Mar 1994 (fl), T. García 203 (BRIT, MO); Laguna de Río Cuarto, Sarapiquí, 400 m, 5 Nov 1984 (fr), J. Gómez-Laurito 10215 (F); along creek in floresta San Carlos, 250 m, 30 Jun 1985 (fl), W. Haber et al. 1770 (MO); Cantón San Ramón, Valley of Río La Esperanza, 4 km SW of La Tigría, Finca Araya Ledezma, Bosque eterno de Los Niños, 10° 18' N, 84° 37' W, 500–600 m, 3 Jul 1992 (fl), W. Haber et al. 11260 (MO); Cantón Upala, Dos Ríos, 5 km S of Brasilia, right bank of Río Pizote to Minga House, 10° 55' N, 85° 20' W, 500 m, 31 Oct 1987 (fr), G. Herrera
1060 (MO); Cantón San Carlos, along Río Rafael, near La Marina, Llanura de San Carlos, 550 m, 21 Feb 1966 (fr), A. Molina et al. 177008 (F); Parque Nacional Rincón de la Vieja Colonia Blanca, farm in Quebrada Rancho Grande, 10° 46' 55" N, 85° 15' 10" W, 500 m, 14 Jul 1991 (fl), G. Riveria 1452 (MO); S slope of Volcan Arenal, above Río Agua Caliente, without elev., 21 Feb 1989 (fr), G. Russell et al. 870 (MO, US); 9.8 km N of Río Naranjo on road to Upala, local name for area is El Macho, 440 m, 8 Nov 1975 (fr), J. Utley & K. Utley 3273 (F); ca. 2 km S of the town of Canalete along road to Upala. 100 m, 12 Nov 1975 (fr), J. Utley & K. Utley 3305 (F); Cantón Aguas Zarcas, Atlantic rain forest area on Hacienda la Marina, Río San Rafael, 450–500 m, 8 Feb 1965 (fr), L. Williams et al. 29120 (F). Guanacaste: Cantón Tilarán, bosque entre La Laguna del Arenal y el Alto de La Carpintería, 700 m, 26 Jun 1930 (fl), A. Brenes 12653 (F); Z.P. Tenorio, Cordillera de Guanacaste, Estación Tenorio, 10° 36' 40" N, 84° 59' 45" W, 1,050 m, 10 Aug 1992 (fl), G. Carballo 436 (MO); Rancho Harold, región del Volcán Cacao, 700–1,200 m, 30 Jul 1986 (fl), J. Chacón & A. Chacón 2153 (MO); La Cruz de Abangares, 1,400 m, 15 Jul 1985 (fl), W. Haber & E. Bello C. 1995 (MO), W. Haber 2000 (MO), 2079 (MO); 2 km SW of La Cruz, on J. Wolfe Farm, 1,400 m, 28 Aug 1985 (fl), W. Haber 2439 (MO), 2440 (LL-TEX), 2441 (MO); La Cruz de Abangares, 1,360 m, 4 Sep 1985 (fl), W. Haber & J. Wolfe 2513 (BRIT, LL-TEX, MO), 1,400 m, 10 Sep 1985 (fl), W. Haber & E. Bello C. 2667 (BRIT, LL-TEX, MO), 2691 (LL-TEX), 2693 (MO), 24 Sep 1985 (fl), W. Haber & E. Bello C. 2888 (LL-TEX, MO); Cantón Tilarán, Río Chiquito ZonaMonteverde, Finca de Campos, Vertiente Atlántica, 10° 25' N, 84° 53' W, 1,100 m, 7 Jun 1987 (fl), W. Haber & E. Bello C. 7439 (MO), 7454 (MO, US); Cantón Liberia, Parque Rincón de La Vieja, del Mirador siguiendo la Fila al Volcán Santa María, 10° 46' N, 85° 49' W, 1,100–1,300 m, 27 Nov 1987 (fl, fr), G. Herrera 1435 (MO); Parque Nacional Guanacaste Estación Pitilla, Finca La Pasomopma, 11° 02' N, 85° 24' W, 300 m, 17 Jun 1989 (fl), U INIBIO 53 (BRIT, MO); Silencio-Tilarán, without elev., 31 May 1932 (fl), W. Kupper 1529 (M); Cantón Liberia, Parque Nacional Guanacaste, Cordillera de Guanacaste, Estación Cacao, trail to Fran’s House, 10° 55' 43" N, 85° 28' 10" W, 1,100 m, 8 Feb 1995 (fr), M. Lobo 25 (BRIT, MO); Sendero Nacho y La Esperanza, 10° 59' 26" N, 85° 25' 40" W, 700 m, 22 Jul 1991 (fl), P. Ríos 385 (MO); Hacienda Tenorio, without elev., 17 Feb 1956 (fl, fr), B. Schubert 1086 (A); ca. 3 km N of Río Naranjo, near the continental divide and ca. 100 m S of the Guanacaste–Alajuela border, 10° 42' N, 85° 04' W, 500 m, 5 Jan 1975 (fl), J. Taylor 18094 (F). Heredia: Carrillo Estación Magsay, Sarapiquí, 10° 24' 18" N, 84° 03' 30" W, 200 m, 5 Jul 1990 (fl), D. Acevedo et al. 128 (MO); 5 Jul 1990 (fl), G. Carballo 151 (BRIT, MO); N of Puerto Viejo, 1.2 km to ferry, over ferry, 6 km along road, 100 m, 3 Feb 1983 (fr), N. Garwood et al. 961 (BM); Cantón Sarapiquí, Parque Nacional Braulio Carrillo, Estación Carrillo, Quebrada Sandijuela, 500 m, 25 Jul 1984 (fl), L. Gómez et al. 22966 (F, LL-TEX, MO); Finca La Selva, the OTS field station on the Río Puerto Viejo just E of its junction with the Rio Sarapiquí, along West River Road, near point, without elev., 16 Aug 1979 (fl), M. Grayson 2403 (MO); edge of trail on point, 100 m, 8 Apr 1982 (fl), B. Hammel 11619 (F), 100 m, 23 Apr 1982 (fl), B. Hammel 11825 (F, LL-TEX); Cantón Sarapiquí, Finca La Selva, Puerto Viejo, forest along Quebrada Leonel, 10° 26' N, 84° 01' W, without elev., 11 Jul 1973 (fl), G. Harshorn 1254 (BRIT, F, MO); La Selva, ca. 1.650 m along Holdridge Trail, at creek crossing, tributary of Quebrada El Pantana, 100 m, 15 Jul 1984 (fl), B. Jacobs 2871 (MO); La Selva, 775 m line, West River Road, 100 m, 22 Oct 1982 (fr), T. McDowell 562 (MO); E of 11.20 West River Road, between Río Puerto Viejo and Hunters Cocoa grove, 100 m, 1 Dec 1982 (fr), T. McDowell 1007 (MO); Finca La Selva, ca. 4 km SE of Puerto Viejo, 10° 28' N, 84° 00' W, 50 m, 21 Jul 1976 (fl, fr), J. Solomon 5238 (F, MO). Limón: Cantón Pococi, R.N.E.S. Barra del Colorado, Llanura de Tortuguero, Sardinas, 15–20 m, 12 Dec 1992 (fl, fr), F. Ayasta 147 (MO); La Concepción, Llanuras de Santa Clara, 250 m, Apr 1896 (fl), J. Donnell Smith 6677 (LL-TEX); Vicinity of U.S. Department
of Agriculture Rubber Experiment Station, Los Diamantes, on Río St. Clara, 1.6 km E of Guapiles, 200 m, 9 Jul 1949 (fl), R. Holm & H. Illeis 315 (G, GH); Cantón Póweł, La Granja, Finca Vieja, 260 m, 26 Jul 1936 (fl), F. Solis R. 416 (F, MO), [Puntarenas: Monteverde, Altos del Río San Luis, División al Río Lagarto, Santa Elena, 10° 16' N, 84° 50' W, 1.000 m, 18 Jul 1989 (fl), E. Bello C. 1032 (MO); Reserva Biológica Monteverde, Altos de Santa Elena, 10° 19' N, 84° 49' W, 1, 400 m, 6 Aug 1991 (fl), E. Bello C. 2929 (INB, MO); Monteverde, lower community, 1.350–1.400 m, 1 Mar 1985 (fl), W. Haber 1427 (MO), 1428 (LL-TEX); Monteverde, Pacific slope forest, 1,450 m, 8 Aug 1985 (fl), W. Haber 2187 (MO), 2188 (LL-TEX), 2189 (MO), 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199 (MO); Monteverde community, 1.450 m, 18 Aug 1985 (fl), W. Haber 2276 (MO), 2315, 2316 (LL-TEX); 2317 (MO), 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2329, 2331 (MO); Monteverde community, Pacific slope, 10° 20' N, 84° 50' W, 1,400 m, 9 Jun 1986 (fl), W. Haber & E. Bello C. 5031, 5039, 5055, 5063 (MO), 16 Sep 1986 (fl), W. Haber & E. Bello C. 5641 (MO). [Province unknown: ] without date, (fl), E. Friedrichsital s.n. (W), (fl), F. Lehmann s.n. (W). [PANAMA. Bocas del Toro: Water Valley, Vicinity of Chiriqui Lagoon, without elev., 9 Sep 1940 (fl), H. von Wedel 661 (LL-TEX, MO), 23 Sep 1940 (fl), H. von Wedel 932 (MO), 9 Oct 1940 (fl), H. von Wedel 1109 (MO), 5 Nov 1940 (fr), H. von Wedel 1536 (LL-TEX, MO), 26 Nov 1940 (fr), H. von Wedel 1769 (MO), Chiriquí: Without further locality, without elev., 1858 (fl), M. Wagner 246 (F Neg. # 20056); Vicinity of San Bartolomé, Península de Búriza, sea level–50 m. 28 Jul–01 Aug 1940 (fl), R. Woodson & R. Schery 906 (LL-TEX, MO).]

As with the other two subspecies of Ardisia opegrapha, marked but continuous quantitative variation in relative sizes of parts and persistence of floral bracts has caused much overdescription. The type of Ardisia bracteolata, a fruiting collection, is notable only for its thin, narrowly oblong sepals that are at times emarginate apically, often varying within the same specimen. Ardisia zelayensis was described owing to its relatively large sepals with obtuse apices, and the leaves with acute apices and cuneate bases. Populations represented by the type of Graphardisia hyalina vary from all others of the subspecies because their anthers have more rounded bases and more narrow apices. The diminutive size of the inflorescence, its rachis and pedicels, together with the extremely slender pedicels of populations from which the type of Graphardisia purpurea was collected probably led to its description.

The numerous, persistent floral bracts distinguish subsp. wagneri from subsp. opegrapha and subsp. paquitensis. In late fruit, the bracts sometimes fall, but even then, this subspecies can easily be recognized by the crowded pedicel scars.


Shrubs or small trees (0.6–)1–6 m tall. Branchlets 4–6(–) mm in diam. Leaves with blades elliptic to broadly elliptic 20.5–30 cm long, (7.5–)8–
Fig. 5. *Ardisia opegrapha* Oersted subsp. *paquitensis* (Lundell) Pipoly & Rickerson. A. Habit, flowering branch. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower, showing corolla and stamens. E. Detail of stamen, showing adaxial and abaxial surfaces. F. Fruit. A, C–E drawn from holotype. B, F drawn from isotype.
14.5 cm wide; petioles marginate, (1.5–)2–3(–3.5) cm long. Inflorescence globose, a panicle of compound corymbs, (2.5–)3–5 (–7) cm long; peduncle obsolete to 0.5(–1) cm long; inflorescence branch bracts 7.2–15.5 mm long, 2.6–6.5 mm wide, caducous; floral bracts 3.7–4.8 mm long, 0.8–1.3 mm wide, caducous; pedicels 8.5–13 mm long. Flowers 7.5–10 mm long; sepals oblong, 4.5–7 mm long, 2.5–3 mm wide; corolla 7–9.5 mm long, the tube 0.6–0.7 mm long, the lobes widely ovate to oblong, 6.5–9 mm long, 4.6–5.7 mm wide; stamens 4–5.2 mm long, the staminal tube 0.6–0.8 mm long, the filaments 1–2.5 mm long, 0.5–0.7 mm wide, the anthers 3.3–3.6 mm long, 0.9–1.1 mm wide at base; ovary with style 4–4.2 mm long, the ovules 11–12, pluriseriate. Fruit 4.5–5(–7) mm in diam.

**Distribution.**—Endemic to Costa Rica, in the Provinces of Limón, Cartago, San José and Puntarenas (especially common in the Cantons of Osa and Golfito); sea level–1,400 m elevation.

**Ecology and conservation status.**—Subspecies paquitensis occurs in primary and secondary tropical wet forests as a locally infrequent component of the understory. Because of its restricted distribution, it should be considered threatened.

**Etymology.**—The specific epithet ‘paquitensis’ refers to the type locality, along the Río Paquita, Province of San José, Costa Rica.

Additional specimens examined. COSTA RICA. Cartago: above Túix, road to Morravia Chirripó, without elev., 1 Oct 1982 (fr), D. Hazlett 5101 (F, LL-TEX). Limón: Reserva Indígena Talamanca Sukut, mouth of Río Sukut at Río Urén path to SE, toward Purísqui, 09° 24' 15" N, 82° 58' 10" W, 350–550 m, 6 Jul 1989 (fl), B. Hammel et al. 17551 (BRIT, MO). Puntarenas: Cantón Osa, Reserva Forestal Golfo Dulce AguaBuena, 08° 41' 50" N, 83° 30' 43" W, 40–50 m, 2 Aug 1991 (fl), R. Aguilar 178 (MO); Cantón Golfito, Parque Nacional Corcovado, Peninsula de Osa, Estación Sirena, Sendero Ollas, 08° 28' 50" N, 83° 35' 30" W, 10 m, 13 Jun 1994 (fl), R. Aguilar 3411 (BRIT, MO); Cantón Osa, vicinity of Palmar Norte, along Río Grande de Terraba, sea level, 2 Jul 1949 (fl), P. Allen 5347 (A, F 3-sheets, GH, MO); vicinity Palmar Norte de Osa, 30 m, 6 Sep 1950 (fl), P. Allen 5657 (F); Parque Nacional Corcovado, Peninsula de Osa, Sendero Mirador, 08° 33' 10" N, 83° 30' 40" W, 200 m, 30 Aug 1995 (fr), L. Angulo 487 (MO); Reserva Biológica Catara Estación Quebrada Bonita, 09° 46' N, 84° 36' W, 30 m, 26 Jun 1990 (fl), E. Bello C. & E. Rojas 2283 (BRIT, MO); near airport, 4 mi W of Rincón de Osa, 08° 42' N, 83° 31' W, 30 m, 4–7 Jun 1968 (fl), W. Burger & R. Stolze 5463 (F); Cantón Golfito, along hwy from Río Claro (on Panamerican Hwy.) to Golfito, 2.5 m SE of Golfito, 27.5 mi S of Río Claro, 08° 36' N, 83° 04' W, 60 m, 15 Sep 1987 (fr), T. Croat 67621 (BRIT, LL-TEX, MO); Sirena, 08° 28' 00" N, 83° 35' 00" W, 1–200 m, 26 Jun 1991 (fl), P. Delprete 5117 (TEX); Quebrada Benjamín, Palmar Norte, 08° 59' N, 83° 28' W, 50 m, 14 Jan 1993 (fr), A. Gentry et al. 78808 (BRIT, MO); Quebrada Cunabri, Hitoy-Cerera, Baja Talamanca, 500–800 m, Jul 1984 (fl), L. Gómez 24093 (MO); divide between Quebrada Benjamín and Quebrada Batambal, SW slope of Fila Retinto, NW of Palmar Norte, 08° 59' 00" N, 83° 28' 30" W, 300–400 m, 9 Jul 1990 (fl), M. Grayum & R. Evans 9867 (MO); La Palma, Río Rincón headwaters, trail to Cerro de Oro, 08° 35' N, 83° 30' 40" W, 100 m, 30 Jul 1990 (fl), G. Herrera 4070 (BRIT, MO); Playa Cacao, lower basin of Quebrada Nazareno, 08° 37' 50" N, 83° 11' 00" W, 70 m, 27 May 1994 (fl), G. Herrera & G. Rivera 7081 (F);
between Palmar Norte and Puerto Cortez, Osa Peninsula, 50 m, 6 Aug 1964 (fl), A. Jiménez 2239 (F); in Webb's forest, between Palmar Sur and Puerto Cortez, 400 m, 23 Aug 1965 (fl), A. Jiménez 36162 (F); Estación Sirena, Naranjo Trail, 08° 27–30' N, 83° 33–38' W, sea level–150 m, 27 May 1988 (fl), C. Kerner 537 (MO); Monkey Woods, 08° 27–30' N, 83° 33–38' W, sea level, 16 Aug 1988 (fr), C. Kerner & P. Phillips 828 (MO); Estación Sirena, S of Río Sirena along Río Camarónal, 08° 28' N, 83° 35' W, sea level, 22 Nov 1981 (fr), S. Knapp 2177 (MO); Corcovado National Park, on hills 0–1 km W of the park headquarters at Sirena, 08° 29' N, 83° 36' W, sea level–200 m, 4 Jul 1977 (fl), R. Liesner 2832 (MO); Along trail and in forest between park headquarters to Sirena and Pavo, 08° 30' N, 83° 36' W, sea level–10 m, 5 Jul 1977 (fl), R. Liesner & G. Vega 2900 (MO); Puntarenas—San José border, Barú, 100 m, 16 Aug 1974 (fl), P. Maas & J. Cramer 1359 (F); Osa Peninsula, Coronado de Osa, 08° 32' 30' N, 83° 18' 30' W, 1–10 m, 24 Jun 1995 (fl), M. Madrigal 76 (MO); Cantón Osa, Fila Esteto Guerra, Sierpe, 08° 34' 30' N, 83° 34' 30' W, 300 m, 27 Sep 1991 (fr), J. Martin 204 (MO); near the airport area, 4 mi W of Rincón de Osa, 100 ft [30 m], 8 Aug 1967 (fr), P. Raven 21627 (F, MO); along road to Pacific Ocean, W of Rincón de Osa, Osa Peninsula, near Mile 15, 100 ft [30 m], 8 Aug 1967 (fl), P. Raven 21681 (F, MO); Rincón de Osa, region N of airfield and ridges running NE, 100–300 m, 23 Jul 1974 (fl, fr), J. Utley & K. Utley 1194 (F); San Luis de Turbuiabes, 450 m, 20 Jul 1933 (fl), M. Valeria 651 (F); San José: Cantón Pérez Zeledon, along road between San Isidro General and Dominical, Fila Tinamastes, 09° 18' 24'' N, 83° 46' 11'' W, 990–1,100 m, 9 Sep 1996 (fl), T. Croat & D. Hannom 79101 (MO); Cantón Tarrazú, San Lorenzo, 09° 34' 20'' N, 84° 03' 52'' W, 1,400 m, 9 Jul 1997 (fr), L. Gutiérrez et al. 64 (MO); between La Lengua y La Víbora de Puriscal, 1,030 m, 23 Apr 1963 (fl), A. Jiménez 692 (F); El General Basin, 675–900 m, Jul 1945 (fl), A. Skutch 5201 (F, MO, NY).

_Ardisia apeagnapha_ subsp. _paquitensis_ is distinctive because of its globose inflorescence, dwarfed by relatively large elliptic to broadly elliptic leaves.

### 3. Ardisia bartlettii Lundell

_Shrubs_ or small _trees_ (0.5–)2–10 m tall, 1–5 cm in diam. _Branchlets_ slender, (1.5–)2–3(–3.5) mm in diam., glabrous throughout. _Leaves_ with blades membranaceous to chartaceous, lanceolate elliptic or oblong 5.5–16 cm long, 1.8–7 cm wide, apically acute to acuminate, basally acute to acuminate, decurrent on the petiole, midrib impressed above, prominently raised below, the secondary veins prominulous above, inconspicuous below, densely and prominently punctate and punctate-lineate, glabrous, the margins entire, undulate to irregularly crenulate; petioles marginate to canaliculate, slender to stout, 0.2–1.1 cm long, glabrous. _Inflorescence_ terminal, bipinnately paniculate, 2–6 cm long, 3.5–7 cm wide, the rachis glabrous, the branches terminating in coryms; peduncle obsolete to 0.5 cm; secondary inflorescence bracts early caducous, membranaceous, oblong, (2.8–)5.5–11.2(–14.2) mm long, (1.3–)2.5–3.9(–5.4) mm wide, apically acute to obtuse, the midrib prominulous above and below, the secondary veins inconspicuous, densely and prominently black punctate, glabrous, the margins entire, sparsely glandular-ciliolate; floral bracts very early caducous, unknown, at times not leaving detectable scars axillant to pedicel (aborted at primordial stage?); pedicels 6–15 mm long, slender, mostly accrescent, glandular-grandulose. _Flowers_
5-merous, chartaceous, 6.8–9.2 mm long; calyx with sepals free, broadly ovate, 1.5–2.5 mm long, 0.9–2 mm wide, apically acute, prominently punctate and punctate lineate, glandular-grandulose within, opaque except at margin, the margins erose to subentire, ciliolate; corolla rotate, 6.5–9.2 mm long, the tube 0.5–1.4 mm long, the lobes ovate, elliptic or lanceolate, 6–8 mm long, 1.6–5 mm wide, apically rounded, prominently punctate and punctate-lineate, yellow glandular-grandulose at base between corolla lobe and tube junction and above staminal tube within, glabrous otherwise; margins entire, ciliolate; stamens 3.5–5.7 mm long, the staminal tube 0.5–1.5 mm long, the filaments 0.5–1.5 mm long, 0.2–0.5 mm wide at base, punctate, glabrous, the anthers linear-lanceoloid, 2.5–3.5 mm long, 0.6–0.9 mm wide at base, apiculate, basally sagittate, dehiscent by subapical pores, the connective darkened; ovary glabrous, the style 4.5–5 mm long, slender, stylodopic at base or not stylodopic (tapered), punctate, glabrous, the ovules 13–16, pluriseriate. Fruit globose to oblong, 4–5.2 mm long, 4.2–5 mm wide, densely and prominently punctate, glabrous.

Because of its yellow glandular-granules within the corolla tube, *Ardisia bartlettii* is most closely related to *A. opegrapha*, but is easily separated from it by the chartaceous ovate, sepals 1.5–2.5 mm long, with acute apices, opaque except at margin, and the margins subentire to erose. The glabrous filaments are also distinctive. *Ardisia bartlettii* is comprised of two subspecies, separated by size of floral parts, tapering vs. stylodopic style base, and habitat.


Fig. 6. Ardisia bartlettii Lundell subsp. bartlettii. A. Habit, flowering branch. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower, showing corolla and stamens. E. Detail of stamen, showing abaxial surface. F. Detail of stamen, showing lateral surface. G. Detail of stamen, showing adaxial surface. H. Fruit. A C, E–H drawn from holotype. D drawn from T. Croatt 15605.
Shrubs (0.5—2—10 m tall, 1—5 cm in diam. Branchless slender, 1.5—3 mm in diam., glabrous throughout. Leaves with blades 5.5—12.5 cm long, 1.8—4.5 cm wide; petioles slender, canaliculate and slightly marginate, 0.2—1.1 cm long. Inflorescence 2—6 cm long, 4—6.5 cm wide; peduncle obsolete to 0.5 cm; secondary inflorescence bracts 5.5—14.2 mm long, 2.5—5.4 mm wide; pedicels 6—15 mm long, slender, accrescent, glandular-grandulose. Flowers 6.8—7.2 mm long; sepals 1.5—1.8 mm long, 0.9—1.1 mm wide; corolla 6.5—7.7 mm long, the tube 0.5—1.2 mm long, the lobes ovate or elliptic to lanceolate, 6—6.5 mm long, 1.6—4.1 mm wide; stamens 3.5—4.8 mm long; the staminal tube 0.5—1.3 mm long, the filaments 1—1.5 mm long, 0.4—0.5 mm wide at base, punctate, glabrous, the anthers 2.5—2.8 mm long, 0.6—0.8 mm wide at base; ovary glabrous, the style 4.5—4.8 mm long, slender, not stylopodic at base, punctate, glabrous, the ovules 15, pluriseriate. Fruit globose to oblong, 4.5—5.2 mm long, 4.2—4.5 mm wide, conspicuously punctate, glabrous.

Distribution.—Known only from eastern Panama (Coclé, Colón, Panamá, Darién, San Blas), and on the Caribbean coast of Colombia (Bolívar), growing at sea level—900 m elevation.

Ecology and conservation status.—Ardisia bartlettii subsp. bartlettii occurs along streams and rivers in wet and pluvial lowland, premontane and cloud forests. It appears to be relatively tolerant of disturbance, so we believe it is not threatened at this time.

Etymology.—The specific and subspecific epithet honors Harley Harris Bartlett (1886—1960), American botanist at the University of Michigan at Ann Arbor, who collected the type specimen.

Additional specimens examined. PANAMA. Coclé: Santa Rita Ridge, 5—10 mi from Transisthmian Hwy., sea level—100 m, 28 Jun 1984 (fl), W. D’Arcy et al. 15548 (BRIT, LL-TEX, MO, PMA); from Torti to Pilota del Toro, mountain overlooking Torti Arriba, without elev., 27 Aug 1977 (fr), J. Fosom & G. Alonzo de Monte 4973 (LL-TEX, MO), 5012 (MO); mountains above Torti Arriba, without elev., 2 Dec 1977 (fr), J. Fosom et al. 6576 (MO); 4—5 hours walk upriver from Torti Arriba, 200—300 m, 6 Dec 1977 (fr), J. Fosom et al. 6844 (MO); lowland area along the stream that passes through Torti, on the S side of the Pan-American Hwy., on Quipo slopes over river, without elev., 25 May 1980 (fl), J. Fosom et al. 7825 (fl, TEX); Hill S of Guacuco, 8 km E of Ipetí, 08° 55’ N, 78° 20’ W, 600 m, 18 Sep 1982 (fr), C. Hamilton & W. D’Arcy 1387 (LL-TEX, MO); Pipeline road, N of Gamboa, upstream of the tenth bridge (Río Guacharo), beyond the big waterfall, 09° 10’ N, 79° 45’ W, 100 m, 4 Aug 1984 (fl), G. de Nevers & D. Hew 3627 (LL-TEX, MO); Pipeline Road near Gamboa, Río Mendoza, upstream of road, without elev., 09° 09’ N, 79° 42’ W, 7 Jul 1985 (fl), G. de Nevers 5963 (LL-TEX, MO, US). Colón: Trail from end of Santa Rita Ridge Road to Río Piedras, 1,400—1,600 ft [427—488 m], 23 Mar 1980 (fr), T. Antonio 3889 (LL-TEX, MO); Santa Rita Ridge, along road, ca. 1 mi from Boyd Roosevelt Hwy., without elev., 9 Jul 1971 (fl), T. Croat 15340 (MO); Santa Rita Lumber Road, ca. 15 km E of Colón, without elev., 20 Apr 1971 (fr), R. Dressler & N. Williams 3967 (MO); Santa Rita Ridge, 20.7 km from Transisthmian Hwy., 09° 23’ N, 79° 40’ W, 530 m, 22 Mar 1992 (ster.), R. Foster et al. 14038 (MO); ridge top 1—3 mi W of Portobello, without elev.,
7 Sep 1971 (fr), A. Gentry 1758 (F, MO); Santa Rita Ridge, ca. 12 km from Transisthmian Hwy., without elev, 28 Jun 1978 (fr), B. Hammel 3646 (MO); end of Santa Rita Ridge Road, 21 km from Transisthmian Hwy., 09° 25' N, 79° 37' W, 400–500 m, 22 May 1982 (fl), S. Knapp & R. Schmalzel 5247 (LL-TEX, MO); 26–28 km from Transisthmian Hwy. on the Santa Rita Ridge Road, 09° 25' N, 79° 37' W, 250–400 m, 23 May 1982 (fl), S. Knapp & R. Schmalzel 5268 (LL-TEX, MO); Santa Rita Ridge Road, 21–26 km from Transisthmian Hwy., 09° 25' N, 79° 37' W, 500–550 m, 4 Jul 1982 (fl, fr), S. Knapp 5892 (LL-TEX, MO); Santa Rita Ridge, SE of Colón, along road from Transisthmian Hwy., 09° 20' N, 79° 45' W, 550 m, 21 May 1986 (fl), G. McPherson 9206 (MO); Santa Rita Ridge Road, ca. 6 km from Boyd Roosevelt Hwy., without elev., 26 Sep 1974 (fr), S. Mori & J. Kalaluki 2140 (LL-TEX, MO); Santa Rita Ridge road, 20–25 mi from Transisthmian Hwy., 09° 24' N, 79° 39' W, 10 Oct 1980 (fr), K. Systma 1523 (LL-TEX, MO); Upper Rio Piedras headwaters, along trail from end of Santa Rita Ridge Road, ca. 11 km SW of Cerro Braja, 09° 25' N, 79° 35' W, 600–700 m, 30 Apr 1981 (fl), K. Systma et al. 4192 (LL-TEX, MO); along Santa Rita Ridge, road to Estación Calibrar Llueva el Agua Clara, 09° 22' N, 79° 42–45' W, 1,300 ft [396 m], 26 Jun 1971 (fl), G. Webster & R. Dresler 16745 (MO). Darién: vicinity of Torti, 38.6 mi E of Bayano Dam Bridge, trail from village to mountains near Rio Torti, 50–250 ft [15–76 m], 17 May 1980 (fl), T. Antonio 4674 (LL-TEX, MO); Rio Tírua 2 mi upstream from Boca del Cupa, 4 Aug 1962 (fr), J. Duke 5381 (MO); vicinity of Las Piñas, without elev., 2 Mar 1967 (fr), J. Duke 10612 (LL-TEX); S of Garachiné near Pacific coast above Casa Vieja, along boundary trail of Parque Nacional Darién, W flank, Serranía del Sapo, 07° 58' N, 78° 23' W, 50–150 m, 21 May 1991 (fl), N. Hensold 1078 (F, MO); Casa Vieja hacia Cerro Sapo, 07° 58' N, 78° 23' W, 180–500 m, 23 May 1991 (fl), H. Herrera, et al. 984 (BRIT, F, MO, PMA); S of Garachinén on W flank of Serranía del Sapo, above place called Casa Vieja, along boundary trail of Darién National Park, 07° 58' N, 78° 23' W, 300–500 m, 24 May 1991 (fl, fr), G. McPherson 15369 (BRIT, MO). Panamá: Barro Colorado, Mojinga swamp near mouth of Rio Chagres, 1 m, 11 Mar 1935 (fl), P. Allen 865 (MO); road to Cerro Jefe, 900 m, 9 Jul 1976 (fl), T. Antonio 1296 (BRIT, LL-TEX, MO); Barro Colorado Island, without elev., 1931 (fl), S. Aviles 10 (MO); Barro Colorado, Snyder-Molina Trail, without elev., 29 Jun 1940 (fl), M. Chrysler 4796 (F); near Gamboa, without elev., 26 Jun 1972 (fl); A. Clewell & E. Tyson 3222 (MO); Barro Colorado, Drayton Trail, without elev., 22 May 1968 (fl), T. Croat 5756 (BRIT, MO); Barro Colorado, Wheeler Trail, without elev., 19 Sep 1968 (fr), T. Croat 6215 (BRIT 2-sheets, MO); Barro Colorado, Wheeler Trail, without elev., 11 Jun 1970 (fl, fr), T. Croat 10845 (F, MO); Barro Colorado, Shannon Trail, without elev., 15 Jul 1970 (fl, fr), T. Croat 11271 (MO); Barro Colorado, Wheeler Trail, without elev., 17 Sep 1970 (fl, fr), T. Croat 12219 (MO); Barro Colorado, without elev., 20 May 1971 (fl), T. Croat 14650 (MO); Barro Colorado, Lake Trail, without elev., 16 Jun 1971 (fl), T. Croat 15005 (MO); Barro Colorado, Barbour Trail, without elev., 25 Jun 1971 (fl), T. Croat 15105 (F, MO), between Fort Sherman and Fort San Lorenzo, without elev., 10 Jul 1971 (fl), T. Croat 15414 (LL-TEX, MO); Cerro Jefe, 2,900 ft [884 m], 21 Jul 1972 (fl), J. Dwyer & A. Gentry 10249 (F, MO); Barro Colorado, Snyder Molino Trail, along edge of trail, 300–600 m, 25 Jun 1960 (fl), J. Ebinger 182 (BRIT, MO); along the border of Canal Zona-Colón Prov., from parallel in NW shore of Canal along road to Achiote, within 2 mi of Achiote, without elev., 23 Jun 1977 (fl), J. Folsom 3880 (LL-TEX, MO); road leading around the shoulder of Cerro Jefe, turns to the right at 21.5 km from the Pan-American Hwy., around the first stream encountered, 800 m, 29 Sep 1977 (fl, fr), J. Folsom et al. 5663 (MO); ca. 1 mi upstream from Frizzel’s Finca Indio, on slope of Cerro Jefe, without elev., 9 Sep 1970 (fl), R. Faster & H. Kennedy 18449 (LL-TEX); Barro Colorado Island, without elev., 9 Oct 1985 (fr), N. Garwood & S. Arne 1595 (F), 1 Dec 1985 (fr), N. Garwood 1687 (F), 28 Sep 1986 (fl, fr), N. Garwood 1943
(F), 18 Nov 1988 (fr), N. Garwood 2658 (F); Pipeline Road, without elev., 30 Sep 1971 (fl), A. Gentry & R. Dressler 1979 (MO), 6 mi N of Gamboa, without elev., 28 Dec 1971 (ster.), A. Gentry 3319 (MO); Cerro Jefe, region roadside along road to Altode Pacora, 2 km N of turnoff to Cerro Jefe radio tower, along small stream, 2,500–2,700 ft [762–823 m], 30 Sep 1978 (fl), B. Hammel 4854 (MO); Fort Sherman, Atlantic coastal forest, without elev., Jul 1965 (fl), M. Hayden 95 (MO); trail along Rio Petitpique from road to Fort Sherman from Gatun Locks, without elev., 22 Oct 1974 (fr), S. Mori & J. Kallunki 2665 (MO), 12 Dec 1974 (fr), S. Mori & J. Kallunki 3661 (MO); ca. 12 km NW of Gamboa, without elev., 26 Aug 1975 (fr), S. Mori 7943 (LL-TEX, MO), 9 km NW of Gamboa, 150 m, 29 Oct 1973 (fr), M. Nee 7657 (LL-TEX, MO), 125 m, 28 Nov 1973 (fl), M. Nee 8435 (LL-TEX 2-sheets, MO); Along road S1, 4 km W of Gatun Dam, 190–200 m, 20 Dec 1973 (fl), M. Nee 8913 (MO 2-sheets); Barro Colorado, near A.V. Armour Trail, 5, on Hubbell Permanent Plot, without elev., 13 Nov 1981 (fl), R. Schmalzel & M. Aide 56 (MO), Sugar Mill, without elev., 20 Dec 1931 (fr), O. Shattuck 611 (F, MO), Standley No. 20, without elev., 31 Jul 1934 (fr), O. Shattuck 1098 (BRIT, F, MO); Gatun Lake, 120 m, 18–24 Nov 1925 (fr), P. Standley 41029 (LL-TEX), Barro Colorado, Zetele Trail, without elev., 6 Jul 1931 (fl), D. Starr 28 (F, MO); Peña Blanca Trail, without elev., Jul 1931 (fl), D. Starr 178 (F); Cerro Jefe, 850–900 m, 29 Oct 1980 (fr), K. Systma 1975 (BRIT, MO); Cerro Jefe, 1.5 mi down right turnoff, 6.7 mi past Goofy Lake, 700 m, 27 Dec 1980 (fl, fr), K. Systma et al. 2900 (MO); Cerro Jefe, 6 mi past Cerro Azul on road to Altos Pacora, 2,600 ft [792 m], 19 Feb 1981 (fr), K. Systma & W. D’Arcy 3690 (LL-TEX, MO); vicinity of Salamanka Hydrographic Station, Río Pequeni, 80 m, 28–29 Jul 1938 (fl), R. Woodson et al. 1569 (F, MO). San Blas: Nusagandi, Campo de PEMASKY, ca. 20 km on El Llano-Carti Road, trails near station, 09° 18’ N, 78° 59’ W, 350 m, 1 May 1992 (fl, fr), R. Foster et al. 917 (MO); 3–4 hours up Río Mulatupo by foot, without elev., 17 Aug 1967 (fr), J. Kirkbride 216 (MO); Udirbi Reserve, waterfall trail along park boundary, 09° 18’ N, 78° 58’ W, 350–400 m, 21 Jul 1986 (fl), J. McDonagh et al. 244 (MO); El Llano-Carti Road, 24.5–25 km from Inter-American Hwy., near continental divide, 13 Apr 1975 (fl), S. Mori & J. Kallunki 5556 (MO), 17.4 km from Inter-American Hwy, 09° 19’ N, 78° 55’ W, 350 m, 27 Sep 1984 (fl, fr), G. de Newers 3943 (BRIT, MO), km 16.7, trail W to waterfall 5 km from road, 09° 19’ N, 78° 55’ W, 350 m, 16 Jun 1985 (fl), G. de Newers & S. Charney 5899 (LL-TEX, MO, US); Cerro Habú, trail from Río Sidro, 09° 23’ N, 78° 49’ W, 800–1,400 ft [244–427 m], 18 Dec 1980 (fr), K. Systma 2650 (MO).

Cuatrocasas misinterpreted *Ardisia romeroi* as a member of subgenus *leucorea*, largely because of the early caducous floral bracts and concolorous, poricidally dehiscent anthers. However, it closely matches the type of *Ardisia bartlettii* subsp. *bartlettii*. *Ardisia lewisii* is notable only for its inflorescence with pedicels in loose (low) anthotactic spirals. *Ardisia tuirana* was separated because of its somewhat less punctate, ovate sepals and sparse, finely stellate tomentum on the lower branches of the inflorescence. It is otherwise not significantly different from the type of the subspecies. Populations corresponding to the type of *Ardisia sapaona* vary from the subspecies type only by having sessile inflorescences with longer secondary inflorescence branch bracts, and longer corolla tubes.

*Ardisia bartlettii* subsp. *bartlettii* may be separated from subspecies *lilacina* by the shorter calyx and corolla, the generally shorter stamens and tapering style base.

Shrubs or small trees (0.5–)2–7 m tall, 1–4 cm in diam. Branchlets slender, 2–3.5 mm in diam., glabrous throughout. Leaves with blades 6–16 cm long, 3.5–7 cm wide; petioles stout, marginate, 0.4–1 cm. Inflorescence 2.5–4 cm long, 3.5–7 cm wide, sessile or nearly so; peduncle obsolete to 0.2 cm; secondary inflorescence bracts 2.8–11.2 mm long, 1.3–3.9 mm wide; pedicles 10–15 mm long, slender, glandular-glandulose. Flowers 8–9.2 mm long; sepals 2–2.5 mm long, 1.5–2 mm wide; corolla 7.5–9.2 mm long, the tube 0.5–1.4 mm long, the lobes ovate to elliptic, 7–8 mm long, 4.5–5 mm wide; stamens 4.5–5.7 mm, the staminal tube 0.5–1.5 mm long, the filaments 0.5–1 mm long, 0.2–0.3 mm wide at base, punctate, glabrous; the anthers 3–3.5 mm long, 0.7–0.9 mm wide at base; ovary glabrous, the style 4.5–5 mm long, slender, stylopodid at base, punctate, glabrous, the ovules 14–16, pluriseriate. Fruit globose, 4–5 mm in diameter, conspicuously punctate, glabrous.

Distribution.—Subspecies lilacina is restricted to the Caribbean coast of Panama (Colon, Panama, San Blas), with one disjunct population in the Chocó, Colombia. We may also expect subsp. lilacina in lowland Antioquia and Valle Departments of Colombia, areas sorely lacking in collections. It grows from sea level–180 m elevation.

Ecology and conservation status.—This subspecies occurs in strand vegetation and beach forests. It is said to be locally uncommon, so it should be considered threatened.

Etymology.—The epithet ‘lilacina’ refers to the striking lilac color of the flowers.

Additional specimens examined. PANAMA. COLON: vicinity of Viento Frio, along the beach, sea level, 07–08 Aug 1911 (fl), H. Pittier 4114 (F); Rio Indio de Fato, sea level, 24 Aug 1911 (fl), H. Pittier 4273 (F, LL-TEX, NY); 3 km SW of Rio Guanche along road from Puerto Pilón to Portobelo, sea level, 20 May 1981 (fl), K. Sytsma & L. Anderson 4791 (LL-TEX, MO). PANAMA: Río Providencia and ridge S of river, 5–170 m, 5 Dec 1973 (fl, fr), A. Gentry & M. Nee 8706 (LL-TEX, MO). SAN BLAS: Rio Cangandi, pueblo Cangandi, path to Quebrada Inadi, 09° 27' N, 79° 07' W, 50 m, 20 May 1987 (fl), H. Herrera & P. Pérez 127 (MO); Vertiente Pacifica de la Cordillera de San Blas, Cabecera del Rio Piriadi, 09° 11' 05" N, 78° 16' W, 100–150 m, 14 Jun 1994 (fl), H. Herrera 1633 (BRIT, F, MO, PMA); Comarca de San Blas, tierra firme de Playón Chico, vicinity of the aqueduct trail, 09° 17' N, 78° 15' W, 30 m, 12 Sep 1994 (fr), H. Herrera 1839 (BRIT, MO, PMA); Playón Chico and vicinity San Blas, Yantuppu, coral island, without elev., 8 Jul 1975 (fl), F. Stier 193 (MO). COLOMBIA. CHOCÓ: Mpio. Acandi, Vereda El Páramo, Quebrada Sardi, 08° 20' N, 77° 06' W, 180 m, 22 May 1989 (fl), R. Fonsega et al. 2792 (HUA, MO), F. Roldán et al. 1190 (HUA, MO).
Ardisia bartlettii subsp. lilacina may easily be separated from subsp. bartlettii by its longer perianth parts, usually longer stamens and unique stylopodic (swollen) style base. While the stylopodic style base is unique within the subgenus, there is no corresponding unique feature for subspecies bartlettii to define it. Therefore, the two taxa are recognized at the subspecific level. In addition, it is restricted to strand and beach forests, while subsp. bartlettii is from tall wet forests.

EXCLUDED NAMES


Now that recent collections have provided us with material both in flower and fruit, it is clear that this species is not a member of subgenus Graphardisia, but rather, subgenus Ardisia. This species has ovate anthers with subapical pores opening into slits, has panicles with racemose branchlets, inflorescence and secondary inflorescence branch bracts that are subcoriaceous to coriaceous and cucullate, and coriaceous sepals that are quincuncial. We postulate that the rather large floral and secondary inflorescence branch bracts of the species may have led to its misplacement.

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NUMERICAL LIST OF TAXA

1. A. weberbaueri Mez 
2. A. opograpba Oerst. 
2a. subsp. opograpba 
2b. subsp. wagneri (Mez) Pipoly & Ricketson 
2c. subsp. paquitensis (Lundell) Pipoly & Ricketson 
3. A. bartlettii Lundell 
3a. subsp. bartlettii 
3b. subsp. liricina (Lundell) Pipoly & Ricketson

LIST OF EXSICCAE

The figures in parentheses refer to the numbers from the numerical list of taxa. Collection numbers in boldface type indicate type specimens. 

Allen, P. 72 (2a); 786 (2a); 865 (3a); 2226 (2a); 2571 (2a); 2577 (2a); 2661 (2a); 3535 (2a); 3561 
(2a); 4404 (2a); 5317 (2c); 5657 (2c). Allen, P. & A. Alston 1846 (2a). Angulo, L. 388 (2a); 487 
(2c). Amorion, T. 1296 (3a); 2573 (2a); 3889 (3a); 4674 (3a); 4961 (2a). Araquistain, M. 3007 (2b); 
3087 (2b); 3130 (2a); 3132 (2b). Araya, F. 147 (2b). Araya, F. et al. 306 (2b). Arwood, J. 3346 (2b). 
Aviles, S. 10 (3a). 
(3a). Beck, C. s.n. (2a). Beck, S. 16323 (1). Bello C. E. 291 (2b); 1032 (2b); 1029 (2b). Bello C. E. 
& E. Rojas 2283 (2c). Blum, K. et al. 2382 (2a). Bencos. A. 4313 (2a); 6349 (2a); 12653 (2b); 19242 
(2b). 
Carballo, G. 151 (2b); 436 (2b). Carvajal, A. 269 (2a). Chacón, J. & A. Chacón 2153 (2b). Chrysler, 
Correa, M. et al. 5139 (2a). Croat, T. 5756 (3a); 6215 (3a); 10845 (3a); 11271 (3a); 12204 (3a); 
12219 (3a); 14690 (3a); 14746 (2a); 15005 (3a); 15105 (3a); 15340 (3a); 15414 (3a); 25189 (2a); 
25995 (2a); 27550 (2a); 34205 (2a); 36349 (2b); 43565 (2b); 46028 (2b); 66873 (2a); 67621 (2c). 
Croat, T. & J. Folsom 33865 (2a); 34267 (2a). Croat, T. & D. Hannon 79101 (2c). Croat, T. & G. 
Zhu 76926 (2a).
Ec обеспечивает эффективное сканирование и поиск текста на странице.
UNA NUEVA ESPECIE DE POLIANTHES (AGAVACEAE) DEL ESTADO DE OAXACA, MÉXICO

ELOY SOLANO CAMACHO

Herbario FEZA, Carrera de Biología, Facultad de Estudios Superiores Zaragoza, U.N.A.M.
A.P. 9-020, Delegación Iztapalapa
09230 México, D.F., MÉXICO

ABISAI GARCÍA-MENDOZA

Jardín Botánico, Instituto de Biología, U.N.A.M.
A.P. 70-614, Delegación Coyoacán
04510 México, D.F., MÉXICO

RESUMEN

Se describe e ilustra Polianthes bicolor, una nueva especie del estado de Oaxaca, México. Esta especie muestra similitudes con Polianthes geminiflora (La Llave et Lex.) Rose var. geminiflora, Polianthes geminiflora (La Llave et Lex.) Rose var. clivicola McVaugh y Polianthes graminifolia Rose.

ABSTRACT

Polianthes bicolor from the state of Oaxaca, México, is described as new and illustrated. This species is similar to Polianthes geminiflora (La Llave et Lex.) Rose var. geminiflora, Polianthes geminiflora (La Llave et Lex.) Rose var. clivicola McVaugh and Polianthes graminifolia Rose.

El género Polianthes es endémico de México y las especies que lo conforman han sido poco estudiadas desde el punto de vista taxonómico. La última revisión fue hecha en 1903 por Rose, quien reconoció 12 especies. Durante mucho tiempo, la delimitación de sus especies y de los géneros cercanamente relacionados ha sido confusa. Actualmente se está realizando la revisión sistemática del género y las observaciones generadas durante el estudio, incluidas las investigaciones anatómicas y la exploración botánica en toda su área de distribución geográfica, revelaron la existencia de una nueva especie que se describe a continuación.

Polianthes bicolor Solano & García-Mend., sp. nov. (Fig. 1). TIPO: MÉXICO.
OAXACA: Municipio de Coixtlahuaca, en la base del Cerro Verde, 4 km al N de Marcos Pérez y 5 km al S de Coixtlahuaca, pastizal, 2500 m, 7 Jul 1986, A. García-Mendoza et al. 2403 (HOLOTIPO: MEXU; ISOTIPOS: BRIT, FEZA, MEXU).

Hierba perenne; lamina semisucculenta, plerunque ondulata; bracteolae florum basaliai saepe in pedicello insertae; tubus floralis supra basim abrupte dilatatus; flores aurantiacovirides, lobis viridibus; filamenta in perianthii tubo 1.1–1.8 cm supra apicem ovarii inserta.

Hierba perenne con un bulbo de (2–)3–4(–5) cm de largo, (1–)1.5–2.5 cm de diámetro; (3–)4–6(–12) hojas basales de (5–)8–15 cm de largo, 0.6–1(–1.4) cm de ancho, lanceoladas, lámina semi-succulenta, generalmente ondulada; margen usualmente ondulado, papiloso, hialino; superficie lisa a papilosa. Brácteas de la base de la inflorescencia 3–5(–7.5) cm de largo y 0.2–0.5 cm de ancho, lanceoladas; inflorescencia de 24–40(–54) cm de longitud, con 3–5(–9) nudos fértiles; flores geminadas, las inferiores a veces fusionadas. Brácteas y bractéolas lanceoladas que disminuyen en tamaño desde la base de la inflorescencia hacia el ápice, bractéolas de las flores basales frecuentemente insertas sobre el pedicelo; pedicelos de 0.6–1.3 cm de largo, rojizos. Flores de (2–)2.3–2.9 cm de largo, (1.6–)2.4–3(–5.5) mm de ancho en la base de los lóbulos de la corola, tubo del perianto abruptamente ensanchado por arriba de la base; lóbulos externos de 2–3(–4) mm de largo, (1.7–)2–3(–4) mm y en ocasiones de hasta 5 mm de ancho, de orbiculares a transversalmente elípticos, apiculados, los internos con los ápices redondeados y pilosos; color de las flores anaranjado-verdoso, con los lóbulos verdes; estambres inclusos, filamentos de 1.8–2.5(–2.8) cm de largo, insertos en el tubo del perianto, 1.1–1.8(–1.9) cm por arriba del ápice del ovario, filiformes, de color verde; anteras de 4–5(–9) mm de largo, 1–1.5(–2.5) mm de ancho, oblongas, amarillo-verdosas; estilo de (1–)1.9–2.6(–3.2) cm de largo; estigma trilobado. Fruto semiesférico de 1.1 cm de largo por 1.1 cm de diámetro. Semillas de 4.5 mm de largo por 2.4 mm de ancho, de color negro, semicirculares vistas en perfil, con uno de los lados recto.

Paratipos: MÉXICO. Oaxaca: Municipio Teposcolula, 3 km al N de Yucunama, 24 Jul 1982, A. García-Mendoza. 1052 (ENCB); Municipio Coixtlahuaca, Cerro Verde, S of Coixtlahuaca, 7 Jul 1986, D. Frame et al. 317 (NY); Municipio de San Juan Mixtepec, Cañada Cerro de Metates, 20 km al NW de San Juan Mixtepec, 8 Jul 1988, J. Reyes 300 (MEXU); Municipio de San Juan Mixtepec, Yucu Shuun (Monte del Tesoro), 16 km al S de San Juan Mixtepec, 6 Oct 1988, J. Reyes 881 (MEXU); Municipio de Teposcolula, aproximadamente 5 km al NE de Marcos Pérez, 5 km al NE de Tierra Blanca, 3 km al NE de Yodobada, a un costado del camino de terracería que va de Tierra Blanca a Marcos Pérez, 26 Jul 1996, E. Solano & Mu. del C. López 857 (FEZA, MEXU); Municipio de Coixtlahuaca, Cerro Verde al NE de Marcos Pérez, 7 Jul 1986, P. Tenorio et al. 11656 (MEXU).

Polianthes bicolor se caracteriza por sus hojas semisucculentas, generalmente con la lámina y el margen ondulados, flores con el tubo del perianto abruptamente ensanchado por arriba de la base, con lóbulos verdes y estambres insertos sobre el tubo del perianto. Además, los estudios anatómicos, muestran la ausencia de taninos en las células del mesofilo y de fibras en la vaina de los haces vasculares de las hojas. Florece en los meses de julio a agosto; sus flores no son fragantes, igual que en los otros taxa con los que aquí se compara.
Solano y García-Mendoza, Una nueva especie de Polianthes

FIG. 1. Polianthes bicolor. a) Planta con inflorescencia, b) Bulbo y cormo con raíces contráctiles, c) Bractéolas insertas en los pedicelos, d) Flor completa, e) Flor disecada, f) Fruto, g) Semilla. Ilustración: a, c, d, e, de A. García-M. 2403; b, f, g, de E. Solano C. & Ma. del C. López B. 857.
Morfológicamente se relaciona con *P. geminiflora* (La Llave et Lex.) Rose var. *geminiflora*, *P. geminiflora* (La Llave et Lex.) Rose var. *clivicola* McVaugh y *P. graminifolia* Rose, de las que se distingue claramente por las características mostradas en la tabla 1.

*Polianthes bicolor* se desarrolla entre los 2300–2500 m, en pastizales, bosques de *Quercus* y *Pinus-Quercus* con *Agave, Anthericum, Opuntia, Salvia* y *Sedum*, en suelos erosionados de color pardo a negro con textura arenosa y material parental calizo.

La especie aquí descrita se localiza en la Mixteca Alta del estado de Oaxaca, en la provincia fisiográfica conocida como sistema montañoso del norte de Oaxaca, en los distritos de Coixtlahuaca, Teposcolula y Juxtlahuaca. Probablemente las plantas señaladas por Howard (1986) para Huajuapan de León, correspondan a esta nueva especie; el mismo autor se refiere a las poblaciones en cuestión como raras y poco similares a *Polianthes geminiflora*, ya que tienen flores de color escarlata, con lóbulos de la corola e interior del tubo verdes.

<table>
<thead>
<tr>
<th>Carácter</th>
<th><em>Polianthes bicolor</em> var. <em>geminiflora</em></th>
<th><em>P. geminiflora</em> var. <em>clivicola</em></th>
<th><em>P. geminiflora</em></th>
<th><em>P. graminifolia</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lámina foliar</td>
<td>Ondulada, rara vez plana, semisuculenta</td>
<td>Plana, rara vez ondulada, no suculenta</td>
<td>Plana, suculenta</td>
<td>Involuta, no suculenta</td>
</tr>
<tr>
<td>Tubo del perianto</td>
<td>Abruptamente ensanchado por arriba de la base</td>
<td>Tubular</td>
<td>Tubular</td>
<td>Tubular</td>
</tr>
<tr>
<td>Color del tubo</td>
<td>Anaranjado-verdoso</td>
<td>Anaranjado, coral o rojo</td>
<td>Anaranjado, rojo o coral</td>
<td>Coral, casi rosa o rojo</td>
</tr>
<tr>
<td>Color de los lóbulos</td>
<td>Verde</td>
<td>Anaranjado, a veces verde</td>
<td>Anaranjado</td>
<td>Casi rosa</td>
</tr>
<tr>
<td>Inserción de los filamentos</td>
<td>11–18 mm por arriba del ovario</td>
<td>1.7–5 mm por arriba del ovario</td>
<td>2–3 mm por arriba del ovario</td>
<td>3.5–8 mm por arriba del ovario</td>
</tr>
<tr>
<td>Tанинs en las células del mesofilo</td>
<td>Ausentes</td>
<td>Presentes</td>
<td>Presentes</td>
<td>Presentes</td>
</tr>
<tr>
<td>Fibras en la vaina del haz vascular</td>
<td>Ausentes</td>
<td>Presentes</td>
<td>Presentes</td>
<td>Presentes</td>
</tr>
</tbody>
</table>
Polianthes bicolor es la especie con distribución más sureña del género, sólo conocida del estado de Oaxaca. En cuanto a los otros taxa, *P. geminiflora* (La Llave et Lex.) Rose var. *geminiflora* se distribuye del estado de Nayarit a Tlaxcala y probablemente hasta el estado de Puebla, *Polianthes geminiflora* (La Llave et Lex.) Rose var. *clivicola* McVaugh es endémica de Jalisco y Michoacán, mientras que *Polianthes graminifolia* Rose solamente se ha registrado de Aguascalientes y Jalisco.

El epíteto específico hace referencia a la coloración que presentan las flores.

AGRADECIMIENTOS

Este trabajo fue realizado con apoyo financiero de la CONABIO, a través del proyecto FB291/H230/96. Asimismo, E. Solano agradece al CONACYT la beca otorgada. Por otro lado, hacemos patente nuestro agradecimiento a J. Rzedowski, T. Wendt, P. Dávila y F. Chiang, por la revisión cuidadosa del manuscrito. F. Chiang preparó la traducción al latín de la diagnosis y T. Terrazas, asesoró los estudios anatómicos. Nuestro reconocimiento a C. Correa por su invaluable ayuda y compañía en la recolecta de especímenes por toda el área de distribución del género. A Elvia Esparza por la ilustración realizada y a los siguientes herbarios por el préstamo de ejemplares: ENCB, FEZA, MEXU y NY.

REFERENCIAS

BOOK REVIEW


This volume, is the third and last of a series of volumes providing practical, user-friendly keys, diagnostic characters, literature references and detailed ecological notes, supplemented by 771 distribution maps, 267 line drawings, 53 color photographs and keys to all the vascular plant families occurring within the 86 counties comprising Michigan. My personal experience with Part I. Gymnosperms and Monocots, as an undergraduate student at Michigan State, combined with my knowledge of Ed’s passion for detail and accuracy, tell me that this volume is an excellent reference as were the previous two. The only item I consider missing from this fine book is that of a summary table, where total number of habitats, number of families, genera, species, and perhaps endangered, threatened or rare species, was included. While one can caution against such lists that often become restrictive and authoritarian, they are nonetheless, extremely useful to conservationists, land use planners and resource managers, particularly those operating at the Great Lakes Regional level. However, that is an insignificant blemish on an otherwise perfect publication. At the incredibly low price of $15.00, this hard bound book on high quality paper is a must for every botanist’s bookshelf.—John F. Pipoly III
POLLEN MORPHOLOGY OF THE GENUS
ECHINOPEPON (CUCURBITACEAE)

CONCEPCIÓN RODRÍGUEZ J. AND
RODOLFO PALACIOS-CHÁVEZ

Departamento de Botánica
Escuela Nacional de Ciencias Biológicas, I.P.N.
Apdo. Postal 17-564
MÉXICO, D.F. CP 11340

ABSTRACT

Pollen descriptions of Echinopepon species and a palynological key are presented. Data on apertures, exine, polarity, shape, and size of pollen grains are included. Pollen morphology is distinctive for the species of Echinopepon and Echinocystis and in some Marah species. The main features of each taxon are illustrated by photographs.

RESUMEN

Se presenta la descripción del polen de las especies de Echinopepon. Se incluyen datos de la apertura, exina, polaridad, forma y tamaño de los granos, así como una clave palinológica para su identificación. La morfología polínica es característica en Echinopepon y distintiva de Echinocystis y de algunas especies de Marah. Se ilustra con fotografías las características principales de cada taxon.

Echinopepon is an American genus, whose distribution extends from southeastern United States to Argentina. It has seven species (Rodríguez, in press): E. cirrhopedunculatus Rose, E. coulteri (A. Gray) Rose, E. gemellus (Ser.) Rodríguez, E. minimus (Kellogg) S. Watson, E. pubescens (Benth.) Rose, E. racemosus (Steud.) C. Jeffrey, and E. wrightii (A. Gray) S. Watson (Table 1); the first four are endemic to Mexico. All species are herbaceous, generally with an annual life cycle; have characteristic capsular, echinate, rostrate, and operculate fruit; and white or white-green pentamerous flowers, five stamens with filaments joined and anthers forming heads.

Jeffrey (1978) placed Echinopepon in the tribe Cyclantheae. He later (Jeffrey 1990) placed it in tribe Sicyeae subtribe Cyclantherinae, showing its close relationship to the genera Marah and Echinocystis as demonstrated by the large number of morphologic characteristics which it shares with these genera. They are distinguished from Echinopepon by two or three stamens and globose fruits with apical and irregular dehiscence. Marah is distinguished also by its perennial habit and swollen seeds.

Palynologically the tribe Cyclantheae (Jeffrey 1964) is characterized
by 4–8-colporate and punctitegillate pollen grains (Jeffrey 1964), the same as the subtribe Cyclantherinae (Jeffrey 1990). This tribe was also described by Marticorena (1963) as having 4 to polycolporate pollen grains except, *Echinopepon wrightii* (A. Gray) S. Watson (as *Echinocystis wrightii* A. Gray) which has only polycolporate pollen grains. In a palynological classification of Cucurbitaceae from India (Shridar & Sing 1990), subtribe Cyclantherinae was described as having multizonocolporate pollen grains.

The pollen morphology of *Echinopepon* species has been little studied. Dieterele (1974) found similarities between *Apatzingania arachoidea* Diet., pollen grains (asymetrical polycolpate, spinulose and exquisitely fo-volate-reticulate) and those of *Echinopepon cirrhopedunculatus* and *E. ge*

### Table 1. The species of *Echinopepon.*

<table>
<thead>
<tr>
<th>Accepted name</th>
<th>Synonyms</th>
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<tbody>
<tr>
<td>E. cirrhopedunculatus Rose</td>
<td><em>Echinocystis coulteri</em> (A. Gray) Cogn., 1877;</td>
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<tr>
<td>E. coulteri (A. Gray) Rose</td>
<td><em>Echinopepon coulteri</em> Rose, 1897;</td>
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<td><em>Echinopepon pavifolius</em> Rose, 1897.</td>
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<td>E. gemellus (Ser.) C. Rodriguez</td>
<td><em>Echinopepon milleflorus</em> Naudin, 1866;</td>
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<td><em>Echinopepon quinquelobatus</em> Naudin, 1866;</td>
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<td></td>
<td><em>Echinocystis gemellus</em> (Ser.) Cogn., 1877;</td>
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<td><em>Echinocystis milleflora</em> (Naudin) Cogn., 1877;</td>
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<td><em>Echinocystis torquata</em> (Ser.) Cogn., 1877;</td>
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<td></td>
<td><em>Echinocystis torquata</em> var. brevipes* Cogn., 1881;</td>
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<td><em>Echinopepon torquatus</em> (Ser.) Rose, 1897.</td>
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<td>E. minimus (Kellogg) S. Watson</td>
<td><em>Echinocystis minima</em> (S. Watson) Cogn., 1881;</td>
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<td></td>
<td><em>Echinopepon peninsularis</em> H.S. Gentry, 1949;</td>
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<tr>
<td></td>
<td><em>Echinopepon minimus</em> (Kell.) S. Watson var. <em>peninsularis</em> (H.S. Gentry)</td>
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<td>E. pubescens (Benth.) Rose</td>
<td><em>Echinocystis floribunda</em> Cogn., 1877;</td>
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<td><em>Echinocystis pubescens</em> (Benth.) Cogn., 1877;</td>
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<td></td>
<td><em>Echinopepon floribunda</em> (Cogn.) Rose, 1897.</td>
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<tr>
<td>E. racemosus (Steu.) C. Jeffrey</td>
<td><em>Echinopepon borridus</em> Naudin, 1866;</td>
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<td><em>Echinocystis lanata</em> Cogn., 1877;</td>
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<td><em>Echinocystis polycarpa</em> Cogn., 1877;</td>
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<td><em>Echinocystis minicosta</em> Cogn., 1878;</td>
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<td><em>Echinocystis araneosa</em> Griseb., 1879;</td>
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<td><em>Echinocystis macrocarpa</em> Britton, 1890;</td>
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<td></td>
<td><em>Echinopepon jaliscanus</em> Rose, 1897;</td>
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<td></td>
<td><em>Echinopepon lanatus</em> (Cogn.) Rose, 1897;</td>
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<td><em>Echinopepon pringlei</em> Rose, 1897;</td>
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<td></td>
<td><em>Echinopepon racemosus</em> (Steu.) Martinez, Cov., 1955.</td>
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<tr>
<td>E. wrightii (A. Gray) S. Watson</td>
<td><em>Echinocystis glutinosa</em> Cogn., 1877;</td>
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<td><em>Echinocystis longispina</em> Cogn., 1877;</td>
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<td><em>Echinocystis paniculata</em> Cogn., 1877;</td>
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<td><em>Echinocystis wrightii</em> (A. Gray) Cogn., 1877;</td>
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<td><em>Echinopepon longispina</em> (Cogn.) Rose, 1897;</td>
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<td></td>
<td><em>Echinopepon nelsoni</em> Rose, 1897;</td>
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<tr>
<td></td>
<td><em>Echinopepon paniculatus</em> (Cogn.) J.V. Dieterele, 1976.</td>
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mellus (as *Echinocystis gemella*). Dieterle (1976) also found that different types of apertures in pollen grains seemed to be associated with thecae form, replicate thecae occurring with non-colpate grains and U-shaped thecae occurring with multicolpate grains. Stafford and Sutton (1992, 1994) indicated that certain species of *Echinopepon* had pantozonocolporate pollen grains, corroborating Dieterle’s idea about palynological similarities between the genera *Apatzingania* and *Echinopepon*, however, there are enough macromorphological differences to distinguish *Apatzingania* from *Echinopepon*. Palacios-Chavez et al. (1995) described *Echinopepon coulteri* pollen the valley of Mexico as 7-colpate, perreticulate and suboblate grains and *E. gemellus* pollen (as *Echinopepon milleflorus*) as 14-colpate, punctitegillate and suboblate.

**MATERIALS AND METHODS**

Pollen samples of the seven taxa of *Echinopepon* and the relatives *Echinocystis* and *Marah* were taken from herbarium specimens at: Escuela Nacional de Ciencias Biológicas, IPN, México (ENCB); Herbario Nacional de México, UNAM, México (MEXU); Instituto de Ecología, Bajío, México (IEB) and Field Museum (F). The samples were prepared using the standard acetolysis method of Erdtman (1943) and mounted in glycerine jelly. The samples were examined by the light microscope. The slides are deposited in the pollen collections of the Palynology Laboratory, Department of Botany, ENCB, Mexico.

**RESULTS**

Palynological key to the species *Echinopepon*

1. Grains stephanocolpate, 7–16-colpate or 7–17-colporoidate, reticulate or punctitegillate.
2. Grains 7-colpate or colporoidate.
   3. Grains 7-colpate, reticulate .................................................... *E. coulteri* (Figs. 6–11)
   3. Grains 7-colporoidate, punctitegillate ............................ *E. pubescens* (Figs. 22–27)
2. Grains 14–16-colpate or 9–10-colporoidate.
   4. Grains 9–10-colporoidate .............................................................. *E. minimus* (Figs. 16–21)
   5. Grains 14-colpate, punctitegillate ............................ *E. gemellus* (Figs 12–15)
   5. Grains 16-colpate, reticulate .............................. *E. cirrhopedunculatus* (Figs. 1–5)
1. Grains 10–12-perirrugate or 7–8-pericolpate, punctitegillate-echinulate or perreticulate.
6. Grains perirrugate, 10–12 rugas, echinulate .......................... *E. racemosus* (Figs. 28–34)
6. Grains pericolpate, perreticulate ........................................ *E. wrightii* (Figs. 35–41)

**Descriptions of pollen grains**

*Echinopepon cirrhopedunculatus* Rose (Figs. 1–5), MEXICO. MORELOS: Zacatepec, *C. Rodríguez et al. 1856* (ENCB).
Grains usually stephanocolpate, 16-colpate (sometimes with 15 or 17 colpi), semitectate, spheroidal, (88–)72–104 × 77–104(–82) μm P/E 1.07. Polar view circular, (103–)92–114 μm in diameter. Exine 5.6 μm, thick, sexine 4 μm and nexeine 1.6 μm, thick reticulate, with colpus thin; membrane smooth.

**Echinopepon coulteri** (A. Gray) Rose (Figs. 6–11). MEXICO. HIDALGO: Cerro Gordo, 5 km W of Pachuca, *J. Rzedowski* 33524 (ENCB).

Grains usually stephanocolpate, 7-colpate, sometimes 8-colpate, semitectate, suboblate, (104–)83–117 × 87–142(–126) μm. P/E 0.82. Polar view circular (118–)77–154 μm in diameter. Exine 4 μm, thick sexine 3.2 μm and nexeine 0.8 μm, thick, reticulate superficially, colpus shallow, membrane smooth.

**Echinopepon gemellus** (Ser.) C. Rodríguez (Figs. 12–15). MEXICO, VERACRUZ: Camino a Tatitla, Las Vigas, *E. Ventura* 77716 (ENCB).

Grains stephanocolporoidate, 14-colporoidate, sometimes 9-colporoidate, tectate, suboblate, (76–)66–97 × 66–106(–90) μm. P/E 0.84. Polar view circular (88–)70–112 μm in diameter. Exine 5 μm, thick, sexine 3.2 μm and nexeine 1.8 μm, thick, punctitegillate superficially, thin; membrane smooth. Pores diffuse.

**Echinopepon minimus** (Kellogg) S. Watson (Figs. 16–21). MEXICO, BAJA CALIFORNIA: Sierra de Plateros, Mulege, *D. Breedlove* 60907 (ENCB).

Grains usually stephanocolporoidate, 10-colporoidate, sometimes 9-colporoidate, semitectate, spheroidal, (71–)60–85.6 × 74–84(–80) μm. P/E 0.95. Polar view circular, (85–)80–96 μm in diameter. Exine 5 μm, thick, sexine 3.2 μm and nexeine 1.8 μm, thick, reticulate superficially, thin; membrane smooth. Pores diffuse.

**Echinopepon pubescens** (Benth.) Rose (Figs. 22–27). MEXICO, OAXACA: Chilapa, Tamazulapa, *J. Rzedowski* 34498 (ENCB).

Grains stephanocolporoidate, 7-colporoidate some times 6-colporoidate, tectate, spheroidal, (94–)81–110 × 81–103(–94) μm. P/E 1.0. Polar view circular (102–)91–112 μm in diameter. Exine 4 μm, thick, sexine as thick as sexine, punctitegillate superficially, thin; membrane, bordered with margin 2–3 μm wide.

**Echinopepon racemosus** (Steud.) C. Jeffrey (Figs. 28–34). MEXICO, OAXACA: Ojilán, Buena Vista, *E. Ventura* 15539 (ENCB).

Grains perirrugate, tectate, apolar, spheroidal, (94–)81–110 × 91–112(–102) μm in diameter. Exine 5.6 μm, thick, sexine as thick as nexeine, echinulate superficially. Rugas 10 or 12 of 16 μm long, situated superficially, with verrucate membranes. Some grains have a triradiate colpus.

**Echinopepon wrightii** (A. Gray) S. Watson (Figs. 35–41). MEXICO, MICHOACAN: 3 km NW of Eréndira Caracuaro, *J. Rzedowski* 33510 (ENCB).

Grains stephanocolpate, usually 7-colpate, sometimes 8-colpate, semitectate,
Figs. 1–11.—Echinopepon cirrhopedunculatus. Fig. 1. Equatorial view; Fig. 2. Polar view; Fig. 3. Optical section exine (× 1000); Fig. 4. Equatorial view (× 800); Fig. 5. Polar view (× 800). Echinopepon coulteri. Fig. 6. Transversal section exine; Fig. 7. Polar view surface × 800); Fig. 8. Polar view optical section (× 800); Fig. 9. Equatorial view surface (× 800); Fig. 10. Reticulate surface; Fig. 11. Optical section (× 1000).
Figs. 12–22.—*Echinopepon gemellus*. Fig. 12. Equatorial view (x 800); Fig. 13. Polar view (x 800); Fig. 14. Polar view, punctitegillate surface; Fig. 15. Optical section (x 1000). *Echinopepon minimus*. Fig. 16. Equatorial view (x 800); Fig. 17. Equatorial view, reticulate surface; Fig. 18. Optical section (x 1000); Fig. 19. Polar view (x 800); Fig. 20. Echinulate apicalpium; Fig. 21. Optical section (x 1000). Fig. 22. *E. pubescens*. Equatorial view (x 800)
Figs. 23–31.— *Echinopepon pubescens*. Fig. 23. Punctitegillate surface; Fig. 24. Polar view (× 1000); Fig. 25. Polar view, optical section (× 800); Fig. 26. Colpi and punctitegillate surface; Fig. 27. Exine thick. Figs. 28–31. *Echinopepon racemosus*. (× 800). Fig. 28. Perirrugate; Fig. 29. Ruga aequatorialis; Fig. 30. Ruga and echinulate surface; Fig. 31. Echinulate surface.
spheroidal, (81–)71–90 × 86–94(–89) μm. P/E 0.94. Polar view circular, (94–)80–108 μm in diameter. Exine 5 μm, thick, sexine and nexine with the same thickness, perreticate superficially, 7 colpi in equatorial position but 8-colpate where one colpus is over a pole.


Grains stephanocolporate, usually 5-colporate, often 6-colporate, tectate, suboblate, (60–)53–68 × 64–77(–70) μm. P/E 0.85. Polar view pentagonal or circular of (69–)64–72 μm in diameter. Exine 4.8 μm, thick, sexine and nexine the same thickness, punctitegillate. Colpi with scabrate membranes, margocolpate. Pores lalongate, (17–)12–20 μm × (7.6–)4–9 μm, with granulate opercula.

**Marah gilensis** (Greene) Greene (Figs. 50–53). U.S.A. ARIZONA: 1968, P. Stewart s.n. (MEXU).

Grains stephanocolporate, usually 4-colporate, often 5-colporate, semitectate, spheroidal, (60–)56–63 × 47–60(–56) μm. P/E 1.07. Polar view quadrangular, (56–)53–63 μm in diameter. Exine 4 μm, thick, sexine thicker than nexine, reticulate (clava forming a reticulum). Colpi with smooth membranes, acute ends, with broad margin 3 μm wide. Transversal colpi (18–)14–21 × 3–5(–4) μm, with scabrate opercula.

**Marah macrocarpa** (Greene) Greene (Figs. 54–57). MÉXICO. BAJA CALIFORNIA: R. Moran 29109 (ENCB).

Grains stephanocolporate, 4-colporate, semitectate, subprolate, (69–)65–76 × 50–62(–57) μm. P/E 1.2. Polar view circular (64–)50–73 μm in diameter. Exine 3 μm, thick, sexine and nexine the same thickness retipilate. Colpi with acute ends, with broad margin 3 μm wide, syncolpate at a pole, membranes smooth. Circular pores (7–)5–10 μm in diameter.

**DISCUSSION**

Pollen morphology is characteristic for *Echinopepon* and *Echinocystis* and for some species of *Marah*.

Pollen from *Echinopepon* species was found to be variable between species, especially in the number of openings and in their ornamentation. The highest number of colpi was sixteen (Table 2) and contrasts with Jeffrey’s data (4–8-colporate) for tribe Cyclanthereae (1964) and subtribe Cyclantherinae (Jeffrey 1990).

The pollen ornamentation was found to be reticulate (R), echinate (E), perreticate (PR) and punctitegillate (PT) in different species (Table 2). The punctitegillate type was reported by Jeffrey (1964,1990) and Stafford and Sutton (1994) for *Echinopepon coulteri*, *E. racemosus* and *Echinocystis lobata*. 
Figs. 32–41.—Echinopepon racemosus. Fig. 32. Echinulate surface; Figs. 33, 34. Triradiate colpi (x 1000). Echinopepon wrightii. Fig. 35. Equatorial view (x 800); Fig. 36. Polar view (x 800). 37. Perreticulate surface; Fig. 38. Equatorial view; Fig. 39. Polar view, optical section (x 800); Fig. 40. Colpus over a pole; Fig. 41. Perreticulate surface (x 1000).
Figs. 42-49. *Echinocystis lobata*. Fig. 42. Equatorial view, punctitegillate surface; Fig. 43. Optical section; Fig. 44. Polar view (x 1000); Figs. 45-49. Optical section (x 800).
Figs. 50–57.—Marah gilensis. Fig. 50. Equatorial view; Fig. 51. Optical section; Fig. 52. Polar view surface; Fig. 53. Optical section (× 1000); M. macrocarpa. Fig. 54. Equatorial view surface (× 1000); Fig. 55. Syncolpate grain; Fig. 56. Polar view syncolpate (× 800); Fig. 57. Optical section (× 1000).
Table 2. Palynological characteristics Echinopepon species.

<table>
<thead>
<tr>
<th>Species</th>
<th>P (µm) X</th>
<th>E (µm) X</th>
<th>P/E</th>
<th>Ornamentation</th>
<th>No. Colpi</th>
<th>Exine</th>
<th>Thecae Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. cirrhopedunculatus</td>
<td>88</td>
<td>82</td>
<td>1.07</td>
<td>R</td>
<td>16</td>
<td>5.6</td>
<td>U</td>
</tr>
<tr>
<td>E. coulteri</td>
<td>104</td>
<td>126</td>
<td>0.82</td>
<td>R</td>
<td>7</td>
<td>4.0</td>
<td>U</td>
</tr>
<tr>
<td>E. gemellus</td>
<td>76</td>
<td>90</td>
<td>0.84</td>
<td>PT</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. minimus</td>
<td>71</td>
<td>80</td>
<td>0.95</td>
<td>R</td>
<td>10 por.</td>
<td>5.0</td>
<td>U</td>
</tr>
<tr>
<td>E. pubescens</td>
<td>94</td>
<td>94</td>
<td>1.00</td>
<td>PT</td>
<td>7 por.</td>
<td>4.0</td>
<td>U</td>
</tr>
<tr>
<td>E. racemosus</td>
<td>94</td>
<td>102</td>
<td>0.93</td>
<td>E</td>
<td></td>
<td>5.6</td>
<td>Replicate</td>
</tr>
<tr>
<td>E. wrightii</td>
<td>81</td>
<td>89</td>
<td>0.94</td>
<td>PR</td>
<td>7</td>
<td>5.0</td>
<td>Straight or Arched</td>
</tr>
</tbody>
</table>

P: Polar Axis E: Equatorial Axis P/E: Relation between polar axis and equatorial axis.

Echinopepon cirrhopedunculatus, E. coulteri, E. gemellus and E. minimus have U-shaped thecae and colporate or colporoidate pollen grains, while E. racemosus has replicate thecae and its pollen grains lack longitudinal colpi. E. pubescens has replicate thecae and colporoidate pollen grains, while the thecae of E. wrightii are straight or arched with a 7–8 colpate pollen. The results presented in Table 2 agree with those reported by Dieterle (1976) for E. gemellus (as E. torquatus), E. racemosus (as E. horridus) and E. wrightii (as E. paniculatum).

The tectate pollen grains and the absence of longitudinal colpi observed in E. racemosus may suggest that it is the most advanced species of the genus. This taxon is quite variable regarding the shape of its leaves, number of tendrils and branches, degree of pubescence and wide geographical distribution from Mexico to Argentina. On the other hand, E. cirrhopedunculatus, E. gemellus and E. minimus may be considered less advanced because their pollen grains are semitectate and 10–17 colpate-colporoidate; they are reported as endemic to Mexico (Rodríguez 1995). Although E. pubescens is also considered endemic to México, it has 6–7-colporoidate pollen grains.

In conclusion, the pollen of Echinopepon, Echinocystis and Marah is often distinctive, which in some cases helps in taxonomic determination. Echinopepon pollen characters have diagnostic value in identification of the seven accepted species.

REFERENCES


Rodríguez and Palacios-Chávez, Pollen morphology of Echinopepon


_____ Taxonomía del género Echinopepon (In press).


BOOK REVIEW


This book contains practical keys, shortcut identification tables, and descriptions for 299 common agricultural weeds in the area bounded by southeastern Canada, Virginia, and Wisconsin. For each species, the description consists of common name, scientific name, important common name synonyms or taxonomic synonyms, a general description, propagation/phenology, seedling description, mature plant description (very brief), roots and underground structures, flowers and fruit (when applicable), post senescence characteristics, habitat, distribution and similar species. On the facing page for each of these descriptions are lovely color photographs of the habit, a line drawing of a drawing and/or photo of the inflorescence or flower (or other reproductive structure for non-angiospermous plants), stem or trunk, and seeds. There are also several comparison tables in the back of the book with salient features of closely related or similar-looking species, and a fold-out grass identification table. A vegetative key runs from page 9 to page 17, and while not dichotomous, seems fairly easy to use.

While not exhaustive, and missing one of my favorite roadside weeds, Antennaria (Asteraceae), it is a wonderful pocket guide for the amateur nature enthusiast, gardeners, farmers, and others interested in weeds. I also thought it strange Andrew F. Senesac is an author on the inside back cover, but not on the front cover, nor on the title page. The high quality of the photos and illustrations, up-to-date nomenclature, glossary, index and other features make this book attractive, user-friendly and worth buying. I certainly recommend it to anyone as a supplemental book, especially for use in poison control centers and other places where people bring in weeds that either their children or pets have eaten.—John J. Pipoly III
VARIATION IN THE BERLANDIERA PUMILA
(ASTERACEAE) COMPLEX

G.L. NESOM
BONAP-NCBG
Coker Hall CB 3280
University of North Carolina
Chapel Hill, NC 27599-3280, U.S.A

B.L. TURNER
Department of Botany
University of Texas
Austin, TX 78713, U.S.A.

ABSTRACT

Plants from southeast Texas and adjacent Louisiana previously identified in part as Berlandiera xbetonicifolia are regarded here as geographical variants of B. pumila and are treated as B. pumila var. scabrella Nesom & Turner, var. nov. Variety pumila and var. scabrella differ in features of cauline and foliar vestiture, that of the upper leaf surfaces allowing the most consistent separation. The type collection of B. betonicifolia (Hook.) Small (Silphium betonicifolium Hook., 1835) represents a species distinct from B. pumila and comprises plants previously identified by the name B. texana DC. (1836), which is displaced by the former. While the morphology of B. pumila var. scabrella has suggested that it originated as a hybrid between typical B. pumila and B. betonicifolia, there is no evidence of current hybridization between these two species.

KEY WORDS: Berlandiera, B. pumila, B. betonicifolia, Asteraceae

RESUMEN

Plantas del sudeste de Texas y la parte adyacente de Louisiana identificadas previamente en parte como Berlandiera xbetonicifolia son consideradas aquí como variantes geográficas de B. pumila y son tratadas como B. pumila var. scabrella Nesom & Turner, var. nov. La variedad pumila y var. scabrella difieren en características del indumento caulinar y foliar, siendo la del haz la que permite una mejor separación. El tipo de B. betonicifolia (Hook.) Small (Silphium betonicifolium Hook., 1835) representa una especie distinta de B. pumila y comprende plantas previamente identificadas como B. texana DC. (1836), que es desplazada por la anterior. Mientras que la morfología de B. pumila var. scabrella ha sugerido que se formó como un híbrido B. pumila típica y B. betonicifolia, no hay evidencia de hibridación actual entre estas dos especies.

Shinners (1951) followed Small (1903, 1933) in treating Berlandiera pumila (Michx.) Nutt. as a species restricted to the southeastern United States east
of the state of Mississippi; its vicariad west of the Mississippi River was identified as *B. dealbata* (Torr. & A. Gray) Small. Turner and Johnston (1956) returned to the concept of Torrey and Gray by including the western plants within a more broadly defined *B. pumila*, acknowledging the existence of a distributional hiatus between the two geographic segments of the species. The western segment of *B. pumila* occurs primarily in east Texas and adjacent Louisiana (Fig. 1), barely reaching into the adjacent corners of southeastern Oklahoma and southwestern Arkansas.

Shinners (1951) accepted the existence of *Berlandiera betonicifolia* (Hook.) Small as a distinct species similar to western *B. pumila* (*B. dealbata* in his sense) in morphology and geography. Turner and Johnston (1956) viewed *B. betonicifolia* as intergrading with both *B. pumila* and *B. texana* DC. and adopted the earlier combination *B. texana* var. *betonicifolia* (Hook.) Torr. & A. Gray. This group of entities/taxa is referred to in the present study as

![Fig. 1. Distribution by county of *Berlandiera pumila* in Texas, Louisiana, Arkansas, and Oklahoma.](image-url)
the “B. pumila complex.”

In a biosystematic study of the whole genus, Pinkava (1967) found that crosses between all combinations of species of *Berlandiera* were easily made under greenhouse conditions and he provided evidence of natural hybridization between many of the taxa. All entities of the genus are reported to have an apparently invariant chromosome number of n=15 (see Pinkava 1970 for original counts and summary of previous literature). Based on the morphology of artificially constructed hybrids, Pinkava observed that “although the [GH] type of *B. betonicifolia* lies between the F₁ [of *B. pumila* and *B. texana*] and *B. texana*, it is definitely an intermediate of the two species and its name has been retained for the hybrid group” (p. 292). Pinkava used the designation “*B. × betonicifolia*” and has been followed in this by recent treatments that have adopted his view.

Pinkava interpreted the *Berlandiera pumila* complex in east Texas (his Fig. 4, p. 294) essentially as an intergrading nexus between *B. pumila*, *B. betonicifolia*, and *B. texana*. In *B. betonicifolia*, “most characters are intermediate to those of the putative parents in varying degrees and combinations over its range of east-central Texas and western Louisiana” (Pinkava 1970, p. 1625). He found apparent intermediates between *B. texana* and *B. betonicifolia*, however, to be rare. Although his histogram of hybrid index values in the “Western *B. pumila/ texana* complex” (Fig. 2b, p. 290) indicates that he observed several populations of such intermediates, only one such collection is mapped on his Fig. 4 (1967); it is in central Louisiana (Rapides Parish), where *B. pumila* apparently is absent but where *B. texana* (sensu Pinkava) is known by a number of collections (Fig. 2).

In the Louisiana flora, Gandhi and Thomas (1989) and MacRoberts (1989) recognized both *Berlandiera pumila* and *B. × betonicifolia*, showing these two taxa with nearly identical geographic ranges. MacRoberts (1989, p. 313) noted that the latter “seems to be inordinately common compared with its putative parents.” *Berlandiera pumila* and *B. × betonicifolia* both have been recognized from the southeastern corner of Oklahoma (Taylor and Taylor 1994).

*Berlandiera × betonicifolia* (sensu Pinkava) was reported from the southwestern corner of Arkansas (Miller Co.) by Orzell and Bridges (1987, p. 88), who adopted Pinkava’s interpretation of variability among the plants they observed. They noted that “Our specimens mostly fit the putative backcross hybrid of *Berlandiera × betonicifolia* with *B. pumila*, . . . although some of our specimens have dense, matted white-tomentose pubescence, and could be referred to *B. pumila*.” Smith (1994) identified these Arkansas plants simply as *B. pumila*.

Cronquist (1980) did not include *Berlandiera betonicifolia* among the three species formally recognized in his treatment of the genus for the southeastern
United States. He referred to it in introductory comments simply as the name covering hybrids between *B. pumila* and *B. texana*.

Despite the considerable previous attention given to patterns of variation and accompanying taxonomy of plants of the *Berlandiera pumila* complex in Texas and Louisiana, field experience in east Texas and adjacent Louisiana suggested that the pattern of variation in this group might be viewed from another perspective. This problem was approached in more detail through study of numerous collections available in regional herbaria and field observations in 1996 and 1997 covering Anderson, Angelina, Cherokee, Hardin, Houston, Jasper, Montgomery, Nacogdoches, Newton, Polk, Rusk, Sabine, San Augustine, San Jacinto, Shelby, Trinity, Tyler, Upshur, Van Zandt, Walker, and Wood counties, Texas, and Vernon Parish, Louisiana.

**THE IDENTITY OF BERLANDIERA BETONICIFOLIA**

Pinkava did not examine the original type material of *Silphium betonicifolium*, but based on a photo, he noted (1967, p. 297) that "Drummond’s holotype [of *S. betonicifolium*] more closely resembles *B. texana* [than *B. pumila*] and was assigned to it [*B. texana*] as a variety by Torrey & Gray (1842),

![Berlandiera betonicifolia](image.png)

Fig. 2. Distribution by county of *Berlandiera betonicifolia* (see text for definition) in Texas and Louisiana. The species also occurs northward through Oklahoma into northern Arkansas, Missouri, and southern Kansas.
who commented that other specimens fitted neither varietal description completely.” Gray annotated at least two of the Drummond sheets now at K (see below) as “Berlandiera texana DC. f. betonicifolia Torr. & Gray.” The present examination of the original material at K shows it to be the species that has long been identified as Berlandiera texana DC., which de Candolle named a year later than Hooker’s S. betonicifolium.

The material at K consists of four sheets, which are similar among themselves in habit and other morphological features, and it seems likely that Drummond collected all of this material at the same site. The lectotype (designated below) bears detailed sketches of the ray and disc achenes, which were probably used by Bentham in his preparation of the Compositae treatment for Genera Plantarum.

The correspondingly modified nomenclature for this species is summarized below.


*Berlandiera texana* DC., Prodr. 5:317. 1836. **Type:** TEXAS: between the Trinity River and Bejar [San Antonio], Jun 1828, J.L. Berlandier 2044 (HOLOTYPE: G fiché; ISOTYPES: F, MO, NY, P).

On the lectotype of *Silphium betonicifolium* (and one of the islectotypes), presumably written by Hooker himself, the collection locality and date are given as “N. Orl. 1833.” The possible GH type material of *S. betonicifolium* was annotated by B.L. Turner and M.C. Johnston in 1955: “Possible isotype, as questioned by Gray (Fl. N. Amer. 2:281. First edition). Drummond’s plant possibly came from Texas—‘New Orleans’ being a citation error.” Gray himself (1842) cited the locality of the type collection as “New Orleans?,” apparently questioning its provenance. There are no other historical or recent collections of any species of Berlandiera from southeastern Louisiana and none from Mississippi, and it seems unlikely on this basis that Drummond made the “betonicifolia” type collection in the area of New Orleans.

One of the iselectotypes bears a glued annotation label (pasted over the lower stem), presumably in Asa Gray’s script: *Berlandiera texana* DC. Torr. Gr. Fl. N. Am. 2.286.” At the bottom of the label, in print, there is a line “Jacksonville (Amer. Bor.) Drummond 1833.” Gray (presumably) crossed out the word Jacksonville and wrote above it “Louisiana.” An early Texas site for “Jacksonville” is not known to the present authors.
Drummond sailed from New Orleans to reach Texas (Brazoria County) in March 1833, and during his 21-month stay in Texas (Geiser 1948), he stayed or traveled in areas where Berlandiera pumila var. pumila occurs (e.g., Fayette, Austin, Lee, Colorado, Fort Bend counties), but he did not travel in the area where plants previously identified as B. ×betonicifolia (see below) occur (Fig. 1). Geiser's account shows that Drummond passed through at least one county (Gonzales Co.) where B. betonicifolia (of the present interpretation) is known to occur (Fig. 2). From among the 100 or more collections of the Berlandiera pumila complex at LL,TEX, the plant most similar to the Kew types is a collection (Gentry & Smith 2024, LL) from Victoria Co., which is only a short distance from Gonzales County.

Considering the information presented in the present study, Drummond probably collected the plants of the type material in south-central Texas at some locality near the Guadalupe River, which traverses both Gonzales and Victoria counties. Drummond collected along this river (fide Gaiser) between 24 April and 26 September, 1834, at which time he was assembling his "set II." One of the islectotypes bears the handwritten notation "Texas II, no No. [s.n.], Drummond."

With his last set of collections, Drummond sailed from New Orleans in December 1834 on his return to Europe. He disappeared enroute (apparently in Cuba) but his specimens arrived safely.

THE NATURE OF BERLANDIERA BETONICIFOLIA

Berlandiera betonicifolia (B. texana of previous interpretations) occurs from panhandle and south-central Texas and adjacent Louisiana (Fig. 2) northward through Oklahoma into northern Arkansas, Missouri, and southern Kansas (Pinkava 1967; Turner and Johnston 1956; Great Plains Flora Assoc. 1986). This species can be separated from the B. pumila complex without intergrades by making comparisons in the key below. Collections of both B. betonicifolia and B. pumila have been made in the same counties in central and east Texas (Victoria, Bastrop, Burleson, Gonzales, Travis, Fayette, and Shelby) and parishes of adjacent Louisiana (Caddo and DeSoto) (Figs. 1 and 2), but in this region of geographic overlap, there are no plants suggestive of hybridization and/or introgression between them. For the most part, plants that previously have been interpreted as such hybrids (B. pumila var. scabrella, as identified here) occur outside of the present geographic range of B. betonicifolia.

As noted by Pinkava (1967), the lower stems of plants of Berlandiera betonicifolia from parts of Texas tend to be silky-pilose with soft, white hairs while those from further north have shorter, thicker, and slightly vitreous hairs. Infraspecific variation in leaf shape and margin also exists within the species, but this variability apparently does not bear on its relationship to B. pumila.
Based primarily on perceived similarities in stem leafiness and leaf insertion, Turner and Johnston (1956) regarded Berlandiera betonicifolia (as *B. texana*) and *B. pumila* var. *scabrella* (as *B. betonicifolia*) as conspecific and intergrading. The current study, in contrast, concludes that *B. betonicifolia* is distinct from other closely related entities.

**VARIATION WITHIN BERLANDIERA PUMILA**

Plants from east Texas and western Louisiana previously identified as *Berlandiera pumila* and *B. ×betonicifolia* are best represented as two entities within a single species (*B. pumila*), differing in features of vestiture. The nomenclatural summary for typical *B. pumila* and the newly recognized variant are given here.

**Berlandiera pumila** (Michx.) Nutt., Trans. Amer. Philos. Soc. ser. 2, 7:342. 1841. *Silphium pumilum* Michx., Fl. Bor.-Amer. 2:146. 1803. **TYPE:** UNITED STATES. **FLORIDA:** [no date], *A. Michaux 10* (HOLOTYPE: P fiche!).


*Berlandiera dealbata* (Torr. & A. Gray) Small, Fl. S.E. U.S. 1246, 1340. 1903. **TYPE:** UNITED STATES. “ARKANSAS” [present day Oklahoma], [date], *T. Nuttall* (HOLOTYPE: NY fiche!).

**Berlandiera pumila** (Michx.) Nutt. var. *scabrella* Nesom & Turner, var. **NOV.** **TYPE:** U.S.A. TEXAS. Jasper Co.: roadside of Hwy 63, 0.8 mi E of jct with FM 1738, 1.0 mi E of crossing of Melholms Creek, 7.0 mi E of jct Hwys 290 and 96 in Jasper; narrow strip of native vegetation along side of hwy, buffer to loblolly pine plantation behind; dominant scrubby post oak, blackjack oak, black hickory, and bluejack oak, with less common sweetgum, dogwood, sassafras, yaupon, buckeye, and winged sumac; *Berlandiera* scattered but abundant along edge of woods for ca 50 yards on N side of hwy, in deep, loose sand; 16 May 1998, *G.L. Nesom 98J1* (HOLOTYPE: TEX; ISOTYPES: ASTC, BRIT, FSU, GH, IE, LSU, MISSA, MO, NCU, NLU, OKL, SHST, TAES, TAMU, UARK, US, USCH).

A *B. pumilo* var. *pumilo* similis sed differ vestimento hispidulo paginis superis foliaribus, trichomatibus basaliter erectis basibus incrassitis.

Most of the variation that occurs among plants of *Berlandiera pumila* is attributable to three patterns: 1) vestiture of the upper leaf surfaces—a relatively abrupt transition in easternmost Texas from fine, thin-based, reclining or appressed hairs to thick, basally erect hairs; 2) vestiture density of the stems and lower leaf surfaces—interpopulational variation in central and east-central Texas and the gradual reduction in density, with loosening of the matted tomentum and shortening and thickening of the hairs, in populations from west to east toward Louisiana; and 3) stem vestiture coloration—production of reddish cross-wall pigments mostly in southeastern Texas and adjacent west-central Louisiana. Each of these patterns is discussed below in more detail.
1) The morphological feature that shows the sharpest geographic transition within *Berlandiera pumila* is the nature of the vestiture on the upper leaf surfaces: fine, silky, thin-based, basally reclining or appressed hairs (var. *pumila*) vs. thicker-based and basally erect hairs (var. *scabrella*). It is primarily on this basis that the taxonomic separation between the varieties of *B. pumila* in the present interpretation can be made most consistently. Intermediacy in hair morphology occurs in Cass, Harrison, Shelby, Polk, and Tyler counties and Caddo and DeSoto parishes (and perhaps others). This feature also was emphasized by Pinkava (1970) in his key to Texas *Berlandiera* and was described by Torrey and Gray (1842, their “*B. tomentosa* y”).

2) Plants of *Berlandiera pumila* var. *pumila* with a dense vestiture of long, thin, matted hairs show white stems and distinctly bicolored leaves (white beneath, green above), the stem and lower leaf surfaces obscured by the tomentum (the “white form” of var. *pumila*). Plants with trichomes shortened in length show a corresponding reduction in density of vestiture and the green surfaces of the stems and leaves are visible through the hairs (the “gray-green form” of var. *pumila*, not mapped on Fig. 1, intermediate between the “white form” and “green form”). Shorter trichomes of the lower leaf surfaces tend to be somewhat erect and separate rather than parallel to the surface and closely intertwined. Only the white form of *B. pumila* occurs in populations from the westernmost area of the range (Fig. 1). The white form and gray-green form occur broadly over east Texas. In this area are plants with dense white tomentum as well as plants with vestiture reduced by degrees in density, this feature tending to be relatively uniform within a local population. A corresponding reduction in stem vestiture appears to be the only morphological difference correlated with the variation in leaf vestiture. The “green form” of *B. pumila* occurs in easternmost Texas counties and in Louisiana; in these plants the vestiture is further reduced, with the lower leaf surfaces showing greenish or yellowish-green and hardly different in color from the upper surface. In this area, the gray-green form occurs infrequently and the white form is rare or absent. The reduction in stem and abaxial leaf vestiture is characteristic of some populations of var. *pumila* and all of var. *scabrella*. In the present attempt to characterize finer patterns of infraspecific variation, we note that the informally designated white, gray-green, and green forms are found within var. *pumila* but var. *scabrella* includes only the green form.

3) The stem vestiture of plants from a cluster of southeasternmost Texas counties (Hardin, Polk, Jasper, Newton, Angelina, and Sabine cos.) and adjacent Louisiana (Fig. 1) is reduced and the hairs distinctly colored. The hairs are basally erect, though not thick and long like those of *B. betonicifolia*, and the strongly colored cross-walls of all the hairs give a purplish or reddish-brown color to at least the upper stems. Such purplish stems are char-
acteristic primarily of plants recognized here as var. *scabrella*, but intergradation in this feature occurs with plants of var. *pumila* (the gray-green form) from slightly further west. In these intergrades, hairs with colored cross-walls are formed among the more abundant white hairs but are less noticeable within the predominately grayish cauline vestiture.

The evolutionary origin of *Berlandiera pumila* var. *scabrella*, as suggested by Pinkava (1977), may have been through hybridization between *B. betonicifolia* and typical *B. pumila*. Both *B. betonicifolia* and *B. pumila* var. *scabrella* have reduced vestiture of stems and leaves and neither produces white tomentum; the upper leaf surfaces in both are somewhat hispid with thickened, basally erect hairs. Stem hairs in both entities usually produce purplish cross-walls. As noted above, however, such hybridization is not currently evident and parallel evolution is an equally reasonable explanation of these morphological similarities between *B. betonicifolia* and var. *scabrella*.

THE NATURE OF TYPICAL *BERLANDIERA PUMILA*

*Berlandiera pumila* in its typical form occurs in western Florida (where the type collection was made by Michaux), Alabama, Georgia, South Carolina, and North Carolina. The general distribution of the species was shown by Pinkava (1967); its absence from Mississippi remains a reality (S. McDaniel, pers. comm.). Various populations of *B. pumila* in this eastern segment of its geographic range correspond to both the “white form” and “green form” of the western segment of the species, as outlined in the comments above. There is no variation within *B. pumila* of the eastern U.S. toward the morphological features characteristic of var. *scabrella*.

KEY TO THE TAXA OF THE *BERLANDIERA PUMILA* COMPLEX

1. Stem hairs thick-based, erect, mostly 1.0–1.5(–2.0) mm long, commonly distinctly flattened and vitreous; lower leaf surfaces greenish; leaves lanceolate to deltate, the mid-cauleal and upper usually sessile ....................... *B. betonicifolia*  
   1. Stem hairs soft and thin, densely matted and closely appressed or sometimes oriented in parallel, the length of the individual hairs difficult to observe, sometimes more loosely arranged and less than 1 mm long, white; lower leaf surfaces white to gray-green or greenish; leaves ovate to triangular or lanceolate, the mid-cauleal and upper usually on short (1–2 mm) petioles .................................................................................. *B. pumila* (2)  
2. Upper leaf surfaces softly pubescent with very thin, appressed or basally reclining hairs (sometimes basally erect in Cass, Harrison, and Shelby cos., Caddo Parish), the leaves strongly to weakly or not at all bicolorred; stem vestiture relatively dense and matted or reduced in density with the stem surface visible, the hairs evenly whitish or some with purplish cross-walls near the base ................................. *B. pumila* var. *pumila*  
2. Upper leaf surfaces minutely hispidulous with relatively thicker-based and basally erect hairs, the leaves not bicolorred; stem surface visible, the vestiture reduced in density, the hairs often reddish-brown to purple because of colored cross-walls ........................................ *B. pumila* var. *scabrella*
ACKNOWLEDGMENTS

Specimens have been examined from ASTC, BRIT, NLU, SBSC, SHST, TAES, TAMU, and LL,TEX. The holotype was loaned to Turner at LL,TEX. Walter Holmes provided information on collections housed at BAYLU and Sidney McDaniel verified the absence of Berlandiera pumila from Mississippi. Thanks to Mark Bierner and Reviewer #2 for their helpful criticisms.

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NEW NAMES AND COMBINATIONS IN NEOTROPICAL MYRSINACEAE

JOHN J. PIPOLY III
Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060, U.S.A.
jpipoly@brit.org; clusia@latinmail.com

JON M. RICKETSON
Missouri Botanical Garden
P. O. Box 299
St. Louis, MO 63166-0299, U.S.A.
jricketson@lehmann.mobot.org

ABSTRACT

Lundell (1981a, 1986) published 68 new names and combinations for binomials in Ardisia and Myrsine. In both papers, he indicated that he was opposed to placement of the taxa involved in those genera and that the combinations and new names were provided in anticipation of future circumscriptions of the genera. We agree with Morales (1997) that in doing so, Lundell inadvertently invalidated his new names and combinations, according to the International Code of Botanical Nomenclature Article 34.1. To remedy the situation, the following new combinations are proposed in Myrsine: M. calcarata (Lundell) Ricketson & Pipoly and M. juergensenii (Mez) Ricketson & Pipoly; the other seven Lundell combinations are taxonomic synonyms and thus, not in need of validation. In addition to those combinations validated by Morales (1997) in Ardisia, 27 new combinations are made, nine new names are proposed, and for those taxa described by Lundell in the segregate genus Leacorea Aublet but never transferred, five new combinations are proposed. The remaining 17 binomials are taxonomic synonyms and therefore, are not validated.

RESUMEN

Lundell (1981a, 1986) publicó 68 nombres y combinaciones nuevos para binomiales en los géneros Ardisia y Myrsine. En ambos trabajos, el indicó que no estaba de acuerdo con la ubicación taxonómica de los taxa dentro de los géneros susodichos y que se estaba llevando a cabo las combinaciones y nombres nuevos para anticipar circunscripciones futuras que podrían ser descritas para los géneros. Estamos de acuerdo con Morales (1997) quien consideraba que Lundell, por haber dicho eso claramente, invalidó sus nombres y combinaciones nuevos según el Código Internacional de Nomenclatura Botánica (ICBN) Artículo 34.1. Para corregir esta situación, las combinaciones nuevas se proponen dentro del género Myrsine: M. calcarata (Lundell) Rickerson & Pipoly, y M. juergensenii (Lundell) Rickerson & Pipoly; las otras siete combinaciones que hizo Lundell se consideran como sinónimos taxonómicos y por lo tanto, no necesitan ser transferidos. Además de las combinaciones validadas por Morales (1997) dentro de Ardisia, se proponen 27 combinaciones nuevas y nueve nombres.
nuevos. Para los taxa descrito por Lundell dentro del género segregado como *Icacorea* Aublet, pero nunca transferidos al género *Ardisia*, se transfieren cinco combinaciones nuevas. Los 17 binomiales restantes son sinónimos taxonómicos y por lo tanto, no necesitan ser transferidos.

**INTRODUCTION**

Cyrus L. Lundell studied the neotropical members of the Myrsinaceae for over 60 years, and was the principal monographer of the family since the monograph of Mez (1902) in Engler's *Das Pflanzenreich*. In addition to treatments of the family for *Flora of Guatemala* (Lundell 1966) and *Flora of Panama* (Lundell 1971), Lundell published a series of 26 papers in the journals *Wrightia* and *Phytologia* dealing with the taxonomy of the family. The senior author began collaboration with Lundell in 1981 while a graduate student, and corresponded with him regarding generic delimitation for almost six years.

*Ardisia* was described by Swartz (1788) in his *Nova Genera et Species Plantarum*, and eventually conserved over the earlier *Icacorea* Aublet (1775). However, Lundell perceived that *Ardisia*, as defined in the broad sense by Mez (1902), was an artificial assemblage (paraphyletic in more modern terminology), and therefore, segregated the following genera from it: *Amatlania* Lundell (1982), *Auriculardisia* Lundell (1981c), *Chontalesia* Lundell (1982), *Gentlea* Lundell (1964), *Gnaphardisia* (Mez) Lundell (1981a), *Ibarrea* Lundell (1981a), *Oerstedianthus* Lundell (1981b), *Synardisia* (Mez) Lundell (1963), *Valerioanthus* Lundell (1982), *Yunckeria* Lundell (1964), and *Zunilia* Lundell (1981c). While some of these segregate genera undoubtedly represent monophyletic lineages, the question of their respective circumscriptions and the consequent limits of the pantropical genus *Ardisia*, as well as the limits of all the genera in the tribe Ardisiaeae, was often a source of confusion.

Simultaneously, circumscription of the genus *Myrsine* L. and its relationship to the pantropical genus *Rapanea* Aublet, formed another source of taxonomic debate. While Mez (1902) recognized *Myrsine* as a small genus of paleotropical species, Hosaka (1940) demonstrated that the characters used to separate the two were not constant, resulting in Walker's (1959) change in taxonomic opinion. Lundell (1966, 1971) recognized *Rapanea* as distinct from *Myrsine*, but noted that Stearn (1969) elected to accept the more inclusive concept of *Myrsine* to include *Rapanea* in his treatment of the Jamaican species, a view increasingly adopted by modern workers (see Pipoly 1996 for a complete discussion).

During the early 1980s, the senior author was in close communication with Lundell and frequently discussed the problem of generic delimitation in the Myrsinaceae, particularly when viewed on a worldwide basis. The problem was compounded when preliminary cladograms were tested, and it appeared that several groups recognized by Mez were found to be paraphyletic (Pipoly 1987). As Lundell carried out the mammoth job of describing the
many neotropical novelties discovered in the late 1970's and early 1980's, it became necessary for him to determine limits of the genera, and he apparently decided to provide names for the Ardisiid taxa both in the narrowest and broadest concepts that had been circumscribed to that date. Unfortunately, this philosophy led to the publication of two papers in which he essentially proposed new names and combinations in anticipation of future circumscription, even though he was not convinced of the placement of the taxa, thus invalidating all of them according to ICBN Article 34.1.

In preparation for our treatment of the Myrsinaceae for the Flora Mesoamericana Project of the National Herbarium of Mexico (MEXU), Missouri Botanical Garden (MO), the British Museum (BM) and other collaborators, we have published synopses for the genera Myrsine (Ricketson & Pipoly 1997a), Stylogyne (Ricketson & Pipoly 1997b), Gentlea (Ricketson & Pipoly 1997c), along with a revision of the genus Ardisia subgenus Graphardisia Mez (Pipoly & Ricketson, 1998). The problems posed by Lundell's (1981b) transfer of Mesoamerican Rapanea species to Myrsine were overlooked, but are rectified below. As work continues on Ardisia in its broadest sense, it becomes increasingly necessary to validate the invalid names and combinations made by Lundell (1986) in transferring species described in the various segregate genera of Ardisia to that genus, just as Morales (1997) did for only a few from Costa Rica and Panama. The consequent combinations, new names and updated synonyms for the taxa we recognize in these two problematic taxonomic groups are also effected below.

NOTES ON MYRSINE

Lundell (1981b) described the genera Ibarrea and Oerstedianthus as new, raised Ardisia subgenus Graphardisia to generic status, and transferred the Mesoamerican (and one Peruvian) species of Rapanea to Myrsine. However, in the introduction, Lundell stated “Nine species described in Rapanea Aubl., all except one from Mexico and Central America, are transferred to Myrsine L. to follow current practice, not out of any conviction as to the justification for this disposition of the taxa!” By including that statement in the introduction, he inadvertently invalidated the subject new combinations because Article 34.1 of the ICBN unequivocally states, “A name is not validly published (a) when it is not accepted by the author in the original publication; (b) when it is merely proposed in anticipation of the future acceptance of the group concerned, or of a particular circumscription, position or rank of the group (so-called provisional names), except as provided for in Art. 59…” While there is no doubt that Lundell recognized the entities involved as distinct taxa, we feel that he purposely effected the transfers as a result of discussions with the senior author and in anticipation of his (and others’) future work on the group as the more broadly cir-
cumscribed Myrsine rather than setting it apart as Rapanea. Therefore, among the nine taxa he transferred, all are invalid. However, Ricketson and Pipoly (1997a) recognized only two of these species, Myrsine calcarata and M. juergensenii. The other six species, Rapanea pittieri, R. peruviana, R. rufa, R. panamensis, R. allenii, R. mexicana and R. reflexiflora, were synonymized, and thus the combinations made by Lundell are nomenclatural synonyms of them, with no need for validation. The new combinations and corrected synonymies for those species are presented below. For complete synonymies and citation of basionyms of recognized taxa, see Pipoly and Ricketson (1997a).


**Myrsine coriacea** (Sw.) R. Br. ex Roem. & Schult. subsp. coriacea, Syst. Veg. 4:511. 1819.


**Myrsine dependens** (Ruiz & Pav.) Spreng., Syst. Veg. 1:664. 1825.


NOTES ON ARDISIA

The situation regarding generic delimitation among the taxa comprising Ardisia in its broadest sense, and that of the segregate taxa proposed or recognized by Lundell, was very similar to that described above for Myrsine. Work underway among these taxa for our studies in Mesoamerica has caused us to reexamine the nomenclatural legalities regarding the new combinations and names proposed by Lundell (1986), particularly in light of the recent new names and combinations made by Morales (1997), in his paper anticipating a treatment of the Myrsinaceae for the A Manual to the Plants of Costa Rica.

Lundell (1986) effected 59 nomenclatural changes, comprising 23 new names and 36 new combinations for taxa previously described in genera segregated from Ardisia. However, in the introduction, he stated, “Just as the very distinct genus Iacorea Aubl. has been ridiculously submerged as a subgenus of Ardisia Sw. for generations, we can also assume that the vagaries of taxonomists will result in the reduction of such recently described genera as Auriculardisia Lundell, Gentlea Lundell, Graphardisia Lundell, Oerstedianthus Lundell, Ibarrea Lundell, Amatlantia Lundell, and Zunilia Lundell to subgenera of Ardisia. The transfer of the following species is made to that genus to obviate the incentive of workers to undertake such unnecessary reductions to subgenera.” While the wording of this introduction is not as clear a violation of the rules of Article 34.1 of the ICBN as that of the Myrsine paper, we feel that the intention was to specifically provide names “proposed in anticipation of the future acceptance of the group concerned, or of a particular circumscription, position or rank” and are therefore, invalid. This agrees with the conclusion reached by Morales (1997) in his validation for six of the subject taxa. In addition, while implied and not specifically stated, we feel that Lundell accepted the taxa, but not the names (i.e., the placement) he published in the work.

Our work thus far has shown that among the segregate genera recognized by Lundell, Gentlea, Cienardisia Ducke (= Yuneckeria Lundell), and Synardisia will all be recognized with certainty, while the remaining groups
will not. Because we recognize *Gentlea* as a genus distinct from *Ardisia*, no validation of the invalidly published Lundell new names and combinations for *Gentlea* species as members of *Ardisia* is necessary, but we provide the following corrections to synonymies listed in our previous work, to include the invalid names (Ricketson & Pipoly 1997c). For complete synonymies, see Ricketson and Pipoly (1997c).


de Zurqui, NE of San Isidro, 2,000–2,400 m (fr), 3 Mar 1926, P. Standley & J. Valerio 50613 (holotype: US; isotype: LL-TEX).


While we agree with Morales (1997) in his view that the new names and combinations published by Lundell (1986) are invalid, Morales did not make direct reference to the invalid names in the synonymy listed with new combinations. Therefore we provide them below in the interest of providing complete synonymy for those species.


Lundell, Phytologia 61:67. 1986, nomen invalidum. Type: COSTA RICA. Heredia: Original forest near the Río Puerto Viejo, ca. 2 km upstream from the confluence with Río Sarapiquí, formerly “Finca La Selva” of L.R. Holdridge, 10° 26’ N, 84° 0’ W. 100 m, 1417 Jun 1968 (fl), W. Burger & R. Stolze 5853 (holotype: F; isotypes: CR, F, TEX, MO).

Regarding those taxa originally placed by Lundell (1981a) in his concept of the segregate genus Gnaphalidisia, the following binomials invalidly published by Lundell (1986) as new combinations and names: Ardisia coibana (Lundell) Lundell, Ardisia ebingeri Lundell, Ardisia esquipulasana Lundell, Ardisia neothyridina Lundell, Ardisia obtusata (Lundell) Lundell, Ardisia riomonteana Lundell, Ardisia sarapiquana (Lundell) Lundell and Ardisia ustupaoana (Lundell) Lundell, are considered taxonomic synonyms (Pipoly & Ricketson 1998) and thus, need no validation.

Lundell (1986) also described two new species of Ardisia, A. hirsutissima Lundell, and A. tarariae Lundell. He aligned Ardisia hirsutissima with A. nevemmannii and A. ursina, two species he had previously transferred (Lundell 1982) to his segregate genus Valerioanthus, and subsequently transferred them once more, to his segregate genus Auriculardisia (Lundell 1985). Curiously, Lundell (1987) transferred Ardisia hirsutissima to Valerioanthus rather than to Auriculardisia, as he had previously done with the other members of Valerioanthus and which, at that point, had its type already transferred. It is unclear whether these nomenclatural transactions represent a mere lapsus calami, or a purposeful taxonomic decision. Lundell (1987) validly transferred Ardisia tarariae Lundell to Auriculardisia. However, our studies have shown that this taxon is also best retained in Ardisia. In order to provide complete synonymies for these apparent taxonomic nomads, we provide the following nomenclator.


Atlantic slope, Cerros Tararia (locally known as Tres Picos), 2,400–2,600 m, 10 Sep 1984 (fl), G. Davidsen, G. Herrera Ch. & M. Grayum 28882 (holotype: LL-TEX; isotype: MO).

For the remaining 27 binomials invalidly published by Lundell (1986), we provide the following new names and combinations.


**Ardisia azaharensis** Pipoly & Ricketson, nom. nov. *Auriculardisia microcalyx* Lundell, Wrightia 7:270. 1984, non *Ardisia microcalyx* Lundell, Wrightia 4:46. 1968. *Ardisia azaharensis* Lundell, Phytologia 61:62. 1986, nomen invalidum. Type: COSTA RICA. ALAJUELA: 15 km NW of San Ramón by air, Cerro Azahar, headwaters of Río San Pedro, by road, 9 km NW of San Ramón to Piedades Norte, then 3 more km NW to La Paz, 1.7 km to cluster of houses, then left again on jeep road 45 km to top of ridge, 10° 09' 30" N, 84° 34' 35" W, 1,4001,500 m, 14 May 1983 (fr), R. Liesner, E. Judziewicz, J. Gómez-Laurito, B. Pérez G. & A. Carvajal 15575 (holotype: LL-TEX; isotypes: F, MO).


In choosing the epithet ‘ellipticifolia’ over ‘elliptifolia’ used by Lundell, we believe we are correcting a spelling error rather than changing the stem.


Finally, the following five taxa were originally described by Lundell (1984, 1987) as species of *Icacorea*, but our studies indicate they are members of *Ardisia* subgenus *Icacorea*, to which we effect the transfers using the following new names and combinations.


ACKNOWLEDGMENTS

We thank the Missouri Botanical Garden and the Flora Mesoamericana Project, for funding that allowed J. Ricketson (MO) to travel to Fort Worth, where he was joined by J. Pipoly (BRIT) on visits to the C.L. Lundell Herbarium (LI-TEX), housed at the University of Texas at Austin. Without access to that critical collection, assembled by C.L. Lundell over a period of nearly 60 years, the present study would not have been possible. Flora Mesoamericana and the Missouri Botanical Garden also provided funding for Pipoly to travel to MO to work with Ricketson. We thank the curators of the herbaria cited for loans of specimens. We are grateful to the staff of TEX, especially Billie L. Turner, Tom Wendt, Carol Todzia, Beryl Simpson, and José Panero, for their cooperation and hospitality. We are also grateful to those who have been so instrumental in assisting us in our work, including K. Gandhi (GH), Dan Nicolson (US), Gerrit and Jeany Davidse, Linda Oestry, Mary Bard, and Catherine Mayo, (MO), Barney Lipscomb, Lindsay Woodruff, Marjorie Weir and Jim Rivers (BRIT). Reviews of the manuscript by K. Gandhi and G. Davidse, and meticulous copy editing by Barney Lipscomb, greatly improved the presentation of the paper.

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BOOK NOTICE


This book is about Charles Christopher Parry's exploration of the southern Rocky Mountains of Colorado. Weber introduces the life of Parry and his botanical collections that introduced the Colorado flora to the world. "Over eighty new species of flowering plants were named from Parry's Colorado collections, and many more from his collections in Mexico and the U.S. Southwest. Two genera, Neoparrrya and Parryella, were dedicated to him. Some of the Colorado novelties, such as Astragalus parryi, Campanula parryi, Chrysothamnus parryi, Helianthella parryi, Oxytropis parryi, Pedicularis parryi, Primula parryi, and Trifolium parryi are Colorado's most well-known wildflowers."

The 183 page book on the "King of Colorado Botany" is broken up into the following: Preface; Acknowledgments; an Introduction to The Collections and The Life of C.C. Parry; 1) Setting the State: The Parry Narratives; 2) Parry's Colorado Expedition of 1861; 3) The Parry, Hall, and Harbour Expedition of 1862; 4) Expedition of 1864; 5) Observations on Snow Line and Timberline; 6) Expedition of 1867; 7) Dedication of Gray's and Torrey's Peaks, 1872; 8) Collections of 1873-1889; and 9) Cryptogamic Collections. These chapters are followed by four appendixes: New Taxa Described from Parry's Colorado Collections, The Parry Herbarium, Parry's Dismissal as Botanist for the Department of Agriculture, and Publications of C.C. Parry. References and Index follow the appendixes.
A NEW SPECIES OF FILMY FERN
(HYMENOPHYLLACEAE: PTERIDOPHYTA)
FROM SOUTH INDIA

C. ABDUL HAMEED

Department of Botany
M.E.S.K.V.M. College
Valanchery
Kerala 676 552, INDIA

P.V. MADHUSOODANAN

Department of Botany
University of Calicut
Kerala 673 635, INDIA

ABSTRACT

Crepidomanes indicum, a new species of filmy fern is described and illustrated from southern Western Ghats of India.

RESUMEN

Se describe e ilustra Crepidomanes indicum, una nueva especie de helecho membranoso de los Ghats del suroeste de la India.

Crepidomanes is an Old World genus of more than a dozen species ranging from East African islands to Japan and Polynesia (Tagawa & Iwatsuki 1979). The name derived from two Greek words viz., Krepis = slipper + manes = cup, alluding to the shape of the indusium (Stewart et al. 1983). The presence of striae and a submarginal pseudovein are the conspicuous diagnostic characters of this genus. Beddome (1883) has reported three species now known as C. kurzii (Bedd.) Tagawa & K. Iwats., C. intramarginale (Hook. & Grev.) Copel. and C. bipunctatum (Poir.) Copel. from South India. Later, Nair et al. (1992) and Manickam & Irudayaraj (1992) reported the occurrence of C. latealatum (Bosch) Copel. and C. plicatum (Bosch) Ching. respectively from the South India. Recently Madhusoodanan and Hameed (1997, 1998) reported C. christii (Copel.) Copel. and C. agasthianum Madhusoodanan & Hameed from the dense evergreen forests of western Ghats, South India.

While revising the genus Crepidomanes of India, the authors collected a very small filmy fern from the mature, dense, tropical evergreen forest of Thommankuthu in the foothills of the Western Ghats mountains in the
Idukki district of Kerala state, S. India (alt. 700 m; annual rainfall 3000 mm; temp 20–35°C). The plant shows a high degree of differentiation from the species previously described under the genus *Crepidomanes* (Beddome 1863, 1866, 1883; Copeland 1938; Devol 1975; Holttum 1954; Iwatsuki 1984, 1985; Jinn-Lai & Wang-Chueng 1994; Sledge 1968). It differs from other species in its smaller size, dark green, evenly pinnatifid fronds having the rachis-wing and segments with an entire margin; thin submarginal veins and cupular indusia with highly dilated mouths. The plant is described here as *Crepidomanes indicum*.

**Crepidomanes indicum** Hameed & Madhusoodanan, sp. nov. (Fig. 1) **Type:** INDIA. Kerala: Idukki Dt.: Thommankuthu water fall. 600 m, 1 Sep 1996, C.A. Hameed CU 34880 (holotype: CALI; isotypes: K, MH).

*Crepidomani agasthianum* affinis, scd frondibus atro-viridibus profunde, regulariter pinnatifidis segmentis acqualibus, margin recto, apice vadose emarginato, venula falsa intra-marginali tenui, cellulis marginalibus latis unistratis contentis repletis differt. Sori 2–8 terminales, involucre cupuliformes, latiore quam longiore, partibus dimidiis involucralibus plenissimis, ore maxime dilatato.

Rhizome filiform, long, creeping & Madhusoodanan, sp. nov. (Fig. 1) **Type:** INDIA. Kerala: Idukki Dt.: Thommankuthu water fall. 600 m, 1 Sep 1996, C.A. Hameed CU 34880 (holotype: CALI; isotypes: K, MH).

*Crepidomani agasthianum* affinis, scd frondibus atro-viridibus profunde, regulariter pinnatifidis segmentis acqualibus, margin recto, apice vadose emarginato, venula falsa intra-marginali tenui, cellulis marginalibus latis unistratis contentis repletis differt. Sori 2–8 terminales, involucre cupuliformes, latiore quam longiore, partibus dimidiis involucralibus plenissimis, ore maxime dilatato.

Rhizome filiform, long, creeping & Madhusoodanan, sp. nov. (Fig. 1) **Type:** INDIA. Kerala: Idukki Dt.: Thommankuthu water fall. 600 m, 1 Sep 1996, C.A. Hameed CU 34880 (holotype: CALI; isotypes: K, MH).

*Crepidomani agasthianum* affinis, scd frondibus atro-viridibus profunde, regulariter pinnatifidis segmentis acqualibus, margin recto, apice vadose emarginato, venula falsa intra-marginali tenui, cellulis marginalibus latis unistratis contentis repletis differt. Sori 2–8 terminales, involucre cupuliformes, latiore quam longiore, partibus dimidiis involucralibus plenissimis, ore maxime dilatato.

Rhizome filiform, long, creeping & Madhusoodanan, sp. nov. (Fig. 1) **Type:** INDIA. Kerala: Idukki Dt.: Thommankuthu water fall. 600 m, 1 Sep 1996, C.A. Hameed CU 34880 (holotype: CALI; isotypes: K, MH).

*Crepidomani agasthianum* affinis, scd frondibus atro-viridibus profunde, regulariter pinnatifidis segmentis acqualibus, margin recto, apice vadose emarginato, venula falsa intra-marginali tenui, cellulis marginalibus latis unistratis contentis repletis differt. Sori 2–8 terminales, involucre cupuliformes, latiore quam longiore, partibus dimidiis involucralibus plenissimis, ore maxime dilatato.
HAMEED AND MADHUSOODANAN, A new species of Crepidomanes

& Hameed in appearance. It shows an affinity to Microtrichomanes nitidulum (Bosch) Copel. in indusium shape and to Microgonium henzanum (Parish ex Hook.) Copel. in the shape of its involucral halves. It differs from C. agasthianum in having pinnatifid, dark green fronds with entire margined laminae and cup-shaped, broader than long indusia with dilated but not spreading mouths. Crepidomanes agasthianum has pale green, digitate, narrowly segmented fronds with undulate margins and cupular sori with nar-
row mouths subtended by branches of costa running into two long overtopping segments. Sori are characteristic in their dilation of the involucral mouths as well as in the overfullness of the involucral halves, which brings about the entire length of receptacle with sporangia visible from the upper view. These characters, along with the extreme dwarfness of the plant, differentiate this new taxon from *C. kurzii*, which is luxuriantly growing in the type locality.

**Paratypes:** INDIA. Kerala. Idukki Dt.: Thommankuthu stream, near Thodupuzha, 750 m, 27 Dec 1996, C.A. Hameed CU 34810 (CALI); Thommankuthu forest, 750 m, 13 Dec 1997, C.A. Hameed CU 34853 (CALI). Trichur Dt.: Athirapally forest, 1 km above Athirapally waterfall, 800m, 21 Dec 1997, C.A. Hameed, CU 34859 (CALI); Athirapally waterfall, 21 Dec 1997, C.A. Hameed CU 34864 (CALI).

**Acknowledgments**

The authors are grateful to J.F. Veldkamp, Rijksherbarium, Leiden, The Netherlands, for the Latin diagnosis.

**References**


Beddome, R.H. 1866. The ferns of British India. Gantz Bros., Madras.


A SECOND SPECIES OF ORITROPHIUM (ASTERACEAE: ASTEREEAE) FROM MEXICO

GUY L. NESOM

BONAP-NCBG

Coker Hall CB 3280

University of North Carolina,

Chapel Hill, NC 27599-3280, U.S.A.

ABSTRACT

Oritrophium durangense Nesom, sp. nov., is described from the Sierra Madre of southern Durango, Mexico. It is the second species of the genus known from Mexico, following another recently described from the northeastern slopes of Pico de Orizaba in Veracruz, about 1000 kilometers northwest of the Durango locality. The remainder of the species of Oritrophium occur in montane habitats of northern South America.

Identification and review of specimens of Asteraceae tribe Astereae in LL,TEX have brought to light a collection of the genus Oritrophium (Kunth) Cuatrec. from near the crest of the Sierra Madre in southern Durango, Mexico. These plants do not correspond to the single previously described species of Oritrophium in Mexico (Nesom 1992) or any other species of the genus from its center of diversity in South America (Aristeguieta 1964; Cuatrecasas 1961, 1969, 1997). The plants from Durango are described here as a new species.

Oritrophium durangense Nesom, sp. nov. (Fig. 1). Type: MEXICO. DURANGO: Mpio. El Salto, 4 km de la desv. hacia San Miguel de Cruces, bosque de pino-encino principalmente, suelo profundo, con piedra suelta, 2200 m; herbacea de 15–25 cm de alto, flores amarillas, en cabezuela, abundante; 6 Jul 1982, R. Hernandez 7676 con P. Tenorio (holotype: TEX!). The specimen was identified (on the distributed label) as "Pionocarpus [= losethane] af. madrensis (Wats.) Blake."

A Oritrophio orizabense Nesom differt caudice tenui foliis basalibus paucis, foliis integris, foliis basalibus caulinis longioribus, et floribus radii paucioribus limbis multo brevieribus.

Perennial herbs from a short, thick (ca. 8 mm) fibrous-rooted rhizome, producing an erect, unbranched stem and a cluster of erect-ascending basal
Fig. 1. Habit illustration of *Oritrophium durangense*, from the type collection.
leaves. Stems 12–16 (–25) cm tall, purplish, minutely pubescent with a mixture of Type B and Type C trichomes (see Nesom 1976 for illustrations), most densely so near the heads. Leaves basal (largest) and cauline (reduced in size); basal leaves linear, 1-nerved, entire, flat, somewhat succulent, 7–14 cm long, 3–6 mm wide, gradually tapered to a long, sharp point, glabrous except near the base, where long, thin, cobwebby hairs (Type B) become copious and conspicuous near the leaf insertion; cauline leaves reduced in size from the basal, linear-lanceolate, 10–14 mm long, 2–2.5 mm wide at the base, subclasping but not at all auriculate, 7–11 per stem, relatively evenly sized up the stem, with internodes 1–3 cm long, most closely spaced toward the base. Heads radiate, turbinate, the involucres 10–14 mm wide; phyllaries thin-herbaceous, without conspicuous venation, purple on the margins and apex, nearly flat, oblong-lanceolate, mostly with acute apices, slightly lacerate-fringed on the distal margins, in 3 (–4) graduated series, the innermost 8–10 mm long, ca. 2 mm wide, the outermost 1/2–2/3 as long as the inner; receptacles flat, epaleate. Ray flowers pistillate, ca. 10–15 in a single series, the corollas 6–7 mm long, the limbs 3–5 mm long, barely exserted from the head, white or creamy, 1.8 mm wide, apically coiling, densely invested with viscid, unicellular hairs around the tube-limb junction, the tube ca 2 mm long; disc flowers functionally staminate, with regular corollas, 5 mm long, yellow, narrowly tubular-funnelform, the lobes triangular, 1 mm long, the style branches linear-lanceolate, 1.8 mm long, densely long-papillate, without stigmatic lines. Ray achenes fertile, densely sericeous, eglandular, 5-nerved, ca. 5 mm long (not completely mature), narrowly oblong, with pappus of numerous barbellate bristles 4–5 mm long in 1–2 series; disc ovaries sterile, with pappus bristles nearly smooth, equalling the disc corolla length.

The new species is known only from the type collection. The type sheet apparently bears two plants (one without the root/caudex system) and four basal leaves disconnected from a plant. The illustration “attaches” several of these leaves to the more complete plant. It is likely that a single plant may produce several flowering stems, as is characteristic of other species of the genus.

The plants of Oritrophium durangense are simple in habit but distinct in appearance, producing a few, linear, basal leaves, a single, monocephalous stem with a few, small, nearly bracteate cauline leaves, and a relatively small head. The ray corollas are white and apparently barely exserted from the involucre, perhaps accounting for why the collectors described the flowers as yellow (the color of the disc corollas). Still, it seems unusual that the species is currently known only from a single collection, since numerous botanists have passed through the area and made collections. The collectors of O. durangense noted that it was “abundante.”
These plants are unequivocally identified as the genus *Oritrophium* by a distinctive set of features: monocarpal herbs producing a basal rosette of elongate leaves, white rays, functionally staminate disc flowers (with sterile ovaries and associated features of the style branches), phyllaries with inconspicuous venation, copiously elaborated, thin, nearly floccose white hairs (Type B trichomes) in the axils of the basal leaves, and a lack of long, uniseriate, thick-walled trichomes (Type A trichomes). The new species is perhaps related to *O. orizabense* and a small group of Venezuelan species (Nesom 1992), but this is speculative. The two Mexican species are different enough from each other that even a hypothesis of sister relationship between them is obscure.

The new species differs from *Oritrophium orizabense* in its relatively thin caudex/rhizome (8 mm vs. 7–15 mm) with few basal leaves (vs. dense cluster of basal leaves), entire (vs. serrate) leaves, longer leaves (basal 7–14 cm vs 1.5–4.0 cm, cauline 10–14 mm vs. 4–6 mm), and fewer ray flowers (10–15 vs. 21–37) with much shorter limbs (3–5 mm vs. 7–10 mm). While the habitat of *O. orizabense* is a cliff face, that of *O. durangense* is in soil ("suelo profundo"), probably in a relatively flat area, with loose rocks ("con piedra sueltos"). The habitat of *O. orizabense* apparently is more like that of most of the South American species, which generally grow "in wet places, the marshy and swampy ground of the *paramos*, locations that are visited by birds looking for water and seeds" (Cuatrecasas 1997, p. 289).

*Oritrophium orizabense* is disjunct from the main part of the genus (from the closest point of distribution in Venezuela) by about 1500 kilometers. The separation between *O. durangense* and *O. orizabense* is about 1000 kilometers, with the latter the midpoint in more or less a straight line, making the distance between the Durango locality and those in South America about 2500 kilometers.

ACKNOWLEDGMENTS

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REFERENCES


UNIQUENESS OF THE ENDANGERED FLORIDA SEMAPHORE CACTUS (OPUNTIA CORALLICOLA)

DANIEL F. AUSTIN and DAVID M. BINNINGER

Department of Biological Sciences
Florida Atlantic University
Boca Raton, FL 33431, U.S.A.

DONALD J. PINKAVA

Department of Botany
Arizona State University
Tempe, AZ 35878, U.S.A.

ABSTRACT

Morphological analysis led to the conclusion that Florida Semaphore Cactus is a distinct species. That conclusion is congruent with genetic studies reported elsewhere. Our plants are properly called Opuntia corallicola (Small) Werdermann (O. subgenus Consoled). The Florida plants are not O. spinosissima, as recorded in recent literature. Indeed, the Florida plants are probably more closely related to O. rubescens and O. milspaughii than to O. spinosissima. Details of the Florida species, and a key to similar and confusing Caribbean relatives are provided. Because of the limited number of individuals remaining in the wild, the threat from the alien pest moth Cactoblastis cactorum, the low genetic diversity within Florida, and recent damage by Hurricane Georges, the Semaphore Cactus may be the most endangered plant in the United States.

RESUMEN

El estudio morfológico nos lleva a la conclusión de que el cactus semáforo de Florida es una especie distinta. Esta conclusión está de acuerdo con los estudios genéticos publicados en otros lugares. Las plantas son propiamente llamadas Opuntia corallicola (Small) Werdermann (O. subgénero Consoled). Las plantas de Florida no son O. spinosissima, tal como fue publicado en la literatura reciente. Es más, las plantas de Florida probablemente son más cercanas a O. rubescens y O. milspaughii que a O. spinosissima. Se ofrecen detalles de la especie de Florida y una clave taxonómica de las especies emparentadas y confusas del área del Caribe. Dado el número limitado de individuos que quedan en estado salvaje, la amenaza de la polilla aloctona Cactoblastis cactorum, la poca diversidad genética dentro de Florida, y el reciente impacto del huracán Georges, el cactus semáforo puede que sea la planta más amenazada de los Estados Unidos de Norte América (EEUU).

In 1930, John K. Small described a cactus from the Florida Keys as a new species that he called Consolea corallicola. Very little was known about the species in the 1930s and in the subsequent decades until it became a candidate for endangerment in the 1970s under the name O. spinosissima.

Cactus hobbyists were thought to have eliminated the species from the state in the late 1970s. Even George Avery, a student of the Keys flora for 25 years at the time, could not locate the plants because they no longer grew where he had known them (Austin et al. 1980; Avery 1981). Somewhat later Ann Williams (in litt. 1986) found plants in the lower Keys and brought them to everyone’s attention. Eventually the land on which the Semaphore Cactus grew was purchased by The Nature Conservancy and it is now managed as a preserve (Gordon & Kubisiak 1998; Negrón-Ortíz 1998).

Although the Florida Semaphore Cactus rarely appears in the literature, there has been a raging controversy behind the scenes about what species it really is. Long and Lakela (1971) seem to be responsible for first calling the plants *Opuntia spinosissima* Miller, and they recorded it as endemic to Florida even though that name was given originally to Jamaican plants (Britton & Rose 1937). *Opuntia spinosissima* was picked up by those compiling the “Smithsonian List” of endangered species from the 1970s and that name continued to be used in subsequent publications (e.g., Benson 1982; Palmer 1984; Wunderlin 1998; Negrón-Ortíz 1998).

In the early 1980s, unpublished letters were being exchanged by Richard Howard of Harvard University and George Avery of Miami. Swayed by Howard and Touw’s (1982) comments on the Lesser Antilles plants, Avery decided that the Florida Keys plants must be *Opuntia rubescens*, Salm-Dyck. ex DC. (G. N. Avery, in litt.).

This was the state of affairs in 1990 when Doria Gordon (The Nature Conservancy, Gainesville), who was concerned about their plants on the preserve, brought the problem to our attention. We present here the first results of our studies. Other studies examine the genetic relationships of these endangered plants and their relatives (Dougherty 1996; Gordon & Kubisiak 1998).

To discover the evolutionary and nomenclatural status of the Florida plants, it was first necessary to determine what taxa have been considered related to those plants. Various authors have considered this alliance at different ranks. Some consider *Consolea* Lemaire a distinct genus (Areces 1996). We consider it a subgenus, e.g., *Opuntia* subg. *Consolea* (Lemaire) A. Burger.

Methods. Survey of the literature revealed nine nominate species. Areces (1996) has excluded *O. babamana* from them and we concur (Fig. 1). We were able to obtain live specimens of six of the taxa. Live material of these six remains in the collections at Fairchild Tropical Garden. Duplicates have been sent to the University of Arizona and Desert Botanical Garden, Tempe. From the living material available, and the literature records of the other species, we created a data matrix of morphological traits that may be used for recognizing these various plants. We present here only those six species most likely to be confused with the Florida plants (Table 1).
Results and Conclusions. Confusion of *O. corallicola* with *O. spinosissima* apparently resulted from previous studies not having examined living plants (Austin and Pinkava 1991). Although names are not fixed by typification in *O. spinosissima* and *O. rubescens*, we are applying them consistently with historical usage. Moreover, the morphotypes have distinct ranges (Table 1) consistent with historical name application, and with the usage by Areces (1996).

As stated by Britton and Rose (1937), *O. spinosissima* is endemic to Jamaica. Although *O. rubescens* is widespread in the upper Antilles (Fig. 1), it too is distinct from the Florida plants. In addition to morphological traits, *O. rubescens* has $2n=132$ chromosomes in the living material we examined. Previous reports have given *Opuntia rubescens* as $2n=22$ and 132 (Spencer 1955; Katagiri 1952; Yuasa et al. 1973). We do not know if these reports represent different chromosome races or misidentifications. At least the numbers are consistent with polyploid series known within the genus (Pinkava et al. 1985).

Analysis of morphology indicates that the Florida population of Semaphore Cactus, *O. corallicola*, is related to *O. millspaughii*, *O. rubescens*, and
<table>
<thead>
<tr>
<th>Traits</th>
<th><em>coryllicola</em></th>
<th><em>spinosissima</em></th>
<th><em>rubescens</em></th>
<th><em>millipanghi</em></th>
<th><em>nashii</em></th>
<th><em>montiformis</em></th>
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</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>Florida Keys</td>
<td>Jamaica</td>
<td>Hispaniola &amp; Puerto Rico to Guadelupe</td>
<td>Cuba and the Bahamas to Caymans</td>
<td>Bahamas</td>
<td>Cuba</td>
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the Jamaican endemic *O. spinosissima* (Austin and Pinkava 1991). Chloroplast DNA study (Dougherty 1996) supports that conclusion. The morphological data (Table 1) indicates more similarities between *O. millspaughii* and *O. coralloclloa* than between the others. RAPD data (Gordon & Kubisiak 1998) also indicate that *O. coralloclloa* is more closely related to *O. millspaughii* (Cayman Brac plants of Gordon & Kubisiak 1998) than to *O. spinosissima*.

As the Cayman Brac plants are a species (*O. millspaughii*) that ranges geographically closer to Florida than Jamaica, the morphological and genetic results are consistent with biogeographic predictions (Brown 1998). More exact relationships among the various species within *Opuntia* subg. *Consolea*, and between those species and the remainder of the genus will be reported by Areces (New York Botanical Garden).

We conclude that Small (1930) was correct when he proposed the Florida Semaphore cacti as distinct. While this uniqueness was confused by use of the name *O. spinosissima* in recent literature, available data indicate that the Florida and Jamaica plants are markedly different species. The Jamaica plants are morphologically unique (Table 1) and endemic to that island, as originally recorded by Britton and Rose (1937).

**TAXONOMY**

The complete taxonomy of the group *Consolea* is being revised by Areces (1996). Here, only the Florida taxon will be addressed.


*Opuntia spinosissima* sensu authors, non Miller (1768).

Description: Shrub or small tree 1—3.5 m tall. Trunk nearly cylindrical, 0.5—2.5 m long, reaching 3—4 cm in diameter. Larger terminal joints light green, standing mostly ascending, all flattened, ca. 1 cm thick, mostly elliptic, but ranging to elongate or asymmetrical, 1—3 dm long. Areoles elliptic, typically 1—1.5 cm apart. Spines numerous, in all areoles or some joints nearly spineless, gray or white, turning brown with age, 2—3(—4) per areole, spreading and deflexed, the longer 7—12 cm, basally 0.25—0.5 mm in diameter, acicular, nearly circular in cross section, twisted, somewhat barbed. Glochids yellow, abundant, 1—1.5 mm long. Leaves rudimentary, small, deciduous, scale-like. Flowers 1.2—2.5 cm in diameter. Sepals green, ovate-deltoid, 3—6 mm long, mostly acute. Petals orange-yellow, turning red shortly after opening, broadly ovate-acute, mucronate, entire. Filaments yellow, 6 mm long; anthers yellow, 0.5 mm long. Styles 6—7.5 mm long, ca 0.5 mm in diameter; stigmas 5, thick, mostly 1.5 mm long. Ovary in anthesis spiny,
flattened. Fruits when produced turning yellow, 5–6 cm long, proliferous; seeds few, circular and flattened, irregular, the edges crista, the sides puberulent, 6–8 mm in diameter.

Range.—Known from 12 plants with vegetative seedlings on The Nature Conservancy preserve in the Florida Keys; also a few individuals that have been brought into cultivation from sites in the keys, both known and unknown. Formerly known from Key Largo and Big Pine Key.

Illustrations.—A color plate 493 was published by Small (1930).

Comments.—Britton and Rose (1937) provided a black and white plate of *O. spinosissima* with a longitudinal section of the flower and ovary showing the nectar chamber typical of subgenus *Consolea*. That chamber is also found in *Nopalea*. Areces (1996:230) has given superlative diagnostic sketches of the flowers of four other species in subgenus *Consolea*: *O. macracantha*, *O. moniliformis*, *O. nashii*, and *O. millsbaughii*. The flowers of *O. corallicola* are most similar to those of *O. millsbaughii*, but these two differ in several other traits (Table 1).

The nectary chamber, the unjointed central woody axis, and distinctive pollen (Leuenberger 1976), are among traits that make *Consolea* distinctive, regardless of the rank it is given (Areces 1996).

**KEY TO SOME CONFUSING CARIBBEAN OPUNTIA**

      Fruits proliferous ................................................... *O. rubescens*
1. Spines gray or white (brownish with age).
   3. Areoles reticulate. Spines >12 cm long, mostly marginal. Fruits non-proliferous. .......................................................... *O. millsbaughii*
   3. Areoles not reticulate. Spines 3–12 cm long, over entire surface. Fruits proliferous.
      4. Areoles sunken, 1–1.5 cm apart. Joints 1–3 dm long. Pericarpels 5–6 cm long .............................................................. *O. corallicola*
      4. Areoles raised and pitted, 1.5–3 cm apart. Joints ≥ 10 dm long.
         Pericarpels 3–4 cm long ............................................ *O. nashii*

The future. Current findings indicate that the Florida plants are an exceptionally rare and endangered endemic species. Presently *O. corallicola* is known from 12 plants on one small land parcel that is owned and protected by The Nature Conservancy. That organization has formulated and implemented an informal recovery plan for this endangered species, but that procedure is complicated by recent events.

The presence of the exotic moth *Cactoblastis cactorum* has initiated a series of problems with those plants (Pemberton 1995). This moth has substan-
tially reduced the abundance of *Opuntia* in the Keys and attacked the Semaphore cacti in the past. Those attacks resulted in most of the remaining plants being placed within screened “cages” in 1990. Although the cacti grow in partial shade conditions, the exclosures may have altered the light quality reaching the plants and caused growth anomalies such as etiolation. No data are available on these characters. Moreover, the cages exclude any potential pollinators of the cacti, precluding potential allogamous sexual reproduction. Future survival with this insect pest is problematical for the Florida plants in spite of the dubious declining infestation trends predicted by Johnson and Stiling (1998). That short-term study, terminated in 1993, did not include the Florida Atlantic University (FAU) campus (Pierce 1995), nor did it address the more recent (1996–1998) upswing in infestation in southern Florida. Cultivated plants on the FAU campus were destroyed during 1997 by *Cactoblastis*, after the native population of *O. stricta* was decimated.

A second more recent event has led to another problem for the plants. Hurricane Georges swept through the Florida Keys in September of 1998. The exclosures were removed when the Hurricane was approaching and have not been replaced. With that event, storm surge swept over the low limestone keys and deposited ocean water. That salty deposit was not immediately diluted by subsequent rainfall, and its long-term impact on the plants is unknown. Also, the main stems on two of the individuals were broken. On others the stems remained erect, but the pads were removed (D. Gordon, pers. comm., 13 Oct 1998). Smaller propagules at the bases of the cacti remain. The full impact of the hurricane on these plants is still being evaluated.

**ACKNOWLEDGMENTS**

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**REFERENCES**


ARKANSAS CAREX (CYPERACEAE): A BRIEFLY ANNOTATED LIST

PHILIP E. HYATT
Kisatchie National Forest
2500 Shreveport Highway
Pineville, LA 71360, U.S.A.

ABSTRACT

Recent collections and herbarium specimen study resulted in this review of the status of the 121 taxa in the genus Carex occurring the state of Arkansas, USA. A list of these taxa provides frequency and habitat data, while county dot maps show known distribution. The list gives additional information on selected taxa, especially on rare species, on taxa previously considered rare in Arkansas, or on nine taxa reported new to Arkansas. This paper considers several taxa as distinct which were previously treated as synonyms by other authors. It reports four hybrids, and treats taxa excluded from the Arkansas flora, as well as taxa considered to be possible additions to the state flora.

RESUMEN

Recientes recolecciones estudios de especímenes de herbario dieron como resultado esta revisión del estatus de los 121 taxa del género Carex del estado de Arkansas, USA. Una lista de estos taxa ofrece datos de frecuencia y hábitat, mientras que los mapas de condados muestran la distribución conocida. La lista da información adicional de taxa selectos, especialmente de especies raras, de taxa considerados raros previamente en Arkansas, o de los nueve taxa citados como nuevos para Arkansas. Este trabajo considera como distintos varios taxa que habían sido tratados como sinónimos por otros autores. Se citan cuatro híbridos, y se tratan taxa excluidos de la flora de Arkansas, así como taxa considerados como posibles adiciones a la flora del estado.

INTRODUCTION

Smith published county record dot maps for 2,469 taxa of vascular plants (1988), and keys to Arkansas’ vascular flora (1994). In May 1991, the author set a goal of publishing a book on Arkansas Carex in 2011 and began field work toward that end. This paper presents initial results of that study through the 1996 field season. The author’s collections, a review of literature, and a review of collections at several herbaria provide the bases for this study.

METHODS

Field work in the last seven years resulted in 1523 Arkansas Carex collections, excluding duplicates. 1794 herbarium collections were reviewed [ACPR had 178 collections, CLEM 18, LSU 24, LSUS 3, LTU 46, MO

149*, MOR 8, NA 88, NLU 652, NO 28, SFRP 21, STAR 147, UAM 113, UARK 237*, UNCC 0, USCH 14, WCUH 1, Buffalo National River herbarium 58, Sylamore Ranger District/Experimental Forest herbarium (Ozark National Forest) 9. An asterisk (*) indicates incomplete reviews. Anthony A. Reznicek reviewed and provided reports of 483 additional Arkansas Carex collections at MICH, excluding Hyatt collections. Several factors make the declaration of state records difficult. Consultation with Reznicek resulted in the recognition of many taxa not formerly recognized as distinct by some authors. Some species pairs previously lumped and now split are not treated herein as state records. Declaring state records draws attention to both species new to Arkansas and to species with vouchers which may have been lying unreported in herbaria.

ECOLOGICAL UNITS OF ARKANSAS

Keys, et al. (1995) provides the basis for a map of the ecological regions of Arkansas (Fig. 1). Keys’ map and accompanying booklet describe ecological units for the eastern United States, defined as part of the Humid Temperate Domain. Within Arkansas, the Subtropical and Hot Continental Divisions of the Domain occur, with the Ozark Highlands and Boston Mountain Sections represented in the latter, and several sections represented in the former Division. A brief description of the ecologically defined Sections represented in Arkansas, and mapped in Figure 1, based, in part, on Keys’ text follows. The figure also shows Crowley’s Ridge, a significant subsection. Two letter abbreviations used in Figure 1 precede each section’s description.

AV—The Arkansas Valley Section contains the Arkansas River in western Arkansas, and unique Mount Magazine, the highest peak in the state. The sandy and alluvial soils of the valley contrast with the sandstone and shale of the Mountain. White Oak, Northern Red Oak, and hickories dominate the hills which hide a few small wetlands and many perennial streams.

BM—The Boston Mountains, made of high hills and low mountains, lay over sandstones. Southern Red, White, Northern Red, and Post Oaks share the hillsides with various hickories, the hills cut by perennial streams.

CP—Often referred to as the West Gulf Coastal Plain, the Middle Coastal Plains, Western Section (as labeled by Keys et. al. 1995), forms smooth to irregular plains and riverine valleys on various mixtures of sands, silts, clays, and gravels. Shortleaf and Loblolly pines mix with a variety of oaks and hickories, with other wetland species along the frequent streams and rivers.

CR—The subsection known as Crowley’s Ridge, an isolated low ridge of Pleistocene loess, nearly bisects the Mississippi Alluvial Basin. Various oaks as well as Beech-Maple forest thrive on this narrow strip of rolling hills surrounded by flatlands. Short stream channels drain the ridge.
MB—The fertile farms of the Mississippi Alluvial Basin Section lie in an area which once held much of Arkansas’ wetlands. Earthquakes infrequently rock northeastern sections near the New Madrid fault, causing liquefaction of the alluvial sands, silts, and clays which cover this section. Forests vary from more upland species such as oaks and hickories, to those associated with wetter sites to riverine wetlands, including Loblolly Pine, Sweetgum, hickories, Willow and other oaks, Sycamore, and Birch. Drainage ditches reduced wetlands, although many wetlands remain.

OU—The Ouachita Mountains, unlike the eroded plain of the Ozarks, fold into open high hills and low mountains, on sandstone, shales, and cherts, often with bouldery characteristics. Shortleaf Pine and a mixture of the above oak species cover the hills, with streams often following the east-west lie of the mountains.

OZ—The low hills, irregular plains, karst, and entrenched valleys of the Ozark Highlands contain cherty clay residuum on dolomites, limestones,
and sandstones. Vegetation includes various Oak forests, including White, Post, Blackjack, and Black Oak, with prairie potential in Bluestem and other grasses. Entrenched streams and cool springs provide a haven for northern carices reaching the southern edge of their range.

ARKANSAS CAREX (CYPERACEAE): A BRIEFLY ANNOTATED LIST

The following alphabetical list provides a snapshot of current knowledge on the 121 Carex taxa recognized in Arkansas. Taxonomy follows the draft of the Flora of North America Carex treatment, provided by A.A. Reznicek of MICH (ined.). The general format for entries follows:

Accepted genus species (in bold); author(s); figure number (distribution mapped); synonyms (in italics); frequency, habitat, comments. An asterisk indicates new state records; voucher specimens cited in some cases.

Frequency statements, unless qualified, represent observed frequency in Arkansas. Arkansas habitats listed include data drawn from personal observations, herbarium labels, consultation with others, or in rare cases, the literature.

The author’s collections skew the distributions of some species; Baxter County, the author’s home for several years, is both the most heavily collected and has the most known species. North Central Arkansas is better represented than most other regions. Recent collections in south Arkansas, nearest the author’s current home, make it better represented than eastern Arkansas, a neglected area. For example, Carex umbellata turned up in 28 new western Arkansas counties on a single trip in 1996, while eastern Arkansas has known records primarily from the author’s recent collections.

Arkansas distribution maps have two shades, solid for counties where the author confirmed the identification of a specimen, cross-hatched when reported elsewhere without the author’s confirmation of the identification. Most of the identifications of the author’s collections were confirmed or corrected by A.A. Reznicek, while most herbarium specimens (with the exception of those at MICH) were not.

C. abscondita Mack.—(Fig. 2). Locally numerous, in dense colonies; restricted to floodplains in moist deciduous woods (prefers natural levees). See Naczi and Bryson (1990).

*C. aggregata Mack.—(Fig. 2). Rare, moist opening in a disturbed creek bottom forest, and also an adjacent pasture (formerly forest) and hedgerow by road next to the pasture (S. & G. Jones, A. & S. Reznicek 11140 BRCH, MICH, TRTE, VDB); Benton Co. Bailey & Gibbons s.n. (UARK) from May 28, 1975 was determined as C. aggregata by Stanley D. Jones (E.B. Smith, pers. comm.).

*C. alata Torr. & A. Gray.—(Fig. 2). A record of this plant (D. Castaner 9119 at WIS) from Crowley’s Ridge State Park area, collected May 10, 1986 was pointed out by Anthony A. Reznicek. This plant, probably scattered in northern Arkansas, also occurs in Missouri within four miles of Fulton County, Arkansas.

C. albicans Willd. var. albicans.—(Fig. 2). Carex aritctica Mack., C. enmonnii Dew. ex Torr. var. mablenbergii (A. Gray) Retig. C. physorhyncha Liebm. Occasional, widespread: bluffs, hillsides.
Fig. 2. Documented county records in Arkansas for Carex species (solid = counties where the author confirmed the identification, and cross-hatched = when reported elsewhere without the author's confirmation).
C. albicans Willd. var. australis (L.H. Bailey) Retig.—(Fig. 2). Carex emmonsii Dew. ex Torrey var. australis (L.H. Bailey) Retig. C. physorrhyncha Liebm. Infrequent, poorly known in state. See Orzell and Bridges (1987).

C. albutescens Schwein.—(Fig. 2). Occasional to common south, infrequent northwest; floodplains, wet woods.

C. alburna Sheldon.—(Fig. 2). Taxonomy of Arkansas material needs study; locally abundant, deep valleys, mesic north-facing slopes.

C. amphibola Steud. sensu lato—(Fig. 2). Common northwest, occasional elsewhere; valleys, floodplains.

C. annectens Bickn. var. annectens.—(Fig. 2). Common (several more counties represented at UARK pers. comm. 1994), ruderal.

C. arkansana L.H. Bailey.—(Fig. 2). Infrequent to rare; prairies, surrounding ruderal areas (Hyatt 4623.03, 4829.03 MICH, UARK).

C. atlantica L.H. Bailey subsp. atlantica.—(Fig. 2). Infrequent; streamsides in bog-like areas, sometimes with Sphagnum mosses. Poorly studied in Arkansas (Orzell 1783 MICH).

C. atlantica L.H. Bailey subsp. capitacea (L.H. Bailey) Reznicek.—(Fig. 2). Locally abundant; bog-like streamside floodplain (Orzell 1321 MICH).

C. austriana (Small) Mack.—(Fig. 2). Occasional to common north, infrequent south; roadsides, prairies.

*C. basiana Schk.—(Fig. 2). Occasional, locally abundant; floodplains, forms large colonies along larger streams. Infrequent in the Ozarks, where C. jamesii largely replaces it (Orzell 1733 MICH). Considered distinct from C. willdenowii. Nacci et al. (1998) discussed the recognition of this species.

C. bicknellii Britt. var. opaca E.J. Herm.—(Fig. 3). Infrequent; prairie regions and remnants. See Jones and Reznicek (1991) for a key to Texas Ovales, and Herman (1972).

C. blanda Dew.—(Fig. 3). Carex laxiflora Lam, var. blanda (Dew.) Boott. Common to abundant, widespread; mesic woodlands, ruderal.

C. brevior (Dew.) Mack. ex Lutell.—(Fig. 3). Occasional; ruderal, natural habitats poorly known in Arkansas.

C. bromoides Schk. var. bromoides.—(Fig. 3). Rare, cherty soil, full shade (Rettig 1982); probably from swampy areas.

C. bulbostylis Mack.—(Fig. 3). Infrequent to occasional, poorly known; “mesic sandy ravine forest with some calcareous influence” (Orzell & Bridges 1987), floodplain forests.

C. bulata Schk.—(Fig. 3). Rare; wet areas on sandy soil, roadside, open or wooded. Known in Arkansas from two collections (Moore 100396, and Bryson 5775; UARK). These represent the only known sites west of the Mississippi River (A.A. Reznicek, pers. comm.). Lipcomb (1980) cites Moore 480070 WIS, from Logan County.

C. bushii Mack.—(Fig. 3). Occasional, locally common; prairies, glades.

C. careyana Torr.—(Fig. 3). Infrequent, very locally abundant; deep mesic valleys on talus slopes often below bluffs (Hyatt 5891 MICH).

C. caroliniana Schwein.—(Fig. 3). Occasional north, common south; ditches, sunny valleys.

C. cephalophora Muhl. ex Willd.—(Fig. 3). Common, widespread; woodlands.

C. cherokeensis Schwein.—(Fig. 3). Common, widespread; floodplains, often of smaller streams, ditches, old fields, wet woods, swamps.

C. communis L.H. Bailey.—(Fig. 3). Occasional, locally abundant; bluffs, especially below bluffs on upper talus slopes.

C. comosa Boott.—(Fig. 3). Infrequent; borders of larger streams, small lakes.

C. complanata Torr. & Hook.—(Fig. 3). Carex complanata Torr. and Hook. var. complanata Infrequent north, common to abundant elsewhere; ditches, pine woods, often ruderal.

C. conjuncta Boott.—(Fig. 3). Rare; open wooded pasture, wet area (Reznicek 9792 MICH,
Fig. 3. Documented county records in Arkansas for *Carex* species (solid = counties where the author confirmed the identification, and cross-hatched = when reported elsewhere without the author's confirmation).
Fig. 4. Documented county records in Arkansas for *Carex* species (solid = counties where the author confirmed the identification, and cross-hatched = when reported elsewhere without the author's confirmation).
UARK). The author has not seen the voucher (Jones & Reznicek 1995).
C. corrugata Fern.—(Fig. 4). Locally common; restricted to floodplains of major rivers, streams, low woods.
C. crawei Dew.—(Fig. 4). Occasional, very locally abundant; calcareous sunny seeps, springs, glades, most frequent in rights-of-way which cross glades.
C. crebriflora Wieg.—(Fig. 4). Occasional to common; local to small drainages, stream floodplains (Demaree 14415 MICH). C. crinata Lam.—(Fig. 4). Locally common; perennial streambanks, wetlands.
C. crus-corvi Shuttlew. ex Kuntze.—(Fig. 4). Occasional, often scattered; wetlands, ruderal wetlands, often roadsides.
C. davisi Schwein. & Torr.—(Fig. 4). Locally common, occasional in north Arkansas, especially on the Salem Plateau; calcareous stream floodplains, pastures, woodlands (Hyatt 1994).
C. debilis Michx. var. debilis.—(Fig. 4). Common to abundant south; sweet bay and magnolia swamps, stream terraces, creekbanks.
C. debilis Michx. var. pubera A. Gray.—(Fig. 4). Rare; Morrow’s Bottoms Natural Area (Sundell and Barnes 9753, UAM).
C. decomposita Muhl.—(Fig. 4). Infrequent, swamp and lake margins (Moore 490043 UARK).
C. digitalis Willd. var. digitalis.—(Fig. 4). Common; upland and north-facing deciduous woods.
C. digitalis Willd. var. macropoda Fern.—(Fig. 4). Infrequent; rich woods and floodplains (Hyatt, et al. 5290, MICH, UARK). Anthony A. Reznicek reports (pers. comm.) a specimen collected by Hasse in Little Rock, May 1886, has vouchers at BH, MICH, and NY.
C. eburnea Boott.—(Fig. 4). Occasional; very local herbaceous dominant, calcareous glade outcrops, bluffs at wet microsites.
C. emoryi Dew.—(Fig. 4). Rare; streambanks (Walker, s.n. UARK).
C. festucacea Schk.—(Fig. 4). Common; prairie wetlands, ruderal. Underrepresented in collections.
*C. fissa Mack. var. fissa.—(Fig. 4). Rare, “Moist, open grassy and sedgey meadow, heavy clay soil (Reznicek 9271, MICH). See Jones, et. al. (1990).
C. flaccosperma Dew.—(Fig. 5). Common; floodplains, widespread in flatlands.
C. frankii Kunth.—(Fig. 5). Abundant; creekbanks, lakeshores, ditches. Arkansas’ most widely reported Carex sedge.
C. gigantea Rudge.—(Fig. 5). Infrequent; riverside (Demaree 3379, UARK), lowlands near Crowley’s Ridge and common in a backwater swamp (Orzell 3483 MICH).
C. glaucescens Ell.—(Fig. 5). Infrequent; floodplains of smaller streams, swamps (A.A. Martin s.n. SFRP).
C. glaucodea Tuckerm.—(Fig. 5). Occasional; ruderal, woodlands, frequent in seldom used woods roads.
C. gracilescens Steud.—(Fig. 5). Rare; steep rocky slopes above the Cossatot River (Naczi 1917, 1926, MICH). Record courtesy of A.A. Reznicek.
C. gracillima Schwein.—(Fig. 5). Rare, two very small, local, Ozark populations on moist north facing rock outcrop (Hyatt 1993), mesic deep valley below sandstone bluff at dripping waterfall (Hyatt 5723, MICH, UARK).
C. granularis Muhl.—(Fig. 5). Locally common to occasional; springs, seeps, ditches.
C. gravia 1.H. Bailey var. gravia.—(Fig. 5). Infrequent; prairies.
C. grayi Carey.—(Fig. 5). Carex grayii Carey, an orthographic variant. Occasional; wooded wetlands, ditches.
C. grisea Wahl.—(Fig. 5). Occasional; calcareous floodplain woods, less frequent in sur-
Fig. 5. Documented county records in Arkansas for Carex species (solid = counties where the author confirmed the identification, and cross-hatched = when reported elsewhere without the author’s confirmation).
Fig. 6. Documented county records in Arkansas for *Carex* species (solid = counties where the author confirmed the identification, and cross-hatched = when reported elsewhere without the author’s confirmation).
rounding uplands.

**C. hirsutella** Mack.—(Fig. 5). *Carex complanata* Torr. and Hook. var. *hirsutella* (L.H. Bailey) Gleason. Abundant to common north, occasional to infrequent south; ruderal, very widespread.

**C. hirtifolia** Mack.—(Fig. 5). Infrequent; mesic valleys and floodplains of small to medium sized streams at many, but localized sites (Thomas et al. 1991).

**C. hitchcockiana** Dew.—(Fig. 5). Infrequent; mesic, topographically shaded and protected, cool north facing slopes in deep valleys near larger intermittent streams. Such Ozark streams often have long superficially dry sections with flow under gravel.

**C. hyalina** Boott.—(Fig. 5). Locally abundant to common, absent outside specialized habitat; prefers shaded deciduous woods often on clay soils, periodically flooded, usually along major rivers and tributaries. Often easily found by looking near bridges on rights-of-way crossing floodplains. See Bryson, et al. (1992), Reznicek and Naczi (1993), Reznicek and Hyatt (1996).

**C. hyalinolepis** Steud.—(Fig. 6). Occasional; forming huge colonies with long, stout rhizomes in swamps, ditches, wet prairies.

**C. hysterica** Muhl. ex Willd.—(Fig. 6). *Carex hysterica* Muhl. ex Willd. an orthographic variant. Occasional, very locally abundant; limestone dominated seeps, springs, and streams. Prefers sunny sites with perennial streams; absent nearly everywhere else; rare at heavily shaded sites.

**C. interior** L.H. Bailey.—(Fig. 6). Rare; calcareous seeps (Orzell and Bridges 1987; Reznicek and Ball 1980).

**C. intumescens** Rudge.—(Fig. 6). Common; widespread in wetland woods, wetland edges.

**C. jamesii** Schwein.—(Fig. 6). Locally abundant; floodplains, especially in deep, narrow valleys.

**C. joorii** L.H. Bailey.—(Fig. 6). Common to infrequent; wetland woods, swamps, wooded roadsides.

**C. laevivaginata** (Kukenth.) Mack.—(Fig. 6). Infrequent; swampy meadows, calcareous seeps.

**C. latebracteata** Waterfall.—(Fig. 6). Infrequent, locally numerous; "well drained dry to dry-mesic slopes" (Orzell & Bridges, 1987).

**C. laxiculmis** Schwein. var. *copulata* (L.H. Bailey) Mack.—(Fig. 6). Infrequent; mesic north-facing slopes in deep valleys.

**C. laxiculmis** Schwein. var. *laxiculmis*.—(Fig. 6). Taxonomy of Arkansas varieties needs study, poorly known, but 1997 collections revealed several new sites; infrequent; mesic valleys in deciduous woods.

**C. laxiflora** Lam. var. *laxiflora*.—(Fig. 6). Arkansas distribution poorly understood, Arkansas material needs taxonomic study; occasional (but varieties in question); mesic woodlands.

**C. laxiflora** Lam. var. *serrulata* Underwood.—(Fig. 6). Arkansas distribution poorly understood, Arkansas material needs taxonomic study; rare; rich woods.

**C. leavenworthii** Dew.—(Fig. 6). Common; ruderal.

**C. leptalea** Wahl.—(Fig. 6). *Carex leptalea* Wahl. var. *leptalea*. Occasional; calcareous seeps in northern Arkansas, wooded seeps at base of slopes in southern Arkansas.

**C. longii** Mack.—(Fig. 6). Occasional and probably very undercollected, especially in south Arkansas; wet woods. See Rothrock (1991).

**C. louisianica** L.H. Bailey.—(Fig. 7). Occasional; swamps and low wetland woods. See Reznicek and Ball (1974); Jones and Hatch (1990).

**C. lupuliformis** Sartwell.—(Fig. 7). Occasional; wetter habitats than and similar habitats to *C. lupulina* (A.A. Reznicek, pers. comm. 1993).

**C. lupulina** Muhl.—(Fig. 7). Common; wetland woods, prairie edges, swamps, ditches.
C. lurida Wahl.—(Fig. 7). Common; widespread along streams, lakeshores, ditches, swamps.
C. meadii Dew.—(Fig. 7). Occasional; limestone glades, sinks, prairies.
*C. mesochorea* Muhl. ex Willd.—(Fig. 7). Reported here as a state record for Arkansas; rare, ruderal; (*Hyatt* 5485, 5494, 5636, MICH, UARK).
C. microdonta Torr. & Hook.—(Fig. 7). Infrequent; chalk glades (*Moore 400161* UARK), prairie openings, glades. See Lipscomb (1980).
C. molesta Mack.—(Fig. 7). Occasional; floodplains, usually of larger streams “commonly ruderal . . . near or along streams and in open woodland. However it often prefers heavy, clayey soils and is definitely more of a calciphile [than *C. molestiformis*]” (*Reznicek & Rothrock* 1997).
C. molestiformis Reznicek & Rothrock.—(Fig. 7). Occasional; riverine floodplains, ruderal. Reznicek and Rothrock (1997), in recently describing this species, note it “thrives in a wide variety of open to somewhat shaded, mostly ruderal, habitats with a wide range of associates, including ditches, dryish roadsides, river and streambanks, moist meadows, and open forests . . . . Typically, colonies of *C. molestiformis* rarely occur far from streams . . . .” collaborating the author’s initial observations. *C. molesta*, while also exhibiting strong ruderal tendencies, occurs more typically in sunny upland spring and stream sites and ruderal settings which imitate these habitats, while *C. molestiformis* is more riverine.
C. muhlenbergii Willd. var. enervis Boott.—(Fig. 7). Varieties poorly studied in Arkansas; common species; dry, acid soil woodland/glade complex (*Orzell & Bridges* 1987).
C. muhlenbergii Willd. var. muhlenbergii.—(Fig. 7). Varieties poorly studied in Arkansas; common species; widespread in woodlands, roadsides. The varieties may have once been separate species with separate habitats and little intergrading until recent disturbance confused the issue (S. D. Jones, pers. comm.).
C. muskingumensis Schw.—(Fig. 7). Infrequent; floodplains. Orzell and Bridges (1987) report it in “open areas of a wet-mesic interstream flatwoods.”
C. nigromarginata Schw.—(Fig. 7), including the poorly differentiated *C. floridana* Schw. Occasional; widespread in woodlands. This species presents a variety of overlapping growth and color forms, with occasional long rhizomes and pale to heavily purple splotted and dark green leaves. Morphology intergrades, making distinctions difficult.
*C. normalis* Mack.—(Fig. 7). Reported here new to Arkansas. Rare; seepy roadside ditch on acid sandstone, deep valley, deciduous woods, floodplain of the Little Red River of the Ozark region (*Hyatt, et. al. 5275*, MICH, UARK), streamside in Sharp County.
C. oklahomensis Mack.—(Fig. 7). Common; ditches, wetlands.
C. oligocarpa Schk.—(Fig. 8). Common; streambanks, north-facing slopes, deciduous woods. *C. ouachitana* Kral, Manhart, & Bryson.—(Fig. 8). Occasional, locally widespread and abundant; “arenaceous oak-hickory-pine uplands” (Kral et al. 1987) and “rocky ridgetop and slope forest throughout much of the Ouachita Mountains” (*Orzell and Bridges* 1987). See also McNelis (1992) and Naczi and Bryson (1990).
C. oxylepis Torr. & Hook. var. oxylepis.—(Fig. 8). Occasional; rich hardwoods in mountains, swamps and ditches elsewhere.
C. oxylepis Torr. & Hook. var. pubescens Underwood.—(Fig. 8). Occasional, locally common; seeps, moist bluffs, floodplains. Rarely reported outside Arkansas.
C. ozarkana Rothrock & Reznicek.—(Fig. 8). Occasional, locally frequent; Rothrock and Reznicek (1996) described this species from the Arkansas hills, Oklahoma Ouachitas, and one Texas location. The author found it at two locations within 30 miles of, and expects it in, extreme north Louisiana. Rothrock and Reznicek (ibid) call it “a species of early succession wetlands on mineral soil . . . . [from] banks of streams and . . . ditches, pond shores, and wet depressions in meadows and pastures.”
C. pellita Willd.—(Fig. 8). *Carex lanuginosa* Michx. Rare (*McNalty 321* STAR).
Fig. 7. Documented county records in Arkansas for Carex species (solid = counties where the author confirmed the identification, and cross-hatched = when reported elsewhere without the author's confirmation).
Fig. 8. Documented county records in Arkansas for Carex species (solid = counties where the author confirmed the identification, and cross-hatched = when reported elsewhere without the author's confirmation).
C. pensylvanica Lam.—(Fig. 8). Occasional; benches on north facing slopes in White Oak woods, habitat poorly reviewed.

C. planostachys Kunze.—(Fig. 8). Rare, locally abundant; chalk glade outcrop complex. Northeastern extent of range barely extending into southwest Arkansas in a unique habitat with Juniperus virginiana on exposed white chalk outcrop (Davis and Rettig 2840 APCR earliest collection found, April 1, 1981).

C. prasina Wahl.—(Fig. 8). Rare; a single collection (Demaree 5050 UARK) from May 12, 1928 along War Eagle Creek in northwest Arkansas. "Rare in Mississippi and Missouri" states A.A. Reznicek (pers. comm.) suggesting "Crowley's Ridge is a likely bet, along a woodland seep with Liriodendron."

*C. radiata* (Wahl.) Small—(Fig. 8). *Carex rosea* sensu Mack. Reported here as new to Arkansas, rare. *Hyatt 5678 MICH, UARK, peh from the Buffalo National River at T16N, R15W, S4, in moist calcareous woods near Arkansas Highway 14.

C. reniformis (L.H. Bailey) Smll.—(Fig. 8). Occasional; floodplains of larger streams, lakeshores.

C. retroflexa Willd.—(Fig. 8). Common; widespread.

C. rosea Schkuhr.—(Fig. 8). *Carex convoluta* sensu Mack. See Webber and Ball (1984) for synonymy and distribution of *C. radiata, C. rosea, and C. socialis*; common mountains, infrequent elsewhere; valleys and riparian areas.

*C. scoparia* Schk. ex Willd.—(Fig. 8). Rare; wet, disturbed meadow dominated by *Juncus, Carex*, and diverse weedy grasses where it forms frequent large clumps (Reznicek 9789 MICH). Numerous authors included it Arkansas' flora (Smith 1988).

*C. scorsa* Howe.—(Fig. 8). Rare; "low woods". Historic record only, no reports in this century. A.A. Reznicek (pers. comm. 1995) located a specimen collected by Hasse in 1885 at MICH.

C. shortiana Dew.—(Fig. 9). Infrequent; calcareous sunny wetlands and springs.

C. socialis Mohlenbrock and Schwegmann.—(Fig. 9). Occasional; floodplains of larger rivers in several areas, associated with *C. hyalina* and *C. corrugata*. Some authors have treated this as a synonym of *C. rosea*; habitat and morphology make it distinct (Webber & Ball 1984).

C. sparganioides Muhl.—(Fig. 9). Infrequent, typically local in small colonies of fewer than 20 plants, sometimes 3-4, rarely near 100, with colonies widespread but well scattered; calcareous valleys and floodplains.

C. squarrosa L.—(Fig. 9). Occasional, usually scattered individuals; ditches, floodplain woods.

C. striatula Michx.—(Fig. 9). Locally common; rich wooded slopes on sandy soils. See Naczi and Bryson (1990).

C. stricta Lam.—(Fig. 9). Infrequent; creek gravelbeds.

C. suberecta (Olney) Britt.—(Fig. 9). Infrequent; calciphile at springs, mossy fens, seeps.

C. swanii (Fern.) Mack.—(Fig. 9). Infrequent; sinks, deep valleys, floodplains.

C. texensis L.H. Bailey.—(Fig. 9). Occasional; mountain valleys.

C. torta Boott.—(Fig. 9). Occasional; mountain gravel streams, forming clumps between rocks.

C. triangularis Boeck.—(Fig. 9). Common; ditches.

C. tribuloides Wahl.—(Fig. 9). Common; widespread. See also Reznicek (1993).

C. typhina Michx.—(Fig. 9). Occasional; oak savannah wetlands, ditches, creek terraces, and other wetlands.

C. umbellata Schkuhr.—(Fig. 9), including Arkansas reports of *C. abdita*. Considered Arkansas' most frequent and widespread sedge (third most widely reported), easily overlooked, upland forests, roadsides. In 1992, ranked S1 (6 or fewer known locations in state) by the
Arkansas Natural Heritage Commission; 1996 collections added 28 counties. Now rivaling the frequently collected C. frankii and C. vulpinoidea. Recommended as the state Carex sedge of Arkansas. Fruits often infested by smut. Early blooming species with fruits often harvested by ants; may be an important spring food for ants.

C. virescens Muhl. ex Willd.—(Fig. 9). Two records: historic Harvey s.n. UARK, “low woods”, July 1884, county unknown; Reitig 554-UARK, 20MAY1982, Mont. Co., “Red Oak, Sweet Gum overstory.”

C. vulpinoidea Michx.—(Fig. 10). Abundant; ruderal and widespread, a wetland species. The second most widely reported Arkansas Carex sedge.

C. willdenowii Willd. var. willdenowii.—(Fig. 10). Rare; known only from a single location (Iron Springs Recreation Area, Ouachita National Forest) west of the Mississippi River (A.A. Reznicek, pers. comm.). See Orzell and Bridges (1987) and Naczi and Bryson (1990). All other Arkansas “C. willdenowii” specimens reviewed should be considered C. basiantha.

**HYBRIDS**

C. albicans var. albicans × C. nigromarginata puzitive hybrid—Determined by A.A. Reznicek (Hyatt 6907, MICH); from Woodruff County.

C. flaccosperma × C. glaucodea puzitive hybrid—Determined by A.A. Reznicek (Hyatt 6488, MICH); from Saline County.

C. flaccosperma × C. granularis puzitive hybrid—Determined by A.A. Reznicek (Reznicek 9291, MICH); from Saline County.

C. lurida × C. lupulina puzitive hybrid—Determined by A.A. Reznicek (Hyatt 5720, MICH, UARK); from Lonoke County.

**POSSIBLE ADDITIONS**

The following taxa, listed as “possible additions” by Smith (1988) have since been confirmed in Arkansas by collections: C. davisii, C. gracilescens, C. hyalina (pre-1988 collections of C. hyalina were not represented at UARK), and C. suberecta. Possible additions to the flora of Arkansas follow.

C. annectens Bickn. var. xanthocarpa (Bicknell) Wiegand.—Hyatt 4343 (MICH, UARK) was misidentified as this taxon initially. This variety could occur in north Arkansas.


C. incomptera Bickn.—Reported for Arkansas by Demaree (1943). No vouchers found.

C. picta Steud.—Possibly rare in southern Arkansas.

C. styloflexa Buckl.—Possibly in “southeast Arkansas in boggy or wet places in hardwoods at the bases of slopes of bluffs” (Reznicek, pers. comm.).

C. tenera Dew.—Possibly rare in northern Arkansas. Unpublished reports by the author based on an immature specimen of C. normalis.

C. verrucosa Muhl.—“Listed for Arkansas by Demaree (1943); perhaps rare in south Arkansas” (Smith 1988).

**EXCLUDED TAXA**

Smith (1988) excluded the following taxa from the flora of Arkansas; I concur; C. baileyi, C. douglasii, C. exilis, C. flava, C. gynandra, C. haydenii,
Fig. 9. Documented county records in Arkansas for Carex species (solid = counties where the author confirmed the identification, and cross-hatched = when reported elsewhere without the author’s confirmation).
Fig. 10. Documented county records in Arkansas for Carex species (solid = counties where the author confirmed the identification, and cross-hatched = when reported elsewhere without the author's confirmation).

*C. lacustris*, *C. muricata*, *C. plantaginea*, *C. platyphylla*, *C. sartwellii*, *C. sprengelii*, *C. tetanica*. Two additional taxa, excluded by Smith (ibid), are now known to occur in Arkansas. Additional excluded taxa follow.

*C. backii* Boott.—Reported for Arkansas by Lipscomb (1980) based on immature specimens of *C. latebracteata*. A.A. Reznicek (pers. comm.) has seen the voucher.

*C. straminea* Willd.—Anthony A. Reznicek (pers. comm. 1996) noted the one Missouri location for this is a considerable disjunct, and Oklahoma reports of *C. straminea* are based on the recently named *C. ozarkana*.

*C. tetanica* Schk.—Anthony A. Reznicek (pers. comm. 1993) notes “not in Arkansas, possibly not in Missouri even.”

ACKNOWLEDGMENTS

Many thanks to A.A. Reznicek (MICH) for his abundant help in nearly all facets of the work required to produce this article, E.B. Smith (UARK) for his continuous encouragement and assistance, and to the various state and federal agencies who provided permission to collect on their lands, including especially the U.S.D.A. Forest Service, Buffalo National River, and the Arkansas State Parks.

REFERENCES


AGALINIS (SCROPHULARIACEAE)
IN THE OZARK HIGHLANDS

JOHN F. HAYS
Ozark Environmental Consulting
3308 Keenes Edge Drive
Columbia, MO 65201, U.S.A.

ABSTRACT

The ten species of Agalinis known to occur in the Ozark Highlands are treated floristically. A key to the species is presented along with descriptions, flowering time, ecological data, and distribution maps. In addition, taxa considered rare are noted and their current statuses indicated.

INTRODUCTION


These revisions, along with nearly 90 years of collecting since Pennell first undertook his study of the genus, necessitate the presentation of new
data concerning the taxonomic status and distribution of *Agalinis* throughout North America. The purpose of my paper is to present an up-to-date account of the distribution, taxonomy, nomenclature, and rarity of *Agalinis* in the Ozark Highlands as well as to provide an unambiguous key for the identification of these species. Approximately 3,000 herbarium specimens from 24 herbaria were examined (listed in acknowledgments), and I made over 200 collections of *Agalinis* during the course of this study. Each dot on a distribution map represents one or more verified voucher specimens. Vouchers I collected were deposited at MO or remain in my possession.

**STUDY AREA**

The Ozark Highlands, often referred to as the Ozark Plateau(s), Ozark Province, the Ozark Highland (Cozzens 1940; Fenneman 1938; Sauer 1920; Thom and Wilson 1980), or locally as simply the “Ozarks,” is a distinct geological area classified as the Ozark Plateaus geomorphic province (Thornbury 1965), an area of over 134,000 square kilometers. Within this geomorphic province fall two distinct ecological sections, the Ozark Highlands Section, and the Boston Mountains Section (McNab and Evers 1994). The Ozark Highlands Section comprises over 85 percent of the area, and dolomites and limestones predominate, forming one of the most extensive karst regions in the country (Nigh et al. 1992). Such extensive karst features as caves, springs, seeps, and sinkholes are common. In the Boston Mountains Section to the southwest, on the other hand, sandstones and shales predominate, and the sandstone exposures that dominate the landscape in this section stand in contrast to the more carbonate landscape of the Ozark Highlands Section.

The Ozark Highlands Section is characterized by gently rolling to heavily dissected hills, whereas the Boston Mountains Section is characterized by low mountains, open hills, and hilly plains. The varied topography, as well as the distinct bedrock and soil types displayed throughout the Ozark Highlands, has produced a unique assemblage of terrestrial and aquatic communities, and the Ozark Highlands is considered a center of endemism (Nigh et al. 1992). Broadleaf deciduous forest (mostly oak-hickory) comprises the dominant vegetation type in the Ozark Highlands, but pine forests, prairies, glades, fens, marshes, and large rivers are also present in the area and add to its biological diversity.

The climate of the Ozark Highlands is continental, with precipitation averaging 122 to 132 centimeters annually, and the annual temperature averaging 13 to 18 degrees Celsius (McNab and Evers 1994). Elevation ranges from a low of 91 meters in Missouri to 914 meters in the Boston Mountains of Arkansas (Keys et al. 1995). Portions of Arkansas, Illinois, Kansas,
Missouri, and Oklahoma fall within the boundaries of the Ozark Highlands, but the overwhelming majority of this geomorphic province is found in Missouri and Arkansas.

**TAXONOMIC TREATMENT**


Ours annual, hemi-parasitic herbs with erect stems; leaves opposite or subopposite, linear to lanceolate or lance-ovate, sessile, entire, or (in two species) the leaves sometimes 3-cleft, laciniate, or with lateral lobes; inflorescences terminating most branches, a raceme or spike, sometimes racemiform; calyx gamosepalous, campanulate to hemispherical, 5-lobed, the lobes sometimes reduced to minute teeth; corolla gamopetalous, zygomorphic, 5-lobed, the two upper lobes reflexed-spreading or projecting forward, the three lower lobes spreading, usually pale pink to light purple, rarely white, the throat often dotted purple and with two yellow, longitudinal lines; stamens 4, didynamous; fruit a loculicidal capsule, globose, subglobose, ovoid, obvoid, or ellipsoid; seeds small, angular, the testa conspicuously reticulate, yellowish to black.

North American species are taxonomically difficult at the macromorphological level, and there is a relatively high percentage of misidentifications, especially in herbaria where specimens have not been examined critically. This frequent misidentification is a source of concern, considering the fact that 25 of the 33 North American species of *Agalinis* are tracked by state natural heritage programs as sensitive or rare species (Unpublished data, State Natural Heritage Programs, 1996 and 1997). The status of each species of *Agalinis* considered rare is indicated following its description. Status is based on the system of ranking rare taxa developed by the Nature Conservancy (LaRoe 1995). The Nature Conservancy's current method of ranking is summarized as follows (G=global and S=state): G1 and S1 (1–5 occurrences - critically imperiled), G2 and S2 (6–20 occurrences - imperiled), G3 and S3 (21–100 occurrences - rare), G4 and S4 (more than 101 occurrences - apparently secure), G5 and S5 (demonstratively secure), GH and SH (of historical occurrence only), GU and SU (possibly rare, but not enough documentation exists to propose a ranking), and GX and SX (apparently extinct or extirpated).

KEY TO SPECIES

Living plants of Agalinis appear quite different from their pressed and dried counterparts. It is helpful, therefore, to familiarize oneself with both fresh and dried material when working with this group. When identifying fresh or dried specimens, it is often necessary to examine specimens at 10X or greater magnification, and preferably with a dissecting microscope; sketching the corolla in the field while fresh to show the orientation of the lobes and the shape of the tube can also be helpful due to the membranous nature of the corollas, which can be easily distorted once pressed. The measurements used in the key and descriptions that follow are based on well-developed flowering and fruiting specimens, both fresh and dried. One must keep in mind that species in this genus demonstrate considerable plasticity, and that immature, depauperate, or diseased plants can make this inherent variation even more difficult to interpret; to the collector of such specimens: beware. There is also a genuine need for a thorough and detailed illustration of each species of Agalinis, which would greatly facilitate proper identification.

KEY TO THE SPECIES OF AGALINIS IN THE OZARK HIGHLANDS

1. Leaves lanceolate to lance-ovate, 5–25 mm wide, the upper leaves with two basal, lateral lobes; stem and calyx tube with retrorse-spreading hairs; calyx 10–16 mm long ................................................................. 2. A. auriculata

1. Leaves linear to lanceolate, 0.5–6(-7) mm broad, the upper leaves without basal, lateral lobes; stem and calyx tube glabrous or occasionally somewhat scabrous; calyx 3.5–8(-9) mm long.

2. Longest pedicels 6 mm or less long, shorter to slightly longer than the calyx.

3. Pedicels 1–3 mm long; calyx lobes 3–6 mm long, clearly longer than the calyx tube, the midveins of the lobes prominently ribbed; leaves lanceolate to linear-lanceolate, lower leaves sometimes 3-cleft or laciniate ............................................................. 3. A. heterophylla

3. Pedicels 2–6 mm long; calyx lobes 0.5–2(-2.5) mm long, shorter than the calyx tube, the midveins of the lobes without prominent keels; leaves linear to narrowly lanceolate, the lower leaves never 3-cleft or laciniate.

4. Calyx 5–9 mm long, long-campanulate; anthers 1.9–2.5 mm long; capsule 7–12 mm long, ellipsoid to oblong, longer than broad; leaves narrowly linear, 0.5–1.5 mm wide, erect and ascending, harshly scabrous above, the hairs heavily silicified, appearing marbled; fascicled leaves also ascending .................. 1. A. aspera

4. Calyx 3–5 mm long, hemispheric to short-campanulate; anthers 2.3–3.5 mm long; capsule 4–6 mm long, globose to subglobose, as broad or nearly as broad as long; leaves linear to linear-lanceolate, 1–4(-5) mm wide, spreading, arching, or curling, scabrous above, but not harshly so, or the hairs neither heavily silicified nor appearing marbled; fascicled leaves spreading, arching, or curling.
5. Middle 2/3 of main stem and largest branches noticeably to harshly scabrous; branches mostly ascending; axillary fascicles usually well-developed; 5 principal veins of the calyx (those leading to the lobes) as well as the lobes, scabrous ..........3. A. fasciculata

5. Middle 2/3 of main stem and largest branches glabrous to sparingly scabrous, but not harshly scabrous; branches spreading to ascending, axillary fascicles weakly to well-developed; 5 principal veins of the calyx as well as the lobes usually glabrous, or occasionally the veins of a few capsules scabrous.
6. Middle 2/3 of main stem and largest branches scabrous, the pubescence obvious, but scattered on both the stem faces and angles (avoid areas immediately around the nodes); branches mostly ascending; axillary fascicles usually well-developed, but sometimes only weakly so, the fascicled leaves often approaching or equaling the subtending leaves in length

6. Middle 2/3 of main stem and largest branches glabrous to subglabrous, the pubescence, when present, conspicuous on the angles (avoid areas immediately around the nodes); branches mostly spreading, but sometimes ascending, axillary fascicles absent or only weakly developed, the fascicled leaves, when present, noticeably shorter than the subtending leaves. .................................................................7. A. purpurea

2. Longest pedicels 6–30 mm long, slightly to much longer than the calyx.
7. Calyx 5–9 mm long, long-campanulate; capsule 7–12 mm long, ellipsoid to oblong, longer than broad; pedicels erect-ascending to arched-ascending; leaves stiffly ascending, harshly scabrous above, the hairs heavily silicified, appearing marbled ........................................1. A. aspera

7. Calyx 3–5.5 mm long, hemispheric to campanulate; capsule 3.5–6 (–7) mm long, globose or obovoid, as broad as long; pedicels spreading to ascending; leaves spreading to ascending, subglabrous to scabrous, but if scabrous, the hairs neither heavily silicified nor appearing marbled.
8. Upper two lobes of the corolla arching or projecting forward over the stamens; corolla glabrous within across the base of the two upper lobes; many pedicels abruptly upcurved distally; axillary fascicles often present.
9. Stem scabrous; leaves narrowly linear, 0.8–1.5 mm wide; the two upper lobes of the corolla projecting forward over the stamens, half the length of the three lower lobes, 2–3 mm long; pedicels scabrous at least basally; anthers 3–4 mm long, the two upper filaments densely villous basally and distally; seeds 0.8–1.6 mm long, the testa cells large in proportion to the total size of the seed .......................................................6. A. homalantha

9. Stem glabrous or with a few scattered hairs on the angles; leaves linear to narrowly lanceolate, 1–5(–6) mm wide; the two upper lobes of the corolla arched over the stamens, subequal to the three lower lobes, 4–5 mm long; pedicels glabrous; anthers 1–2.3 mm long, the upper filaments sparingly hairy throughout, but not densely villous basally and distally; seeds 0.7–1 mm long, the testa cells small in proportion to the total size of the seed .......................................................... 9. A. tenuifolia
8. Upper two lobes of the corolla reflexed-spreading; corolla pubescent within across the base of the two upper lobes; pedicels not abruptly upcurved distally (occasionally a few pedicels of A. gattengeri are upcurved distally); fascicles absent.

10. Outside of the three lower corolla lobes pubescent; leaves spreading, arching, or curling; numerous floriferous, lateral branches present, the flowers appearing solitary at the nodes, a terminal raceme rarely developed, the inflorescence more racemiform; stem subterete to 4-angled ......................................................... 4. A. gattengeri

10. Outside of the three lower corolla lobes glabrous; leaves mostly erect and ascending; few to many branches bearing obvious terminal racemes present; stem noticeably 4-angled and appearing winged.

11. Stem scabrous on the angles; few to many strongly ascending branches present; calyx hemispherical, the longest lobes 0.7–1.2 mm long; fruit globose ...................................................... 8. A. skinneriana

11. Stem glabrous on the angles; a few to many widely spreading branches present; calyx campanulate, the longest lobes 1.5–2.2 mm long; fruit obovoid ...................................................... 10. A. viridis


*Stem* 2–7 dm, subglabrous to sparingly scabrous, the branches ascending. *Leaves* narrowly linear, stiffly ascending, 0.5–1.5 mm wide, 1.5–4 cm long, harshly scabrous above, presenting a marbled appearance, and frequently scabrous on the midveins below. *Fiscicles* well-developed and also ascending. *Inflorescences* short to elongate racemes. *Pedicels* erect to arched-ascending, stout, 5–11 mm long, to 16 mm in fruit. *Calyx* campanulate, 5–9 mm long, the lobes 1.0–2.5 mm long. *Corolla* deep pink, 16–25(–28) mm long, the throat glabrous within or with a few scattered hairs across the base of the two reflexed-spreading, upper lobes. *Anthers* 1.9–2.5 mm long. *Capsule* ellipsoid to oblong, clearly longer than broad, 7–12 mm long. *Seeds* black, 0.9–1.1 mm long. *n=14* (Löve & Löve 1982). Note: voucher not seen. *Flowering* late August–early October.

*Distribution.*—Dry prairies, open woodlands, glades, and bluffs. Very rare in the Ozark Highlands (Fig. 1).

*Ecology and conservation status.*—G5; S2 in Arkansas. Although this species has been reported from Arkansas (Smith 1988), I have not found any vouchers specimens; all specimens labeled *A. aspera* from Arkansas have proved to be another species. *Agalinis aspera* is largely a species of the eastern Great Plains, and populations found eastward of this area are mostly peripheral and of scattered occurrence, usually being restricted to xeric habitats, such as bluffs, glades, and loess hills.

Stem 2–7(–8) dm, retrorsely scabrous, simple to sparingly branched above. Leaves lanceolate to lance-ovate, the upper with two basal, lateral lobes, 2.3–6 cm long, 0.5–2(–2.5) cm wide, scabrous above and below, lateral veins visible on both surfaces. Inflorescences spikes. Flowers essentially sessile, occurring in pairs in the upper leaf axils. Calyx campanulate, 10–16 mm long, the tube spreading-pubescent, the lobes 6–12 mm long, scabrous, longer than the tube. Corolla pink, 20–27(–29) mm long, the throat pubescent within across the base of the two reflexed-spreading, upper lobes. Anthers 1.9–2.4 mm long. Capsule ovoid, 9–14 mm long. Seeds yellowish, 1.2–1.6 mm long. n=13 (Kondo 1973). Flowering late August–September.

Distribution.—Dry or mesic prairies, fallow fields, borders of dry woods, and roadsides. Very rare in the Ozark Highlands (Fig. 2).

Ecology and conservation status.—G3; S1 in Arkansas, S2 in Illinois, S2 in Kansas, S2 in Missouri, and S1 in Oklahoma. Although a rare species throughout its range, Agalinis auriculata apparently can tolerate considerable disturbance, as evidenced by its ability to persist in degraded prairies, fallow fields, grazed meadows, and roadsides. Despite this apparent ability to tolerate continued human disturbance, the Jasper, Newton, Ozark, and St. Louis County, Missouri, sites, as well as the St. Clair County, Illinois, site, are based on historic collections or the populations are thought to be extirpated. Fortunately, however, there are a number of recent collections from the northern half of Missouri.


Gerardia fasciculata Elliott f. albiflora Palmer.

Stem 2.5–12 dm, scabridulous to harshly scabrous, much branched on larger plants, the branches ascending or spreading. Leaves linear to narrowly lanceolate, 1–4 cm long, 1–2(–4) mm wide, spreading, arching, or curling, scabrous above and often on the midveins below. Fascicles present and well-developed or sometimes only weakly so, the fascicled leaves shorter than to nearly approaching the main leaves, also spreading, arching, or curling. Inflorescences short to elongate racemes. Pedicels 2–6 mm long. Calyx campanulate to hemispherical, 3–5(–6) mm long, the lobes 0.5–1.5(–2) mm long, the five principal veins of the calyx (leading to the calyx lobes) scabrous; corolla pink to light purple, rarely white, 15–30 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes. Anthers 2.3–3.5 mm long. Capsule subglobose, 4.5–6(–7) mm long. Seeds 0.6–1 mm long, dark brown to black. n=14 (Canne 1981). Flowering from late August–late September.

Distribution.—Dry to moist prairies, borders of woods and ponds, open ground, fallow fields, and roadsides. Scattered in the Ozark Highlands (Fig.
3), occurring most frequently in the west and southwest portions of our area, where it nears the northern and northwesternmost limit of its range.

Ecology and conservation status.—G5; S2 in Kansas. In our area, *A. fasciculata* is most easily confused with the closely related and widespread *A. purpurea* (L.) Pennell. Less scabrous specimens of *A. fasciculata* with weakly developed fascicles are especially troublesome and difficult to separate from the more fascicled and scabrous specimens of *A. purpurea* (fortunately few specimens pose such problems). It is not the amount of stem pubescence on the less scabrous specimens of *A. fasciculata* that best distinguishes it from the more scabrous specimens of *A. purpurea*, but rather the size of the hairs, which
tend to be larger and broader-based, and in the distribution of the pubescence, which is usually scattered, but present throughout the stem faces as well as on the angles of the main stem in \textit{A. fasciculata}.

\textit{Agalinis purpurea}, on the other hand, has smooth stem faces and quite often smooth stem angles. On a noticeably pubescent plant of \textit{A. purpurea}, the broad-based hairs occur mostly along the stem angles at regular intervals. It is important to rely on the middle two-thirds of the main stem and largest branches when making observations concerning stem pubescence, as the smaller branches on both species can be quite scabrous, especially distally. In addition, the nodes should be avoided when relying on pubescence in identification, because both species are usually quite scabrous around these areas.

4. \textit{Agalinis gattingeri} (Small) Small \textit{ex Britton}. \textit{Gerardia gattingeri} Small.

\textit{Agalinis skinneriana} (sensu Holmgren 1986).

\textit{Stem} 1–5 dm, subglabrous to slightly scabrous, with spreading to somewhat ascending branches. \textit{Leaves} narrowly linear, 0.4–1.4 mm wide, 1.5–3(–4) cm long, spreading, arching, or curling, slightly scabrous above, and often on the midveins below. \textit{Fascicles} absent. \textit{Inflorescence} racemiform, a true raceme rarely developed, most flowers appearing solitary at the nodes on numerous short, floriferous, lateral branches. \textit{Pedicels} slender, spreading-ascending, 4–25(–30) mm long. \textit{Calyx} hemispherical, 3–5 mm long, the lobes 0.5–1.4 mm long. \textit{Corolla} pink to light purple, 8–15 mm long, the throat noticeably pubescent across the base of the two reflexed-spreading, upper lobes, the outside of the three lower lobes pubescent. \textit{Anthers} 1.3–2.0 mm long. \textit{Capsule} subglobose, 4–5 mm long. \textit{Seeds} 0.5–0.9 mm long, yellowish. \textit{n=13} (Canne 1984). \textit{Flowering} late August–early October.

\textit{Distribution}.—Dry, open woodlands, often in rocky soils of chert or sandstone, borders of dry forests, dry roadsides, glades, bluffs, and exposed ridges. Common throughout the Ozark Highlands (Fig. 4).

\textit{Ecology and conservation status}.—None. Holmgren (1986) combined \textit{A. gattingeri} with \textit{A. skinneriana}, but the two species have been shown to be distinct based on macromorphological and anatomical evidence (Canne-Hilliker 1987; Canne-Hilliker and Kampny 1991). \textit{Agalinis gattingeri} and \textit{A. tenuifolia} are the two most common species in the Ozark Highlands and are the only two species that have established themselves throughout the region with any frequency. Our other species occur mostly on the periphery of the Ozarks or are localized within the area in particular habitat types.

5. \textit{Agalinis heterophylla} (Nutt.) Small \textit{ex Britton}. \textit{Gerardia heterophylla} Nutt.

\textit{Stem} 3–8 dm, glabrous to very sparingly scabrous, usually much branched
Fig. 2. Presently confirmed county records in the Ozark Highlands for *Agalinis auriculata*.

above. *Leaves* linear-lanceolate to lanceolate, 1.5–3.5 cm long, 1.8–6 mm broad, the lowermost sometimes 3-cleft or laciniate, but these usually not present at flowering time, scabrous above and occasionally on the midveins below, the undersurfaces of larger stem leaves with a few faint, but noticeable, lateral veins, (these veins usually not noticeable on dried specimens). *Fascicles* absent. *Inflorescences* short to elongate racemes. *Pedicels* stout, 1–3 mm long. *Calyx* campanulate, 5.5–10(–11) mm long, the lobes 3–6 mm long, clearly longer than the calyx tube, usually with a prominent midnerve and appearing ribbed. *Corolla* pink to light purple, 20–33 mm long, the throat glabrous across the base of the two reflexed-spreading, upper lobes.
Flowering late August–September.

**Distribution.**—Moist prairies, fallow fields, moist, open ground, and roadsides, usually in moist soils, but occasionally found in drier sites. Rare and localized in the Ozark Highlands (Fig. 5).

**Ecology and conservation status.**—G5; S2 in Kansas, S1 in Missouri. This is another species of *Agalinis* that nears the northwesternmost occurrence of its range in the Ozark Highlands; it is much more common in southern Arkansas, eastern Texas, Louisiana, and Oklahoma outside of the Ozarkian region of the state.


**Stem** 3–10 dm, scabrous. **Leaves** narrowly linear, scabrous above and on the midveins below. 1.5–4.5 cm long, 0.8–1.5 mm wide. **Fascicles** well-developed. **Inflorescences** short racemes, with only 3–8(–10) flowers per raceme. **Pedicels** slender, spreading-ascending, often upcurved distally, 6–30 mm long, usually scabrous throughout, but at least basally. **Calyx** campanulate, 3–5(–6) mm long, the lobes 0.6–1.5 mm long. **Corolla** deep pink, 15–26 mm long, the throat glabrous across the base of the two flattened to slightly arched, forward projecting upper lobes, the upper two lobes 2–3 mm long and half the length of the three spreading lower lobes. **Anthers** 3–4 mm long, the upper filaments densely pubescent basally and distally. **Capsule** globose, 5–7 mm long. **Seeds** dark brown to nearly black, 0.8–1.6 mm long, *n*=13 (Vincent 1982). **Flowering** August–September.

**Distribution.**—Dry, sandy soils along roadsides, along the dry, sandy banks of the Arkansas River and the dry to xeric, sandy terrace communities just beyond the banks of the river. Very rare in the Ozark Highlands (Fig. 6), restricted to a few counties where the Ozark Highlands approach the Arkansas River Valley in Conway, Crawford, Franklin, and Pope counties in Arkansas, and Sequoyah County in Oklahoma. This is yet another species of *Agalinis* that reaches the limits of its range in the Ozark Highlands; in this case the species northernmost occurrence.

**Ecology and conservation status.**—G5; S1 in Arkansas, S1 in Oklahoma. This species was only recently found to occur in Arkansas, and most of the sites in the state are found outside of the Ozark Highlands along the Arkansas River. I believe based on my field work along the Arkansas River alone that enough sites will eventually be found to judge this species demonstratively secure in Arkansas. *Agalinis homalantha* has also been collected recently in Mississippi. While reviewing the holdings of *Agalinis* at the Missouri Botanical Garden in January 1997, I found a specimen originally determined as *A. tenuifolia* that is actually *A. homalantha*; this collec-
tion represents the first known occurrence for this species in Mississippi. MISSISSIPPI: Bolivar Co.: 2 mi S of Rosedale, W of MS HW 1, T23N, R8W, S. 27, S2; coarse, sandy soil along wood's edge between levee and Mississippi River, 16 Aug 1990, Bryson 10170 (MO).

In our area this species is most easily confused with *A. tenuifolia*, from which it can be readily distinguished by its scabrous stems and pedicels, the two very short, flattened or slightly arched upper corolla lobes, the size of the anthers, which average twice as long as those of *A. tenuifolia*, and the much larger seeds.

*Gerardia purpurea* L. f. *albiflora* Britton.

*Stem* 1–10 dm, glabrous to subglabrous, much branched on larger plants. *Leaves* linear to narrowly linear-lanceolate, 1–4(–5) mm wide, 1–5 cm long, spreading, arching, or curling, scabrous above and often on the midveins below. *Fascicles* usually absent or only weakly developed, but when present clearly shorter than the main leaves. *Inflorescences* short to elongate racemes. *Pedicels* 2–5(–6) mm long. *Calyx* campanulate to hemispherical, 4–6 mm
long, the lobes 0.8–2(–2.3) mm long, the five principal veins of the calyx (leading to the calyx lobes) glabrous or rarely a few veins slightly scabrous. *Corolla* rose-purple, rarely white, 18–33 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes. *Anthers* 2–3.5 mm long. *Capsule* subglobose, 4–6 mm long. *Seeds* dark brown to black, 0.7–1.2 mm long. $n=14$ (Canne 1981). *Flowering* late August–early October.

*Distribution.*—Moist prairies and roadsides, moist open ground, ditches, and pond margins. Rare and scattered in the Ozark Highlands (Fig. 7), but probably more common than its distribution suggests.
Ecology and conservation status.—G5; S2 in Kansas, S2 in Missouri. *Agalinis purpurea* and *A. fasciculata* are the most difficult species to distinguish from one another in the Ozark Highlands due to the variable nature of each taxon (see the discussion under *A. fasciculata*). Although *A. fasciculata* can be found under wet to mesic conditions, *A. purpurea* cannot tolerate the more xeric conditions favored by *A. fasciculata* in our area, and thus a difficult specimen collected on an upland prairie or another dry to xeric site can be default to *A. fasciculata*. Occasionally, *A. purpurea* is found in dry soil, but close attention to its associate species will indicate that the habitat is actually a seasonally dry, moist to wet community.

*Stem* 1–5(–6) dm, sharply 4-angled, appearing winged, the angles scabrous but the stem faces glabrous, simple to sparingly branched, the branches ascending. *Leaves* linear, ascending-appressed, the lowermost slightly spreading, 0.5–1.5 mm wide, 1–2(–2.5) cm long, scabrous above and on the midveins below. *Fascicles* absent. *Inflorescences* short racemes. *Pedicels* 0.4–1.6(–2) cm long. *Calyx* hemispherical, 2–4(–4.5) mm long, the lobes 0.4–1.2 mm long. *Corolla* pink to rarely white, 8–16 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes, the outside of the three lower lobes glabrous. *Anthers* 0.6–1.2 mm long. *Cap-
Agalinis in the Ozark Highlands

Fr.; Presently confirmed county records in the Ozark Highlands for *Agalinis skinneriana.*

Globose, 3.5–5 mm long. Seeds 0.6–1.0 mm long, yellowish. *n*=13 (Canne 1984). Flowering late August–early October.

**Distribution.**—Dry prairies and large dolomite glades. Rare and localized in the Ozark Highlands (Fig. 8).

**Ecology and conservation status.**—G3; S2 in Illinois, S3 in Missouri. Although not state-listed in Kansas, there are only a handful of known sites there, and the species clearly warrants protection in that state. Smith (1988) reported *A. skinneriana* from numerous counties in Arkansas, but I have been able to locate only one historic (19th century) specimen of this species for the state in all of my herbarium searches, and the specimen has

Fig. 8. Presently confirmed county records in the Ozark Highlands for *Agalinis skinneriana.*
very imprecise label data. ARKANSAS: Prairies and woods, N.W. Arkansas, *Floyd s.s.* (UARK); all other specimens seen by me labeled *A. skinneriana* have proved to be another species. The sites in Barry and Iron counties, Missouri, are based on historic collections, but I believe that *A. skinneriana* will eventually be relocated in Iron County or found in adjacent Reynolds County, due to the abundance of suitable habitat (in this case igneous glades) that still remains in both counties. Steyermark (1963) also recorded *A. skinneriana* from McDonald County, Missouri. He was undoubtedly referring to a specimen collected by B.F. Bush, cited by Pennell (1929), that resides in the herbarium of the Botanical Museum at the University of Copenhagen, Denmark (C). But because I did not review this specimen I have not included *A. skinneriana* from McDonald County, although Pennell’s annotation was in all likelihood correct.

On dry prairies *A. skinneriana* occurs mostly where the vegetation is sparse, such as the summit of hills or on gentle slopes where the substrate is near the surface, or along the upper parts of the narrow draws that frequently occur on prairies, where some slight erosion is usually evident. On dolomite glades it is found in either the more vegetated parts of the glade or in nearly bare soil.

In the Ozark Highlands *Agalinis skinneriana* is often confused with *A. gattingeri*, or smaller plants of *A. tenuifolia*. It is readily distinguished from *A. tenuifolia* by the corolla, which in *A. skinneriana* is pubescent within the base of the two reflexed-spreading, upper corolla lobes, and by the sharply winged stem with its noticeably scabrous margins. It can be distinguished from *A. gattingeri* by the presence of a true raceme, the glabrous outsurface of the three lower corolla lobes, and erect-ascending leaves.


*Agalinis besseyana* (Britton) Britton.

Stem 2–7 dm, subglabrous to glabrous, much branched on larger plants. Leaves linear to lanceolate, spreading, ascending, or arched, 1–5(–6) mm wide, 3–7 cm long, scabridulous above and often on the midveins below. Fascicles absent or present. Inflorescences elongate racemes. Pedicels slender, spreading, often abruptly upcurved distally, 6–25 mm long. Calyx hemispherical, 3–5.5 mm long, the lobes 0.5–2 mm long. Corolla light to dark pink, 10–16 mm long, the lobes 4–6 mm long, the throat glabrous within across the base of the two forward arching, upper lobes, the two upper lobes subequal to the three lower lobes. Anthers 1–2(–2.3) mm long. Capsule globose,
4–6 mm long. Seeds tan to dark brown, 0.7–1 mm long. *n* = 14 (Canne 1984). Flowering principally from late August–early October, occasionally flowering as early as late June.

**Distribution.**—Dry or moist prairies, borders of woodlands, ponds, marshes, and rocky streams, also in ditches, fallow fields, and along railroads and roadsides Common in the Ozark Highlands (Fig. 9), but less frequent in the west and southwest portions of the region.

**Ecology and conservation status.**—G5; S3 in Oklahoma. Along with *Agalinis gattingeri*, *A. tenuifolia* is the most common species in the Ozark Highlands, and is the most common and widespread species of *Agalinis* in North
America. Agalinis tenuifolia and A. gattingeri are the only two species that occur with any frequency in the Ozark Highlands, the other species being restricted to the periphery of our area or to particular habitats within the Highlands. Agalinis tenuifolia is easily recognized in the field during flowering by the two long, forward arching, upper lobes of the corolla, which project over the anthers and most of the style. The only species that it can be confused with in the field during flowering in our area is A. homalantha. In A. homalantha, however, the style extends well beyond the two very short, forward to slightly arching upper corolla lobes, the pedicels are scabrous, and the species has a specific habitat and restricted range in our area.

Agalinis tenuifolia is a complex and variable species for which a number of intergrading varieties have been described. As Steyermark (1963) aptly stated of the varieties in our area: “The varieties presented here are not very distinct, except in their extremes, often showing overlapping characters, thus making their determination doubtful or unsatisfactory.” Although it is possible at times to identify plants confidently as a particular variety, I believe it best at present to treat these weak varieties as one highly variable species pending future research.

10. Agalinis viridis (Small) Pennell Gerardia viridis Small.

Stem 1–6 dm, sharply 4-angled, appearing winged, the angles and stem faces glabrous, with a few to many widely spreading branches. Leaves linear 0.5–2 mm wide, sometimes the lowermost stem leaves approaching 3 mm in width, 1–2.5(–3) cm long, scabrous above and on the midveins below. Fascicles absent. Inflorescences racemes. Calyx campanulate, 3–4.5 mm long, the longest lobes 1.5–2.2 mm long. Corolla translucent to pink, 8–12 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes, the outside of the three lower lobes glabrous. Anthers 0.8–1.3 mm long. Capsule obovoid, 5–6(–7) mm long. Seeds yellowish, 0.7–1 mm long. n=? Flowering late August–September.

Distribution.—Moist prairies, along the non-forested portions of prairie draws, along the borders of seasonally wet depressions in prairies where the vegetation is sparse, and rarely on the drier portions of prairies. Very rare in the Ozark Highlands (Fig. 10), where it is currently known from only four counties.

Ecology and conservation status.—G4; S1 in Missouri, S1 in Oklahoma. Agalinis viridis is yet another species that reaches its northern and northwesternmost occurrence in the Ozark Highlands; it is much more common south of the Arkansas River, and occupies a wider range of habitats there. The Jasper County, Missouri, location represents an isolated occurrence of this species; it was once collected throughout this county, but is now re-
Fig. 10. Presently confirmed county records in the Ozark Highlands for *Agalinis viridis*.

stricted to Wah-Sha-She Prairie Natural Area, over 300 kilometers from the nearest known extant site for this species.

ACKNOWLEDGMENTS

I thank Jim Harlen of the University of Missouri’s geography department for his help with distribution maps; Judith Canne-Hilliker of the University of Guelph in Ontario, Canada, for sharing her fathomless knowledge of *Agalinis* with me during our frequent communications; John Thieret of Northern Kentucky University, Floyd Swink of the Morton Arboretum in Lisle, Illinois, and George Yatskievych of the Flora of Missouri Project at the Mis-
souri Botanical Garden for critiquing the manuscript; Tom Foti and John Logan of the Arkansas Natural Heritage Commission for pointing me to areas of interest in Arkansas; William Hess of the Morton Arboretum and Robin Kennedy of the Dunn-Palmer Herbarium at the University of Missouri-Columbia for procuring loans as well as providing working space; and the curators of the following herbaria for providing me with loans or allowing me to visit their herbaria: APCR, DSC, F, ILL, ILLS, KANU, KSP, MISS, MO, MODNR, MOR, NLU, OKL, SEMO, SIU, SOTO, STAR, SMS, TULS, UAM, UARK, UCAC, UMO, and WARM.

REFERENCES


BOOK NOTICE


This book contains results of a symposium hosted by the Smithsonian Migratory Bird Center. It includes an extensive introduction and 19 chapters contributed by some of the most active field researchers studying forest patches in the Tropics. Original concepts and thought-provoking guidelines for further investigation are proposed in Chapters 1, 3, 4, 7, 8, 9, 12, 14, and 17. The remaining chapters largely contain case studies that are extremely useful, especially to indicate where much more data is needed for us to efficiently promote forest patches as a mechanism to conserve significant elements of tropical biological diversity. The summary chapter (19) by Fisher and Bunch is useful because it skillfully presents the problems encountered in fostering forest patches in the tropics, and because of its frequent citation of symposia results, independently published works, and other publications out of the mainstream of scientific literature indices.

In summary, this book absolutely essential for the library of any conservation biologist, landscape ecologist, or land use planner. The wealth of information, practicality of presentation, extensive literature citations and thrifty price, make it ideal for use in courses as well. I highly recommend this book without any hesitation.—John Pipoly, III

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FLORA ORNAMENTAL EN PLAZAS Y JARDINES PUBLICOS DEL AREA METROPOLITANA DE MONTERREY, MEXICO

ALEJANDRA ROCHA ESTRADA, TERESA E. TORRES CEPEDA, MA. DEL CONSUELO GONZÁLEZ DE LA ROSA, SALOMÓN J. MARTÍNEZ LOZANO y MARCO A. ALVARADO VÁZQUEZ

Departamento de Botánica
Facultad de Ciencias Biológicas
Universidad Autónoma de Nuevo León
Apto. Post. 2790, Monterrey, N.L., MÉXICO

RESUMEN
Se realizó un inventario de las especies vegetales que son utilizadas con fines ornamentales en el área metropolitana de Monterrey, encontrándose que se cuenta con 137 especies pertenecientes a 68 familias, de las cuales Fraxinus sp., Ligustrum lucidum Ait., Rosa centifolia L. y Melia azedarach L. son las especies más frecuentes.

ABSTRACT
An inventory was taken of the ornamental plants in the metropolitan area of Monterrey. We found 137 species in 68 families. The most frequent species are Fraxinus sp., Ligustrum lucidum Ait., Rosa centifolia L. and Melia azedarach L.

INTRODUCCION
Es indudable la importancia ecológica y estética de las plantas ornamentales en las ciudades modernas, donde se conjuntan inﬁnidad de problemas que son el resultado de la urbanización exhaustiva, y en las cuales las plantas ornamentales pasan en el mejor de los casos a segundo término, sin considerar los múltiples beneficios que estas aportan, como son: puriﬁcación de la atmósfera, la cual es contaminada por el mismo hombre; liberación de oxígeno; evitan la erosión del suelo, pueden funcionar como cortina rompiente, etc. Desde el punto de vista estético, las plantas aumentan la belleza de la ciudad con su follaje multicolor, hermosas y abundantes ﬂores, además del equilibrio que proporcionan al paisaje.

Por ser las plantas ornamentales poco estudiadas en el estado de Nuevo León y en particular para el área metropolitana de Monterrey, se consideró pertinente realizar un inventario de éstas plantas con el ﬁn de ampliar el conocimiento de las mismas y aportar datos que contribuyan a estudios posteriores.

Algunos autores han trabajado diversos aspectos acerca de la Flora en el
estado de Nuevo León, sin embargo ninguno de ellos, tiene un enfoque particular hacia las plantas ornamentales, aunque algunos por su amplitud hacen mención de algunas de ellas. Entre estos trabajos destacan el de González (1888), pionero de los estudios botánicos en el estado, él realizó un inventario florístico acerca de las plantas cultivadas y silvestres para Nuevo León, encontrando cerca de 264 especies incluidas en 70 familias. Por su parte Rojas-Mendoza (1965), describió la vegetación y la flora para el Estado, él reporta 148 familias, 657 géneros y un total de 1484 plantas con categoría de especie, subespecie, variedad o forma.

Es conveniente mencionar que si existen trabajos florísticos o inventarios de plantas ornamentales para otras ciudades en el país, como es el caso de Teresa de Tovar (1982), quién llevó a cabo un estudio descriptivo de los árboles y arbustos más comunes en el Bosque de Chapultepec, describiendo un total de 57 familias, 113 géneros y 168 especies. Capitanachi-Moreno y Amante-Haddad (1995), realizaron un estudio de vegetación urbana en Xalapa, Veracruz, encontrando 443 especies correspondientes a 317 géneros incluidos en 117 familias.

**ÁREA DE ESTUDIO**

El área metropolitana de Monterrey comprende los municipios de San Nicolás de los Garza, Guadalupe, San Pedro Garza García, Santa Catarina y Monterrey. Ocupa una superficie de 1976.480 Km², localizándose entre las coordenadas 25° 02' y 25° 47' de latitud Norte y entre los 100° 06' y 100° 43' de longitud Oeste, con una altitud de 554 msnm. La precipitación pluvial es escasa, oscilando la media general anual entre 300 y 600 mm, pero hay zonas que registran lluvias anuales mayores de 800 mm.

**MATERIAL Y MÉTODO**

La colecta de las plantas se llevó a cabo en plazas y jardines públicos del área metropolitana de Monterrey, las cuales suman un total de 393, debido a su considerable número, se hizo necesario calcular un tamaño de muestra estadísticamente significativo, para lo cual se realizó un muestreo piloto, en tres plazas o jardines públicos (seleccionados aleatoriamente) de cada municipio y con los resultados obtenidos se realizó el cálculo para el tamaño de muestra total (número de plazas y jardines a muestrear) mediante la fórmula de muestreo estratificado (Abad de Servín y Servín-Andrade 1978), lo cual nos permitió conocer el número de plazas y jardines a muestrear en cada municipio, así como el número total para el área metropolitana de Monterrey.

El tamaño de muestra total fue de 52 plazas y jardines, de las cuales cinco corresponden al municipio de Santa Catarina, tres al municipio de Guadalupe, ocho al municipio de San Pedro, dieciséis al municipio de San Nicolás y veinte al municipio de Monterrey.

RESULTADOS

Se colectaron un total de 137 especies, las cuales están incluidas en 68 familias representativas de las plantas ornamentales. La familia con el número mayor de especies corresponde a Leguminosae con 10 especies, seguida por las familias Liliaceae y Malvaceae con 8 y 6, las familias Apocynaceae, Compositae y Euphorbiaceae con 5 especies y el resto de las familias con menor número de miembros (Fig. 1 y listado).

Las especies que con mayor frecuencia se encontraron en los sitios de colecta fueron: Fraxinus sp. (80.76%), Ligustrum lucidum Ait. (59.61%), Rosa centifolia L. (42.30%) y Melia azedarach L. (36.52%) (Fig. 2).

Se apreció que las plantas encontradas en las plazas y jardines públicos del área metropolitana de Monterrey son básicamente hierbas (37.95%), árboles (30.65%), arbustos (26.27%), palmas (2.91%) y trepadoras (2.18%) (Cuadro 1).

En relación al origen de la flora ornamental del área en estudio, se encontró que del total de especies aproximadamente un 38% son especies nativas y el resto (62%) son especies introducidas provenientes básicamente de Europa, Asia y África.

Fig. 1. Familias con mayor número de especies ornamentales en los parques y jardines públicos del área metropolitana de Monterrey, N.L., México.
Por otra parte en el Cuadro 2 puede apreciarse que existen diferencias entre la diversidad florística presente en los municipios del área metropolitana de Monterrey, donde sobresale Monterrey con un promedio de 19 especies por área verde, en tanto que el municipio de Guadalupe solo existen 6 especies en promedio.

**DISCUSIONES Y CONCLUSIONES**

De las especies colectadas por González (1888) para el Estado de Nuevo León, 25 coinciden con las aquí encontradas; así como 73 con el inventario realizado por Rojas-Mendoza (1965) para el estado y 24 con Teresa de Tovar (1982) quien estudió el bosque recreativo de Chapultepec; con el estudio realizado por Capitanachi-Moreno y Amante-Haddad (1995) coincide con 45 especies reportadas en este trabajo.

La forma biológica más frecuente fue la herbácea, esto contrasta con el estudio realizado por Tovar de Teresa (1982) en el Bosque de Chapultepec, ya que ella menciona que las especies arbóreas son las que tienen mayor diversidad y frecuencia. Por su parte Capitanachi-Moreno y Amante-Haddad (1995) concuerda con la forma herbácea.

En relación al origen de las especies se encontró que solo un 38% son especies nativas y el resto son introducidas (62%), lo cual es congruente con lo mencionado por Rzedowski y Calderón de Rzedowski (1990), quienes mencionan que dentro del conjunto de plantas introducidas en México la mayoría tiene un origen europeo, siendo particularmente frecuente la procedencia mediterránea.

![Gráfico 2](image-url)

**Fig. 2.** Especies ornamentales más frecuentes en los parques y jardines públicos del área metropolitana de Monterrey, N.L., México.
Cuadro 1. Formas biológicas de las plantas ornamentales del área metropolitana de Monterrey, N.L., México.

<table>
<thead>
<tr>
<th>Forma biológica</th>
<th>No. especies</th>
<th>Porcentaje</th>
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</thead>
<tbody>
<tr>
<td>Hieba</td>
<td>52</td>
<td>37.95</td>
</tr>
<tr>
<td>Arbol</td>
<td>42</td>
<td>30.65</td>
</tr>
<tr>
<td>Arbusto</td>
<td>36</td>
<td>26.67</td>
</tr>
<tr>
<td>Palma</td>
<td>4</td>
<td>2.91</td>
</tr>
<tr>
<td>Trepadora</td>
<td>3</td>
<td>2.16</td>
</tr>
</tbody>
</table>

Cuadro 2. Número de especies promedio presentes en los municipios del área metropolitana de Monterrey, N.L., México.

<table>
<thead>
<tr>
<th>Municipio</th>
<th>No. especies promedio</th>
<th>No. mínimo</th>
<th>No. máximo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monterrey</td>
<td>19</td>
<td>7</td>
<td>70</td>
</tr>
<tr>
<td>San Nicolás</td>
<td>14</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td>Guadalupe</td>
<td>6</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>San Pedro</td>
<td>115</td>
<td>20</td>
<td>29</td>
</tr>
<tr>
<td>Santa Catarina</td>
<td>15</td>
<td>7</td>
<td>29</td>
</tr>
</tbody>
</table>

APPENDICE

Listado de especies ornamentales en parques, plazas y jardines públicos del área Metropolitana de Monterrey, N.L., México.

ACANTHACEAE
Ruellia brittoniana Leonard, NH

ADIANTACEAE
Pteris longifolia L., IH

AIZOACEAE
Sesuvium portulacastrum L., IH

AGAVACEAE
Agave asperrima Jacobi, NH
Sansevieria zeylanica Willd., IH
Yucca carnerosana (Trel.) McKelvey, NP

AMARANTHACEAE
Alternanthera repens (L.) Kuntze, IH
Amaranthus caudatus L., IH

AMARYLLIDACEAE
Crinum zeylanicum L., IH
Hippeastrum equestre Herb., IH
Nothoscordum bivalve (L.) Britton, IH

ANACARDIACEAE
Rhus laurina Nutt., IA

APOCYNACEAE
Carissa grandiflora A. DC., IA
Nerium oleander L., IA
Ochrosia elliptica Labill., IA
Thevetia peruviana (Pers.) K. Schum., IA
Vinca rosea L., IH

ARACEAE
Monstera deliciosa Liebm., NH
Philodendron cordatum Kunth, IH

ARALIACEAE
Hedera helix L., IT

BEGONIACEAE
Begonia semperflorens Link & Otto, IH

BIGNONIACEAE
Chilopsis linearis Sweet, NA
Jacaranda mimosifolia D. Don, IA
Tecoma stans (L.) Juss ex HBK, NA

BORAGINACEAE
Cordia boissieri A. DC., NA
Ehretia anacua (Teran & Berl.) I.M. Johnst, NA
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Author</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CANNACEAE</strong></td>
<td>Canna indica L.</td>
<td>IH</td>
<td></td>
</tr>
<tr>
<td><strong>CARICACEAE</strong></td>
<td>Carica papaya L.</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td><strong>CAPRIFOLIACEAE</strong></td>
<td>Abelia chinensis R. Br.</td>
<td>IA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lonicera japonica Thunb.</td>
<td>IT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sambucus mexicana Presl</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td><strong>CARYOPHYLLACEAE</strong></td>
<td>Diplotaxis caryophyllus ex J. R. G. Forrest</td>
<td>IH</td>
<td></td>
</tr>
<tr>
<td><strong>CASUARINACEAE</strong></td>
<td>Casuarina equisetiiolia</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td><strong>COMMELINACEAE</strong></td>
<td>Commelina tuberosa L.</td>
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</tr>
<tr>
<td></td>
<td>Tradescantia virginiana L.</td>
<td>NH</td>
<td></td>
</tr>
<tr>
<td><strong>COMPOSITAE</strong></td>
<td>Artemisia absinthium Nutt.</td>
<td>NH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cosmos bipinnatus Cav.</td>
<td>NH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tagetes erecta L.</td>
<td>NH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tagetes patula L.</td>
<td>NH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zinnia elegans Jacq.</td>
<td>NH</td>
<td></td>
</tr>
<tr>
<td><strong>CONVOLVULACEAE</strong></td>
<td>Ipomoea fistulosa Mart.</td>
<td>NT</td>
<td></td>
</tr>
<tr>
<td><strong>CRASSULACEAE</strong></td>
<td>Kalanchoe blossfeldiana Poellnitz</td>
<td>IH</td>
<td></td>
</tr>
<tr>
<td><strong>CUPRESSACEAE</strong></td>
<td>Cupressus sempervirens L.</td>
<td>IA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Juniperus monosperma (Engelm.) Sarg.</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thuja occidentalis L.</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td><strong>CYPERACEAE</strong></td>
<td>Cyperus alternifolius L.</td>
<td>IH</td>
<td></td>
</tr>
<tr>
<td><strong>ERICACEAE</strong></td>
<td>Arctostaphylos glauca Lindl.</td>
<td>NAr</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rhododendron mucronatum Don.</td>
<td>IA</td>
<td></td>
</tr>
<tr>
<td><strong>EUPHORBIACEAE</strong></td>
<td>Cnidoscolus chayamansa Mc. Vaugh.</td>
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<td></td>
<td>Croton ciliato-glandulosum Ocht.</td>
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<td>Euphorbia pulcherrima Willd. ex Klotsch.</td>
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<td>Jatropha dioica Cerv.</td>
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<td></td>
<td>Sapium sebiferum (L.) Roxb.</td>
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<tr>
<td><strong>FAGACEAE</strong></td>
<td>Quercus virginiana Mill.</td>
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<tr>
<td><strong>FOUQUIERIACEAE</strong></td>
<td>Fouquieria splendens Engelm.</td>
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<tr>
<td><strong>GERANIACEAE</strong></td>
<td>Pelargonium zonale Ait.</td>
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<tr>
<td><strong>GRAMINEAE</strong></td>
<td>Bambusa vulgaris Schrad. ex Wendl.</td>
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<td></td>
<td>Cortaderia selloana Aschers &amp; Graebn.</td>
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<td>Saccharum officinarum L.</td>
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<td>Stenotaphrum secundatum (Walt.) O. Kuntze</td>
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<td><strong>HAMAMELIDACEAE</strong></td>
<td>Liquidambar styraciflua L.</td>
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<td><strong>JUGLANDACEAE</strong></td>
<td>Carya cordiformis (Wangenh.) K. Koch</td>
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<td><strong>LABIATAE</strong></td>
<td>Ocimum basilicum L.</td>
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<td>Tecomium cubense L.</td>
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<td><strong>LAURACEAE</strong></td>
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<td>Acacia farnesiana (L.) Willd.</td>
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<td>Bauhinia variegata L.</td>
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<td>Caesalpinia mexicana Gray.</td>
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<td>Caesalpinia pulcherrima (L.) Swartz.</td>
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<td>Erythrina coralloides D.C.</td>
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<td>Leucaena glauca L.</td>
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<td>Mimosa malacophylla Gray.</td>
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<td>Parkinsonia aculeata L.</td>
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<td>Prosopis glandulosa Torr.</td>
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<td>Trifolium repens L.</td>
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<td>Allium scaposum Benth.</td>
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<td>Asparagus sprengeri Regel.</td>
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<td>Asparagus virgatus Baker</td>
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<td>Chlorophytum capense Thunb.</td>
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<td>Dasylihon longissimum Lem.</td>
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<td>Hemerocallis middendorffii Traufv.</td>
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<td>Ophiopogon jaburan Lodd.</td>
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<td><strong>LYTHRACEAE</strong></td>
<td>Lagerstroemia indica L.</td>
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<td><strong>MAGNOLIACEAE</strong></td>
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<td><strong>MALVACEAE</strong></td>
<td>Hibiscus rosa-sinensis L.</td>
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Hibiscus syriacus L., IAr
Lavatera trimestris L., IAr
Malva viscous arbores Cav., NAr
Sida abutitolia Miller, NH
Thespesia populnea (L.) Soland ex Correa, IAr

MELIACEAE
Melia azedarach L., IA

MORACEAE
Morus alba L., IA
Ficus elastica Roxbg., IA

MUSACEAE
Musa paradisiaca L., IAr

MYRTACEAE
Callistemon species DC., NAr
Eucalyptus globulus Labill., IA

NYCTAGINACEAE
Bougainvillea glabra Choisy, IAr
Mirabilis jalapa L., NH

OLEACEAE
Fraxinus velutina Torr., NA
Ligustrum japonicum Thunb., IAr
Ligustrum lucidum Ait., IA

PALMAE
Arecastrum romanzeffiana Becc., IP
Phoenix dactylifera L., IP
Washingtonia filifera (Linden) H. Wendl., NA

PINACEAE
Pinus halepensis Mill., NA

PITTOSPORACEAE
Pittosporum tobira Ait., IAr

PLATANACEAE
Platanus occidentalis L., NA

PLUMBAGINACEAE
Plumbago capensis Thunb., IAr

POLYPODIACEAE
Nephelepis exaltata (L.) Scott, NH

PUNICACEAE
Punica granatum L., IAr

RANUNCULACEAE
Delphinium ajacis L., IH

RHAMNACEAE
Colubrina greggii Wats., NAr

ROSACEAE
Eriobotrya japonica Lindl., IA
Prunus persica (L.) Osbeck., IA
Pyracantha coccinea L., IAr
Rosa centifolia L., IAr

RUBIACEAE
Gardenia jasminoides Ellis, IAr

RUTACEAE
Citrus aurantium (Christm.) Swingle, IA
Citrus sinensis Osbeck., IA
Sargentia greggii Wats., NAr
Zanthoxylum fagara (L.) Sarg., NAr

SALICACEAE
Populus tremuloides Michx., IA
Salix nigra Marsh., IA

SAPINDACEAE
Koeleuteria paniculata Laxm., IA

SCROPHULARIACEAE
Leucophyllum frutescens (Berl.) I.M. Johnst., IAr
Mimulus punicus Steud., IAr

SOLANACEAE
Petunia axillaris BSP, IH
Petunia hybrida Hort. ex Vilm, IH

STRELIIZIACEAE
Strelitizia reginae Banks, IH

TAMARICACEAE
Tamarix gallica L., IA

TAXODIACEAE
Taxodium mucronatum Ten., NA

TROPAEOLOACEAE
Tropaolum majus L., IH

ULMACEAE
Celtis laevigata Willd., NA
Celtis pallida Torr., NA

UMBELLIFERAE
Coriandrum sativum L., IH

VERBENACEAE
Lantana camara L., IAr
Verbena bipinnatifida Nutt., IH

Nota: las siglas que aparecen a la derecha corresponden al origen: - desconocido, N nativa, H herbácea, A árbol, Ar arbusto, P palma, T trepadora.
REFERENCIAS


GONZÁLEZ, J.E. 1888. Un discurso y un catálogo de plantas Clasificadas. Imprenta Católica.


ROJAS-MENDOZA, P. 1965. Generalidades sobre la vegetación del estado de Nuevo León y datos acerca de su flora. Tesis doctoral inédita Universidad Nacional Autónoma de México, México, D.F.


DOCUMENTED CHROMOSOME NUMBERS
1998:1. CHROMOSOME NUMBERS IN CAREX SECTION OVALES (CYPERACEAE): ADDITIONS, VARIATIONS, AND CORRECTIONS

P.E. ROTHROCK
Randall Environmental Center
Taylor University
Upland, IN 46989-1001, U.S.A.

A.A. REZNICEK
University of Michigan Herbarium
North University Building
Ann Arbor, MI 48109, U.S.A.

ABSTRACT

Chromosome counts for 14 species of Carex section Ovales are documented completing at least a single report for each of the over 40 species known for eastern North America. The haploid numbers in this report ranged from $n = 24$ to $n = 42$. Counts for Carex feta, C. muskingumensis, C. oronensis, and C. tetraspatha were determined for the first time and six aneuploid (sensu lato) series are indicated. The only previously published counts for C. adusta, C. argyrantha, and C. foenea (C. aenea) were found to be incorrect.

RESUMEN

Se documentan los recuentos de 14 especies de Carex sección Ovales completando al menos una cita de las más de 40 especies conocidas del este de América del Norte. Los números haploides varían de $n = 24$ hasta $n = 42$. Se hacen por primera vez recuentos de Carex feta, C. muskingumensis, C. oronensis, y C. tetraspatha y se indican seis series aneuploides (sensu lato). Los únicos recuentos previos de C. adusta, C. argyrantha, y C. foenea (C. aenea) se ha encontrado que son incorrectos.

INTRODUCTION

Carex section Ovales is a large, coherent group of sedges with a center of diversity in North America. At least 40 species occur east of the Rocky Mountains and about as many species occur from the Rocky Mountains westward (Mastrogiuseppe et al. in review). Numerous karyological studies over the past 50 years (Whitkus 1991) have shown much chromosomal variation at the sectional, species, and population level. Even individual plants may have some cell to cell changes in karyotype. Much of this variation is thought to be the consequence of polycentric chromosomes with diffuse centromeres (Grant 1981). Polycentric chromosomes have the ability to fragment or fuse with other chromosome pieces and still retain the potential of completing...
normal movements during mitosis and meiosis. In spite or because of this variation, chromosome data have been informative in understanding the taxonomy and probable phylogenetic relationships among these species (Rothrock & Reznicek 1996a). And previously unrecognized species, such as Carex azarkana and C. molestiformis, have been revealed to have distinctive chromosome numbers (Rothrock & Reznicek 1996b; Reznicek & Rothrock 1997).

As part of ongoing taxonomic studies of eastern North American species of Carex section Ovales and especially as part of the Flora of North America project, an effort was made to complete a karyological survey of all species which occur in eastern North America and, where possible, to capture additional intraspecific variability. This update documents the karyotypes of 40 plants from 14 species.

MATERIALS AND METHODS

As described previously (Rothrock & Reznicek 1996a), living plants were collected in the field during their fruiting stage and cultivated in a sand-peat-perlite medium under greenhouse conditions. In this study, two species, C. prati
cola and C. xerantica, were grown from seed taken from herbarium specimens. Cold treatment was used to stimulate the production of new inflorescences by the following spring. Immature spikes were preserved in methanol, chloroform, propionic acid (6:3:2). Within the subsequent 72 hours, anthers were dissected from the spikes and squashed in 2% lactic-acetic-orcein (Cooperrider & Morrison 1967). Meiosis I chromosome figures were examined from five or more pollen mother cells. Photographs and drawings were made with a Nikon Labophot-2 microscope using phase contrast at 1000x magnification.

Voucher specimens were typically prepared at the time of field collection or occasionally from fruiting greenhouse material. Vouchers, on deposit at the University of Michigan Herbarium (MICH), include photographic micrographs and drawings of countable figures.

RESULTS AND DISCUSSION

The chromosome counts for the 14 species reported in this study ranged from $n = 24$, the lowest now known for section Ovales (Whitkus 1991), to $n = 42$ (Table 1). For six of the species intraspecific variation in chromosome number is reported. Five counts published by Löve and Löve (1981) are clearly at odds with our results and, given the often subtle differences between species, likely indicate faulty identification of the plant being examined.

Carex adusta F. Boott.—Our material from Washington Co., Maine, comes from near the eastern extreme of the distribution of C. adusta. Its $n = 39$
<table>
<thead>
<tr>
<th>Species</th>
<th>n</th>
<th>Location/Voucher or Reference</th>
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<tbody>
<tr>
<td>Carex adusta F. Boott</td>
<td>39</td>
<td>Washington Co., ME: A.A.R 10560</td>
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<td></td>
<td>32*</td>
<td>Löwe &amp; Löwe 1981</td>
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<td>Carex argyrantha Tuckerman</td>
<td>40</td>
<td>Hancock Co., ME: P.E.R. 3479</td>
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<td></td>
<td>40</td>
<td>Washington Co., ME: A.A.R. 10087</td>
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<td>40</td>
<td>Centre Co., PA: P.E.R. 3494</td>
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<td></td>
<td>40</td>
<td>Wahl 1940</td>
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<td>32*</td>
<td>Löwe &amp; Löwe 1981</td>
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<td>24</td>
<td>Kaufman Co., TX: A.A.R.10345b</td>
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<tr>
<td></td>
<td>24+IV</td>
<td>Kaufman Co., TX: A.A.R. 10345c</td>
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<td>26</td>
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<td></td>
<td>28</td>
<td>Christian Co., IL: P.E.R. 3545</td>
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<td>30</td>
<td>Lonoke Co., AR: P.E.R. 2885</td>
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<td></td>
<td>30+IV</td>
<td>Coahoma Co., MS: Bryson 14829</td>
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<td>Fayette Co., IL: P.E.R. 3540</td>
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<td>Pulaski Co., AR: P.E.R. 2902</td>
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<td>34</td>
<td>Löwe &amp; Löwe 1981</td>
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<tr>
<td>Carex feta L.H. Bailey</td>
<td>33</td>
<td>Lane Co., OR: Wilson 7869</td>
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<td>Carex fienea Willd.</td>
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<td>41</td>
<td>Strafford Co., NH: P.E.R. 3478</td>
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<td></td>
<td>42</td>
<td>Hancock Co., ME: P.E.R. 3480</td>
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<td></td>
<td>32*</td>
<td>Löwe &amp; Löwe 1981</td>
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<td>37</td>
<td>Morris Co., TX: A.A.R. 8489</td>
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<td>37</td>
<td>Rothrock &amp; Reznicek 1996a</td>
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<tr>
<td>Carex longii Mackenzie</td>
<td>29</td>
<td>Cumberland Co., TN: P.E.R. 3638</td>
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<td>28+IV</td>
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<td>35</td>
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<td>Carex molesta Bright</td>
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<td>White Co., IN: P.E.R. 3356</td>
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<td>35</td>
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<td></td>
<td>34</td>
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<td>Löwe &amp; Löwe 1981</td>
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<td>Carex muskingumensis Schwein.</td>
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<td>38, 39</td>
<td>Packer &amp; Whitkus 1982</td>
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<td>38, 39</td>
<td>Whitkus 1991</td>
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<td>32*</td>
<td>Löwe &amp; Löwe 1981</td>
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<td>32</td>
<td>Zavala Co., TX: Wipff 2915</td>
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<td></td>
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<td>Brazos Co., TX: Jones 12345a</td>
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<td>33</td>
<td>Brazos Co., TX: Jones 12345b</td>
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<td></td>
<td>34</td>
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*problematic, unvouchered reports; see text
disagrees with the \( n = 32 \) listed by Löve and Löve (1981). Unfortunately many Löve and Löve chromosome counts for Carex section Ovales, including this one, have no known, extant voucher specimens. We suspect, however, that their \( n = 32 \) count may be based upon an individual belonging to some other species, perhaps \( C. \text{brevior} \) (Dewey) Mackenzie.

**Carex argyrantha** Tuckerman.—Based upon single plants from 3 localities, this species had a consistent \( n = 40 \). Wahl (1940) published a count of \( n = 40 \) for this species under the misapplied name \( C. \text{foenea} \). Löve and Löve (1981) incorrectly attribute an \( n = 32 \) to this species. Their material came from a Manitoba source which lies outside the range of \( C. \text{argyrantha} \). Unfortunately no voucher is known for their count.

**Carex brevior** (Dewey) Mackenzie.—Our material (10 plants) gave a surprisingly broad range of chromosome counts, from \( n = 24 \) to 32. Morphologically the species is variable but we were unable to correlate any particular phenotype with chromosome count. We thus have no reason as yet to suspect that 2 or more sibling species are hidden within this taxon. The lowest counts, \( n = 24 \), 24 + IV, and 26 are from unusually robust individuals collected in Kaufman Co., Texas. The \( n = 30 \) individual was noteworthy in having clear nervation on the dorsal face of the perigynia. A previous report for \( C. \text{brevior} \) (with voucher specimen documentation available) is \( n = 34 \) (Löve & Löve 1981). This report is plausible, though the number remains unconfirmed.

**Carex feta** L.H. Bailey.—This species, from western North America, had an \( n = 33 \). Given the size and shape of the perigynia and achenes as well as the clear collar at the orifice of the leaf sheath, we suspect that \( C. \text{feta} \) is most closely related to \( C. \text{festucacea} \) Schk. ex Willd. found in eastern North America. The later species has a chromosome range of \( n = 33 + \) III, 34, and 35 (Wahl 1940; Rothrock & Reznicek 1996a).

**Carex foenea** Willd.—Our material (4 plants) had \( n = 41 \) and 42. In fact, the short aneuploid series was observed within the population from Hancock Co., Maine. Many taxonomic treatments (e.g. Fernald 1950) have incorrectly called this taxon \( C. \text{aenea} \) Fern. Löve and Löve (1981) published an \( n = 32 \) for \( C. \text{aenea} \) for material collected from near Brandon, Manitoba. No voucher specimen from this locality could be found. On the other hand, their voucher from Maskwa rapids, Manitoba (Löve & Löve 5512, WIN!) is a specimen of \( C. \text{foenea} \) and the annotation label indicates that the chromosome count was \( 2n = 64 \). Unfortunately this voucher was intended for their report of \( C. \text{tenera} \), a species with \( n = 26 \) to 28 (Wahl 1940; Rothrock & Reznicek, unpublished data).

The relatively high chromosome number for \( C. \text{foenea} \) compares favorably to that of several other species possessing long pistillate scales. These
include *C. adusta* (*n* = 39), *C. argyrantha* (*n* = 40), and perhaps *C. silicea* Olney (*n* = 37, 38).

**Carex hyalina** F. Boott.—This specimen from the southwestern extreme of the species’ range had *n* = 37. Our previous report (Rothrock & Reznicek 1996a) for the rare *C. hyalina*, from the northern portion of its range in Mississippi, also provided an *n* = 37.

**Carex longii** Mackenzie.—Previous work (Rothrock & Reznicek 1996a) found *n* = 28 + IV and 31 for plants from the coastal plain of the southeastern US and from southern Michigan. This plant with *n* = 29 comes from the Cumberland Mountain region of Tennessee.

**Carex merritt-fernaldii** Mackenzie.—Given a count by Tanaka (1942) of *n* = 35, our result of *n* = 37 suggests possible aneuploidy for this species. Löve and Löve (1981) offer an undocumented count of 2*n* = 68. However their count must be in error since the plant material came from Melita in extreme southwestern Manitoba, well outside the known range for *C. merritt-fernaldii* in that province.

**Carex merritt-fernaldii** often is morphologically confused with *C. brevior*. The differences in chromosome condition, however, reinforce its recognition at the species level.

**Carex molest* Bright.—*Previous work found* *n* = 34 for this taxon (Wahl 1940). Löve and Löve (1981) also found *n* = 34 for undocumented material from Manitoba where, as far as we know, *C. molest* does not occur. We confirm *n* = 34 but also found an aneuploid variation of *n* = 35.

**Carex muskingumensis** Schwein.—The count of *n* = 40 (based upon 2 plants) is the first for this species. For a member of *Carex* section *Ovales*, *C. muskingumensis* is quite distinctive. The stiff inflorescence, spikes, and lanceolate perigynia are unusually large. The vegetative culms have numerous evenly spaced leaves reminiscent of the *C. tribuloides* group (with *n* = 32 & 35), the mostly likely near relative of *C. muskingumensis*.

**Carex oronensis** Fernald.—The counts of *n* = 37 are the first for this rare endemic of the Penobscot River valley in central Maine. Dibble (1991) hypothesizes that the European *C. ovales* is a near relative. However, this is not supported by the numerous chromosome counts for *C. ovalis* which range from *n* = 32 to 34 (Whitkus 1991). We are unable to suggest possible close affinities between *C. oronensis* and other species in eastern North America.

**Carex praticola** Rydb.—Primarily a species of western North America, this plant comes from a disjunct southern outlier of the species’ natural distribution. Its *n* = 39 is identical to that of Packer and Whitkus (1982) and Whitkus (1991), who additionally reported *n* = 38. The unvouchered re-
port of \( n = 32 \) by Löve and Löve (1981) is highly suspect.

Carex tetrastachya Scheele.—Formerly known as \( C. \) brittoniana, \( C. \) tetrastachya displays an aneuploid series. Among the material available, we observed \( n = 30 + III \) (1 plant), 32 (3 plants), 33 (4 plants). Correll and Johnson (1970) suggest that this taxon and \( C. \) hyalina are most closely related. Vegetatively we especially find the two to be quite distinctive and the \( C. \) hyalina counts of \( n = 37 \) do not immediately suggest a close affinity.

Carex xerantica L.H. Bailey.—Our plant from a disjunct and eastern outlier of the species in Ontario yielded an \( n = 34 \). This confirms an unvouched (but geographically plausible) report by Löve and Löve (1981) for this northern species.

ACKNOWLEDGMENTS

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REFERENCES


Recent field and herbarium studies have yielded 37 vascular plant taxa previously undocumented in Kansas. Seventeen of these are introduced and naturalized; the others are considered native to Kansas. Notes about these taxa are provided to update distribution data contained in the *Atlas of the Flora of the Great Plains* (1977) and the *Flora of the Great Plains* (1991) and to make these data more widely available to botanists working on the *Flora of North America* project. All voucher specimens are deposited in the R.L. McGregor Herbarium (KANU), University of Kansas, unless otherwise indicated.

**Acalypha deamii** (Weath.) H.E. Ahles (Euphorbiaceae).—*Acalypha deamii* occurs at scattered localities from the Ohio River valley west to Kansas. It typically grows in floodplain forests along rivers and streams. Geoffrey A. Levin, Illinois Natural History Survey, discovered a single sheet among KANU specimens of *Acalypha* while annotating material for the *Flora of North America* project in 1995. The collection site, in Chase County, was visited in 1995 but no *A. deamii* was found. A population of several dozen plants was discovered the following year in east-central Shawnee Co.

Voucher specimens: KANSAS. Chase Co.: Cottonwood Falls, 6.5 mi S, wooded area along Rock Creek, moist, rich soil, 12 Sep 1975, Stephens 88044. Shawnee Co.: T12S, R16E, sec 1, W 1/2, Tecumseh, 0.5 mi S, 0.5 mi W, elev 880–920 ft, floodplain forest with scattered limestone outcrops along Stinson Creek between US 40 & I-70, 27 Aug 1996, Freeman 8172.

**Alyssum desertorum** Stapf var. *desertorum* (Brassicaceae).—This small, introduced annual is an innocuous range weed throughout much of the western U.S. (Rollins 1993). In the northern Great Plains it is encountered on disturbed prairies, along roadsides, and in waste places, especially in the High Plains (Great Plains Flora Association 1991). A single population was discovered in northwest Kansas, where plants occupy a cemetery and shoulder of an adjacent gravel road.

Amaranthus californicus (Moq.) S. Watson (Amaranthaceae).—A number of sheets of this species recently were discovered among KANU specimens identified as A. blitoides S. Watson. *Amaranthus californicus* can be distinguished from *A. blitoides* by its smaller seeds (0.8–1.1 mm diameter vs 1.2–1.7 mm diameter) and fewer (1–3 vs. 4–5), scabrous, pistillate sepals (Henrickson 1993). California pigweed is a widespread native in the western U.S. and first was reported in the Great Plains based on a 1995 collection from Dawes Co., Nebraska, by Steve Rolfsmeier. We also have vouchers from South Dakota (Shannon Co.) and Texas (Deaf Smith, Gray, and Parmer cos.)


Antennaria parvifolia Nutt. (Asteraceae).—Small-leaf pussy’s-toes is a common, widespread, spring ephemeral in the northern and central Great Plains (Great Plains Flora Association 1991). Earlier collections document its range in the central Great Plains south to the near the north border of Kansas. The species is added to the Kansas flora based on two collections from the northwest part of the state.


Arabis hirsuta (L.) Scop. var. adpressipilis (M. Hopkins) Rollins (Brassicaceae).—Two varieties of hairy rockcress occur in the Great Plains. *Arabis hirsuta* var. *pycnocarpa* (M. Hopkins) Rollins has trichomes on the stem spreading and unbranched and occurs throughout the northern Great Plains southward into central Kansas. Variety *adpressipilis*, with appressed and forked stem trichomes, barely enters the southeastern Great Plains. It is the common variety throughout Missouri (Steyermark 1977) and occurs in extreme southeast Kansas at a single locality.

Voucher specimen: KANSAS. Cherokee Co.: T34S, R25E, sec 35, NW 1/4, NE 1/4 & NE 1/4, NW 1/4, jct US 166 & KS 26, 1.5 mi N, Schermerhorn Park, elev 830–900 ft, rocky, oak-hickory forest on bluffs and uplands N of Shoal Creek, scattered along creek in NW part of park, 23 Apr 1992, Freeman 4323.

Armoracia lacustris (A. Gray) Al-Shehbaz & V.M. Bates (Brassicaceae).—Al-Shehbaz and Bates (1987) mapped the distribution of this aquatic pe-
rennial throughout the Great Lakes region, Midwest, lower Mississippi River valley, and at other widely scattered sites in the eastern U.S. A population discovered in southeast Kansas extends the western range of the species roughly 30 kilometers. Unfortunately, it was destroyed by construction activity shortly after it was discovered.


Aster lateriflorus (L.) Britton var. lateriflorus (Asteraceae).—This aster erroneously has been attributed to Kansas (Gates 1940; Great Plains Flora Association 1991; Gleason & Cronquist 1991) based on misidentified specimens of A. ontariensis Wiegand. It is fairly common in mesic forest and woodlands in Missouri (Steyermark 1977), and a population discovered during recent field studies in northeast Kansas confirms the species occurs in Kansas.


Atriplex prostrata Bouchér ex DC. (Chenopodiaceae).—An examination of KANU Atriplex specimens by Steve Rolfsmeier, University of Nebraska, revealed A. prostrata, an introduced, European annual previously undocumented in Kansas. Kansas specimens all had been mistaken for A. patula L., which appears to be rare in the Great Plains.


Atriplex prostrata var. nipponica (C. A. Mey.) Nakai (Chenopodiaceae).—Japanese barberry is cultivated widely as a hedge plant and ornamental. During recent field surveys of the Ft. Leavenworth Military Reservation in northeast Kansas, widely scattered plants were encountered in open woods and mesic forests.


Bromus nottowayanus Fernald (Poaceae).—Nottoway brome grows in mesic forests from southern Quebec south to northern Georgia and east to eastern Texas (Pavlick 1995). It may be confused with B. pubescens Muhl. ex Willd., from which it is distinguished by its sericeous lower leaf sheaths
and densely pilose collars. A population of *B. nottowayanus* discovered in northeast Kansas extends its range westward from Missouri. At the site, it grows in close proximity with *B. pubescens*. However, *B. nottowayanus* is strictly confined to the narrow floodplain of a small, upland, intermittent stream in mesic, oak-hickory forest, whereas *B. pubescens* is much more widespread, occupying gentle slopes and ridges throughout the forest.


*Calibrachoa parviflora* (Juss.) D’Arcy (Solanaceae).—Streamside petunia is a prostrate annual known to occur throughout the southern U.S. and tropical America (Correll & Johnston 1970; Nee 1993), with historical collections north to Oregon (Halse 1996). A large population was discovered in central Kansas where it occurs in seasonally wet basins. This is the northernmost locality for the species in the Great Plains. It is possible that this species has been overlooked in the Great Plains due to the ephemeral nature of its habitat.


*Chenopodium pumilio* R. Br. (Chenopodiaceae).—Rridged goosefoot is an annual plant native to Australia and reported over much of the eastern U.S., southeastern Oklahoma, much of Texas, and on the West Coast (Gleason & Cronquist 1991; Hatch et al. 1990; Wilken 1993). A central Kansas collection extends its range some 270 kilometers westward from Missouri.

Voucher specimen: KANSAS. Reno Co.: T22S, R7W, sec 10, NE 1/4, Nickerson, 9011 N Riverton Rd., common in farm yard, 1 Sep 1992, Foster s.n.

*Digitalis lanata* Ehrh. (Scrophulariaceae).—Grecian foxglove is a biennial or perennial sometimes grown as an ornamental or cultivated for the production of digitalis, a drug used as a cardiac stimulant (Moe & Farah 1975). It is a native of the Balkan Peninsula, Hungary, and Romania. In 1994 it was reported in southeast Kansas by a landowner in whose scrub-oak woodland pasture plants were very common and spreading rapidly. This is the only report of this species naturalizing and becoming noxious in North America. Since 1995, the Plant Health Division, Kansas Department of Agriculture, has been attempting to eradicate the plant, a task made difficult by the large seed bank apparently present at the site.


*Dirca palustris* L. (Thymelaeaceae).—Leatherwood grows on rocky slopes
and along floodplains in mesic, deciduous forests in the eastern U.S. and southeastern Canada. A thriving population discovered in extreme eastern Kansas extends the range of this shrub nearly 120 kilometers westward from central Missouri (Steyermark 1977). The plants first were discovered around 1990 when a site analysis was conducted and land use plans were being developed for the Overland Park Arboretum and Botanical Gardens, which now occupies the site.


Elaeagnus umbellata Thunb. (Elaeagnaceae).—Autumn olive is an Asian species planted in the U.S. as an ornamental and for wildlife habitat. Scattered, mature plants occupy clearings and disturbed sites on the Ft. Leavenworth Military Reservation in northeastern Kansas. The first collections from non-cultivated plants in Missouri were made in the late 1980s, but the species is believed to be naturalized in most Missouri counties and is a serious pest (Smith 1997).

Voucher specimen: KANSAS. Leavenworth Co.; T8S, R22E, sec 11, NW 1/4, Ft. Leavenworth Military Reservation, central part ENE of Hancock Hill at Fort de Cavagnal Picnic Area, elev 860–1000 ft, mesic to dry-mesic, oak-hickory forest on hills and bluffs above Missouri River, open, disturbed areas along roads and trails, several dozen scattered shrubs, 21 Jul 1995, Freeman 7441.

Elodea bifoliata H. St. John (Hydrocharitaceae).—This aquatic macrophyte, which is native to parts of the Great Plains, Rocky Mountains, and Pacific Northwest, is added to the Kansas flora based on specimens annotated in 1995 by Robert R. Haynes, University of Alabama. The three specimens originally were identified as E. nuttallii (Planch.) H. St. John, another member of the genus that occurs in a few, scattered localities in the state.

Voucher specimens: KANSAS. Cheyenne Co.; St. Francis, 9 mi SW, small seepage feed pool along Republican River beneath county road bridge, 5 Aug 1980, Brooks 14822; St. Francis, 4 mi SW, pool in South Fork Republican River, 15 Oct 1980, McGregor 32079; St. Francis, 3.5 mi SW, pool along South Fork Republican River, 16 Aug 1983, McGregor 34761.

Eragrostis pectinacea (Michx.) Nees var. miserrima (E. Fourn.) Reeder (Poaceae).—This variety (as E. tephrosanthos Schult.) was included in synonymy in the *Flora of the Great Plains* (Great Plains Flora Association 1991). However, following Reeder's (1986) treatment of the species, we have vouchers for var. miserrima from the following eastern Kansas counties: Allen, Anderson, Bourbon, Coffey, Douglas, Franklin, Jefferson, Labette, Leavenworth, Linn, Lyon, Marion, Miami, Morris, Osage, Shawnee, Wilson, and Woodson. The rangewide distribution of this variety is from Florida and the southern Gulf Coast west to southeastern Arizona and south through Mexico, Cen-
central America, and the West Indies (Koch 1974). Variety *pectinea*, which is widespread in the U.S., Mexico, and Central America (Koch 1974), is common statewide.

**Euonymus fortunei** (Turcz.) Hand.-Mazz. (Celastraceae).—This climbing shrub is a frequently planted ornamental in eastern Kansas. Large, well-established, naturalized populations along the Missouri and Wakarusa Rivers in eastern Kansas recently have come to our attention. At these sites, *E. fortunei* forms dense, spreading carpets in the understory of disturbed floodplain forests. This species has been seen at numerous other sites in eastern Kansas, most of which have not been documented by vouchers. The varietal status of these plants has not been determined.


**Eupatorium purpureum** L. var. *holzingeri* (Rydb.) E. Lamont (Asteraceae).—Lamont (1990; 1995) distinguished two varieties of widespread *Eupatorium purpureum* based on leaf pubescence. Variety *purpureum* has glabrous or nearly glabrous abaxial leaf surfaces and occurs throughout most of the range of the species. In var. *holzingeri*, the abaxial leaf surface is densely and persistently puberulent to villose. This variety occurs largely in the Midwest and eastern Great Plains. An examination of specimens at KANU reveals both varieties are present in Kansas, with var. *purpureum* documented only from Cherokee Co. We have vouchers for var. *holzingeri* (Rydb.) E. Lamont from the following 21 counties: Allen, Anderson, Atchison, Bourbon, Cherokee, Coffey, Crawford, Doniphan, Douglas, Franklin, Jefferson, Johnson, Labette, Linn, Leavenworth, Miami, Neosho, Osage, Shawnee, Woodson, and Wyandotte.

**Leptochloa uninervia** (J. Presl) Hitchc. & Chase (Poaceae).—Mexican sprangletop is added to the Kansas flora based on a single specimen annotated in 1990 by Neil Snow, Washington University. This is the only Great Plains record of this grass, which generally ranges from southern Texas south into Central and South America (Gould 1975).

Lespedeza bicolor Turcz. (Fabaceae).—This perennial legume was introduced from Asia and now is naturalized throughout much of the southeastern U.S. (Isely 1990). A small, persistent population found in eastern Kansas extends the range of the species more than 300 kilometers from localities in eastern Missouri (Mühlenbach 1979) and northern Arkansas (Smith 1988).


Loeflingia squarrosa Nutt. subsp. texana (Hook.) Barneby & Twisselm. (Caryophyllaceae).—This diminutive, native annual grows in sandy soil from east-central Texas north to north-central Oklahoma, with widely disjunct populations in Dawes Co., Nebraska (Barneby & Twisselmann 1970) and Weston Co., Wyoming (Hartman et al. 1985). Smyth (1898) reported it from Wichita Co., Kansas, but no voucher has been located. The discovery of a population in southwest Kansas supports its inclusion in the state’s flora.


Lupinus argenteus Pursh var. argenteus (Fabaceae).—Silvery lupine is a common species on rocky, mixed grass and shortgrass prairies throughout the High Plains (Great Plains Flora Association 1977, 1991). A population found in northwest Kansas is nearly 200 kilometers from the nearest locations in western Nebraska and eastern Colorado.


Malus coronaria (L.) Mill. var. coronaria (Rosaceae).—Wild crab apple is a low shrub or small tree of thickets and woods in the northeastern U.S. (Gleason & Cronquist 1991). A small, presumably native population was discovered in extreme eastern Kansas. This species has been documented in scattered counties in Missouri (Steyermark 1977), including Jackson and Clay, which are just east of the Kansas locality.

Voucher specimen: KANSAS. Wyandotte Co.: T11S, R25E, sec 34, NW 1/4, Roeland Park, N side of town, Rosedale Park, elev 850–950 ft, open, oak-hickory forest on predominantly N-facing slopes S of Turkey Creek, forest slightly to moderately disturbed, 4 May 1998, Freeman 10698.

Malus floribunda Siebold ex Van Houtte (Rosaceae).—This handsome, non-native, ornamental tree is cultivated widely in eastern Kansas. It is added
to the flora based on a collection from the east-central part of the state.

Voucher specimen: KANSAS. Douglas Co.: University of Kansas West Campus, bushy woodland SW of greenhouse, area originally an open wooded pasture, undisturbed for 45 years, 7 Apr 1995, McGregor 41140.

Paspalum dissectum (L.) L. (Poaceae).—This mat-forming grass grows along muddy streambanks, ditches, and the margins of ponds in the southeast U.S. and in Cuba (Gould 1975; Steyermark 1977). Populations in southeast Kansas extend the range of the species westward 120 kilometers from the nearest Missouri sites (Steyermark 1977).

Voucher specimens: KANSAS. Woodson Co.: T26S, R14E, sec 11, Woodson County State Lake, on dry lake shore flats, common. 13 Oct 1988, McGregor 39793; T25S, R15E, sec 15, SW 1/4, Yates Center, ca 0.25 mi SW, moist area in drained lake bed, 2 Sep 1993, McGregor 41064.

Polygonum cespitosum Blume var. longisetum (Bruijn) Steward (Polygonaceae).—This introduced, Asian annual has been reported from several localities along the Missouri River in Iowa and Nebraska (Great Plains Flora Association 1991). Mitchell and Dean (1978) report the species has spread rapidly in the U.S. since the 1940s. In recent years, populations in two northeast Kansas counties have come to our attention. In 1998, it was observed to be an abundant weed in pots and on the grounds of a plant nursery in Douglas County, Kansas.


Rhamnus cathartica L. (Rhamnaceae).—Common buckthorn is a European shrub or small tree cultivated in the U.S. as a hedge plant. It has become naturalized and occasionally weedy in parts of the eastern U.S. and southern Canada (Elías 1980; Smith 1997). Scattered, small trees were discovered in a disturbed forest in extreme eastern Kansas.


Schoenoplectus californicus (C.A. Mey.) Sojak (Cyperaceae).—A single specimen of California bulrush was discovered among KANU specimens of Schoenoplectus in 1993 by S. Galen Smith, University of Wisconsin–Whitewater, while he was annotating specimens for the Flora of North America project. As far as we are aware, this is the only record of this taxon in the Great Plains. It differs from other members of the Schoenoplectus lacustris complex (S. tabernaemontani (C.C. Gmel.) Pall, S. acutus (Muhl. ex Bigelow)
Á. Löve & D. Löve, and *S. heterochaetus* (Chase) Soják) in having bluntly trigonous culms near the inflorescence, leaf blades lacking or up to 2 mm long, strap-like floral bristles, and smooth floral scales. In the U.S., *Schoenoplectus californicus* is distributed discontinuously from the southern Atlantic Coastal Plain west to California.

Voucher specimen: KANSAS. Barber Co.: 2 mi SE of Sun City, edge of creek bank, 4 Aug 1959, McGregor 14712.

*Shepherdia argentea* (Pursh) Nutt. (Elaeagnaceae).—Smyth (1892), Hitchcock (1899), and Gates (1940) listed buffaloberry in Kansas, but we are unable to locate a voucher substantiating the historical occurrence of this species in the state. This is a common, widespread shrub in the northern half of the Great Plains. A small population in northwest Kansas confirms its presence in Kansas and extends the species’ range south from Nebraska roughly 40 kilometers.

Voucher specimen: KANSAS. Rawlins Co.: T4S, R36W, sec 32, ca 8.5 mi S, 5.5 mi E of McDonald, SE-trending canyon that joins Beaver Creek to the S, elev 3100–3160 ft, grazed, upland, shortgrass prairie and canyons with extensive outcrops of the Oglala Formation, restricted to a ca 50 yd stretch of the N bank of Beaver Creek, 19 Sep 1990, Freeman 3248 & Brooks.

*Sida rhombifolia* L. (Malvaceae).—No other reports of this pantropical annual, which occurs sporadically in ruderal sites in the eastern U.S. (Fryxell 1985; Gleason & Cronquist 1991), are known for the Great Plains. When it was collected, the land owner reported the population had been present at least 10 years. It is not known if this population persists.

Voucher specimen: KANSAS. Shawnee Co.: Topeka, backyard of home at 1916 SW Atwood, lawn weed at edge of garden, known from the site for at least 10 years, 5 Oct 1992, Coleman s.n.

*Stellaria pallida* (Dumort.) Crép. (Caryophyllaceae).—Lesser chickweed first was reported for North America by Morton (1972), who collected it in North Carolina. Rabeler (1997) reported it for Texas and noted that it had been found in nearby southeastern states, including Arkansas and Tennessee. Our field and herbarium studies reveal this annual weed of lawns and disturbed areas occurs in 84 Kansas counties. In the past it has been misidentified as the ubiquitous *Stellaria media* (L.) Vill., common chickweed. Rabeler (1997) considered *S. pallida* to be a probable recent introduction, but specimens indicate it has been in Kansas at least 67 years. The oldest collections we have seen are deposited at the Kansas State University Herbarium (KSC): a 1931 collection from Lyon Co. and a 1946 collection from Cherokee Co.

*Tridens xoklahomensis* (Feath.) Feath. (Poaceae).—Oklahoma tridens is a naturally occurring, sterile hybrid between *Tridens flavus* (L.) Hitchc. and *T. strictus* (Nutt.) Nash (Crooks & Kucera 1973). It currently is known from two sites in southeast Kansas, and additional field studies likely will
reveal other populations where the parent species are sympatric.


**Trifolium incarnatum** L. (Fabaceae).—Records of crimson clover in the Great Plains are based on infrequent escapes from plantings (Great Plains Flora Association 1991). This showy, European legume was found at a single locality in east-central Kansas where the land owner reports it has persisted for at least four years.

Voucher specimen: KANSAS. Douglas Co.: T12S, R19E, sec 21, E 1/2, SW 1/4, jct KS 10 & US 40 (W of Lawrence), 1.5 mi N, 1.5 mi E, elev 890-960 ft, disturbed, oak-hickory woodland on N-S ridge between two unnamed tributaries to Baldwin Creek, mowed path on E side of ridge, 5 May 1998, Freeman 10699.

**Veronica biloba** L. (Scrophulariaceae).—Two-lobe speedwell, an annual introduced from western Asia, has been reported in the Great Plains from ruderal sites along the Front Range of the Rocky Mountains (Great Plains Flora Association 1991) and from two recent collections in Nebraska. It is added to the Kansas list based on a collection in north-central Kansas.

Voucher specimen: KANSAS. Ottawa Co.: T11S, R4W, sec 1, SE 1/4, Minneapolis, S edge of town in Markley Grove Park, elev 1240 ft, wooded floodplain on S side of Solomon River, woods dominated by Quercus macrocarpa, understory mostly mowed, 6 May 1997, Freeman 8675.

**Veronica hederifolia** L. (Scrophulariaceae).—Ivy-leaf speedwell is a widely introduced, European species known from three previous collections in the Great Plains: two in Nebraska and one in South Dakota (Great Plains Flora Association 1977, 1991). Populations discovered in Lawrence, Kansas, in 1993 and 1995 are persisting.

Voucher specimens: KANSAS. Douglas Co.: T12S, R19E, sec 31, Lawrence, NW of the University of Kansas campus, W side of Emery Rd, ca 30 ft S of jct with Sigma Nu Place, disturbed, open, wooded, weedy, E-facing slope, 17 Apr 1993, Freeman 4761; 4 May 1993, Freeman 4778; T13S, R20E, sec 6, NW 1/4, NW 1/4, Lawrence, alley on W side of Tennessee just S of corner of 16th and Tennessee, dominant ground cover along alley and behind house at 1627 Tennessee, 24 Apr 1995, Morse 203; Clinton Lake, lawn of headquarters office, 20 Apr 1997, McGregor 41252. Franklin Co.: In Ottawa, lawn of city park, 19 Apr 1997, McGregor 41250.

**Veronica persica** Poir. (Scrophulariaceae).—Bird-eye speedwell is another widely introduced, European annual known from a few sites in the Great Plains. It was inadvertently omitted from the *Flora of the Great Plains* (Great Plains Flora Association 1991), although it has been documented in Iowa, Nebraska, South Dakota, and Wyoming. A 1975 collection from western Kansas went unnoticed until recently, and it is not known if the species still occurs at the site.

Voucher specimen: KANSAS. Scott Co.: Scott City, park at south edge of city, scattered in lawn, 26 Jul 1975, McGregor 27516.
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NEW AND NOTEWORTHY ANGIOSPERM RECORDS FOR IOWA

CRAIG C. FREEMAN

R.L. McGregor Herbarium, Division of Botany
Natural History Museum and Biodiversity Research Center
University of Kansas, 2045 Constant Ave.
Lawrence, KS 66047-3729, U.S.A.
c-feeman@ukans.edu

Recent field work in Iowa has resulted in the discovery of three angiosperms previously unknown in the state and populations of nine other angiosperms that are rare. Eight of the 12 species are considered native in Iowa. Most populations were discovered during field surveys that are part of an effort to complete a comprehensive flora of Bremer County, located in northeast Iowa. One species excluded from the Iowa flora by recent workers should be reinstated based on a 1998 collection in the state and an older herbarium specimen at the R.L. McGregor Herbarium (KANU), University of Kansas.

NEW STATE RECORDS

Eleocharis intermedia (Muhl.) Schult. (Cyperaceae).—A number of authors have included Iowa within the range of this cespitose spike-rush (Ryder 1932; Svenson 1957; Mohlenbrock 1976; Gleason & Cronquist 1991); however, it was not listed for the state by Eilers and Roosa (1994). A small population discovered along the Cedar River in 1997 supports its inclusion in the state's flora.

Voucher specimens: IOWA. Bremer Co.: T92N, R14W, sec 22, SW 1/4, SW 1/4 & sec 21, SE 1/4, SE 1/4, Waverly, 0.5 mi W, 1.5 mi N, Cedar Bend Conservation Park, E end, drying mud flats along the Cedar River, 7 Oct 1997, Freeman 10198 (ISC, KANU).

Rumex stenophyllus Ledeb. (Polygonaceae).—Eilers and Roosa (1994) excluded this introduced species from their checklist, stating that reports of the taxon in Iowa were unsubstantiated. It was mapped in Harrison County, Iowa, in the Atlas of the Flora of the Great Plains (Great Plains Flora Association 1977) based on a voucher at KANU, and it recently was collected at a second locality in the state.


Spergularia marina (L.) Griseb. (Caryophyllaceae).—This diminutive, introduced, annual weed occurs sporadically in central North America and more commonly along the coasts (Rossbach 1940). A small population was discovered in 1991 in a disturbed, grassy site at the edge of a sidewalk in a rest area along Interstate 35. More plants were discovered in a grassy median in the parking lot of the same rest area in 1995. Annual visits reveal this population is persisting.


**NOTEWORTHY RECORDS**

Astragalus distortus Torr. & A. Gray var. distortus (Fabaceae).—Bent milk-vetch is documented in 11 southeastern and eastern Iowa counties; however, extant populations occur in only six of these (Roosa et al. 1989). The species typically is associated with sand prairies (Eilers & Roosa 1994) and is a special concern plant (Iowa Administrative Code 571 1994). A small, degraded, sandy prairie remnant in a cemetery north of Janesville supports roughly two-dozen plants of this species. Despite the small size of this population, many individuals produced fruits in the spring of 1998. This is the first report of the species from the county.

Voucher specimen: IOWA. Bremer Co.: T91N, R14W, sec 35, NE 1/4, NE 1/4, NE 1/4, Janesville, 0.5 mi N, Oakville Cemetery, mowed, sandy, upland cemetery E of the Cedar River, 24 May 1998, Freeman 10757 (ISC, KANU).

Besseya bullii (Eaton) Rydb. (Scrophulariaceae).—Eastern kitten tail is a Midwest endemic found on dry prairie ridges, in woodlands, and along sandy river terraces (Roosa et al. 1989). It has been documented in more than a dozen eastern and north-central Iowa counties, including Bremer County. It is a threatened species in the state (Iowa Administrative Code 571 1994). A new population of fewer than 20 individuals was discovered in Bremer County in 1997, and because the population is small, a voucher specimen was not collected. Instead, a photograph was taken and serves as the voucher for this population.

Voucher specimen: IOWA. Bremer Co.: T91N, R14W, sec 21, W 1/2, Janesville, 2 mi N, 2.5 mi W, Shell Rock Greenway, Shell Rock Access, mesic floodplain forest along a tributary to the Shell Rock River and small area of remnant tallgrass prairie along an old road right-of-way, 3 Jun 1997, Freeman s.n. [photographic vouchers] (KANU).

Carex conoidea Schkuhr ex Willd. (Cyperaceae).—Field sedge is a special concern plant in Iowa (Iowa Administrative Code 571 1994). It is documented from Black Hawk, Bremer, Fayette, Linn, and Scott counties in eastern Iowa (Mark Leoschke, pers. comm.; Roosa et al. 1989). A second Bremer County population recently was discovered in a mesic prairie growing with C. bicknellii Britton, C. cristatella Britton, C. sartwelliï Dewey, and C. stricta Lam.
Voucher specimen: IOWA. Bremer Co.: T92N, R13W, sec 29, NE 1/4, NE 1/4, NE 1/4, Bremer, 1.1 mi S, elev 1000 ft, small, mesic, upland, tallgrass prairie remnant along intermittent stream on W side of blacktop, soil rich and loamy, infrequent, 19 Jun 1998, Freeman 11055 (ISC, KANU).

**Carex siccata** Willd. (Cyperaceae).—The only previous record of this sedge in Iowa is a 1936 collection from Clay County (Gilly 1946; Roosa et al. 1989), where it was reported as *C. foenea* Willd. However, the name *Carex foenea* has been misapplied in much of the literature (Cronquist et al. 1977; Gleason & Cronquist 1991). While I have not seen the voucher cited by Gilly (1946), his key and description match *C. siccata* rather than *C. foenea*. True *C. foenea* is a member of section *Ovales* and occurs north of Iowa. *Carex siccata*, a member of section Arenariae, is widely distributed in the northern U.S. and southern Canada (Cronquist et al. 1977). It is listed (as *C. foenea*) as presumed extirpated by Roosa et al. (1989) and is a special concern plant (Iowa Administrative Code 571 1994). A small population was discovered in a sand prairie remnant along the Wapsipinicon River, where *Stipa spartea* Trin. is the dominant species. Common species at the site are *Dichanthelium depauperatum* (Muhl.) Gould, *Euphorbia corollata* L., *Plantago patagonica* Jacq. var. *patagonica*, *Poa pratensis* L., *Lespedeza capitata* Michx., *Rumex acetosella* L., and *Vulpia octoflora* (Walter) Ryd.


**Florekia proserpinacoides** Willd. (Limnanthaceae).—This weak, forest annual is reported only from Dubuque County (Eilers & Roosa 1994). It is a species of special concern (Iowa Administrative Code 571 1994). A large colony was discovered in a narrow, forested, creek floodplain southeast of Waverly.

Voucher specimen: IOWA. Bremer Co.: T91N, R13W, sec 16. NW 1/4, SW 1/4, Waverly, 3 mi E, 1.5 mi S, rich, mesic, upland, maple-basswood forest and oak-hickory forest on slopes along Baskins Creek and its tributaries, large colony along floodplain of creek, 24 May 1997, Freeman 8947 (ISC, KANU).

**Geum vernum** (Raf.) Torr. & A. Gray (Rosaceae).—Spring avens is reported from five Iowa counties, mostly in the southern third of the state (Eilers & Roosa 1994). It is a species of special concern (Iowa Administrative Code 571 1994). Scattered plants were discovered in northeast Bremer County in 1997, the first record for the county.

Voucher specimen: IOWA. Bremer Co.: T93N, R11W, sec 13, N 1/2, NE 1/4, Sumner, 1 mi N, 0.5 mi E, North Woods County Park, mesic, maple-basswood-hickory forest E of the Little Wapsipinicon River and clearings in the forest, infrequent, 4 Jun 1997, Freeman 9049 (ISC, KANU).

**Platanthera flava** (L.) Lindl. var. *herbiola* (R. Br.) Luer (Orchidaceae).—This orchid has been reported in low, mesic prairies and sedge meadows in
eight counties scattered in the eastern third of the state (Roosa et al. 1989), including Bremer County. It is endangered in Iowa (Iowa Administrative Code 571 1994). Two populations were discovered in the Wapsipinicon River drainage in Bremer County. One population of less than a dozen individuals (Freeman 9685) was found in a formerly pastured, sedge meadow. This appears to be the first record of the species at this site. The second population (Freeman 110,20) is much larger, comprising more than 100 individuals scattered in a 2-acre area of mesic tallgrass prairie on the north end of the Sweet Marsh Wildlife Management Area. This population first was discovered in 1993 by Mark Leoschke of the Iowa Department of Natural Resources (John Pearson, pers. comm.).


Platanthera psycodes (L.) Lindl. (Orchidaceae).—Purple fringed orchid has been documented in 10 counties in northeast and east-central Iowa where it typically grow in mesic prairies, sedge meadows, and fens (Roosa et al. 1989). Nekola (1990) reported populations from two sites in Bremer County. Recently, one additional site for this threatened species (Iowa Administrative Code 571 1994) was discovered in the same county. A photographic voucher was taken due to the small size of this population.


Potentilla intermedia L. (Rosaceae).—This European native previously was reported only from Black Hawk County, Iowa (Eilers & Roosa 1994). A small population was discovered in 1997 in adjacent Bremer County.


ACKNOWLEDGMENTS

Deborah Lewis (ISC) and Ronald L. McGregor (KANU) provided helpful comments on the manuscript, for which I am grateful. The members of the Bremer County Conservation Board are acknowledged for their continuing support of my field work in northeast Iowa.

REFERENCES


BOOK NOTICE


“The Genus Gentiana is the first full account of all the species of Gentiana written as a single book. It is a major taxonomic revision of the whole genus, with an emphasis on species. A definitive reference work, combining the information needed by botanical, horticultural, nursery, specialist, and general gardening audiences.”

“Profusely illustrated by Jarmila Haldova, an exquisite rendering appears on every page. Finally you can see and learn about such elusive plants as Hebe-looking Gentiana pachyphylla or the most ornamental species as G. amplicrater, G. grandiflora, G. sedifolia, G. delavayi, G. szechenyi or G. boilierii which Halda has introduced to cultivation in recent years.”

The contents of the book include: Introduction; Morphology; Cultivation; Propagation; Key to the subgenera; Synopsis of the Genus Gentiana; Subgenus Gentiana; Subgenus Stylphora; Subgenus Onophora; Subgenus Pneumanantha; Subgenus Newberryi; Subgenus Gummatis; Subgenus Cruciat; Subgenus Phyllocalyx; Subgenus Frigida; Subgenus Monopodiae; Subgenus Isomaria; Subgenus Microsperma; Subgenus Stenogyna; Subgenus Calathianae; Subgenus Chondrophyllae; Gentians hybrids and cultivars; Related genera; Species originally described as Gentians later transferred to the related genera; References; and Index.
LUZIOLA PERUVIANA (POACEAE: ORYZEAE) PREVIOUSLY UNREPORTED FROM TEXAS AND A KEY TO TEXAS SPECIES

STEPHAN L. HATCH
S.M. Tracy Herbarium (TAES)
Department of Rangeland Ecology and Management
Texas A&M University, College Station
TX 77843-2126, U.S.A.
s-hatch@tamu.edu

DAVID J. ROSEN
US Army Corps of Engineers
New Orleans District, P.O. Box 60267
New Orleans, LA 70160, U.S.A.

JAMES A. THOMAS
Texas Parks and Wildlife Department
Upper Coast Wetland Ecosystem Project
1201 Childers Rd., Orange, TX 77630, U.S.A.

JOHN E. DAWSON III
S.M. Tracy Herbarium (TAES)
Department of Rangeland Ecology and Management
Texas A&M University
College Station, TX 77843-2126, U.S.A.

Luziola peruviana Gmel. was collected June 28, 1997, while collecting wetland plant specimens at the J.D. Murphree Wildlife Management Area southwest of Port Arthur, Texas. Luziola peruviana was identified using Chase (1951), Allen (1975), and Terrell and Robinson (1974) and verified from specimens in the S.M. Tracy Herbarium (TAES).

Luziola peruviana has previously been reported to occur in western Florida (Chase 1951) but specimens were not examined by Hall (1978). Allen (1975) reported the species from Orleans and Plaquemine Parishes in Louisiana. A search of Texas floras and checklists does not render a report for this species (Correll & Johnston 1970; Gould 1975; Hatch et al. 1990. Jones et al. 1997).

A KEY TO _LUZIOLA_ IN TEXAS

1. Pistillate inflorescences a raceme or solitary spikelet, axillary; staminate inflorescences a raceme or panicle, terminal; culms 30–100 cm long, slender, floating-trailing; leaf blades 2–4 cm long, 2–4(–5) mm wide, flat, linear to lanceolate................................. _L. fluitans_

1. Pistillate inflorescences a panicle, axillary, diffuse; staminate inflorescences a panicle, terminal; culms 21–35 cm long, slender, ascending; leaf blades 10–12 cm long, 2.5–3 mm wide, flat, linear................................. _L. peruviana_


For a description see Gould (1975) under the synonym _Hydrochloa carolinensis_ Beauv.

_Luziola peruviana_ Gmel. Syst. Nat. 2:637. 1791. (Fig. 1).

Plants monoecious, stoloniferous, aquatic. Culms 21–32(–35) cm long, slender, ascending; nodes often with a dark purple ring below. Leaves cauline; sheaths open, tessellate; ligules 5–11(–12) mm long, membranous, lacerate with 3–several hyaline, acuminate divisions; blades (those subtending pistillate inflorescences) 10–12 cm long, 2.5–3 mm wide, linear, flat, glabrous, margins serrulate. Spikelets unisexual, florets disarticulating at the base; glumes absent. Staminate inflorescences a panicle, terminal, narrow, exserted above leaves; staminate spikelets 5.3–6.5(–7) mm long, hyaline; lemmas 7-veined; paleas 5-veined, sub-equal to lemmas; stamens 6; anthers 3–3.2 mm long, basifixed, yellow, visible through floret. Pistillate inflorescences a panicle, axillary, not exserted above the leaves, diffuse. Pistillate spikelets (1.8–)2.1–2.5 mm long, glabrous, ovoid, acuminate; lemmas 7-veined; paleas 5-veined, sub-equal to lemmas, loosely enclosing mature caryopses.

The species _L. peruviana_ was flowering when collected in 0.6–0.75 m of water. The water temperature at the site was 28°C and the salinity 0.2 ppt (fresh water). The associated species included _Panicum repens_ L., _Paspalum distichum_ L., _Limnium spongia_ (Bosc.) Steud., _Hydrocotyle umbellata_ L., _Alternanthera philoxeroides_ (Mart.) Griseb., _Ludwigia peploides_ H.B.K., and _Ludwigia uruguayensis_ (Camb.) Hara.

_Distribution._—In Texas, along coastal waterways of Jefferson County.


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ACKNOWLEDGMENTS

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LACTUCA SALIGNA (ASTERACEAE), A LETTUCE NEW FOR TEXAS

ROBERT J. O’KENNON
Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060, U.S.A., bokennon@brit.org

GEORGE M. DIGGS, JR.
Department of Biology
Austin College
Sherman, TX 75090 U.S.A.
and Botanical Research Institute of Texas, gdiggs@austinc.edu

BARNEY L. LIPSCOMB
Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060, U.S.A., barney@brit.org

Lactuca saligna L., willow-leaf lettuce, is a European native (Feráková 1976) naturalized in a variety of localities in the United States. It is usually described as a weed inhabiting roadsides, disturbed places, and waste areas. The species is widely known from the eastern U.S., with localities reported from near the east coast (North Carolina, South Carolina, Virginia) west to Arkansas, Michigan, Missouri, Ohio, Tennessee, and West Virginia (Robinson & Fernald 1908; Britton & Brown 1913; Fernald 1950; Gleason 1952; Gleason & Cronquist 1963, 1991; Steyermark 1963; Radford et al. 1968; Strausbaugh & Core 1978; Cronquist 1980; Smith 1988). Its spread has apparently occurred mainly during this century because it was reported by neither Watson and Coulter (1889), Britton and Brown (1898), nor Small (1903, 1913, 1933). Further, Strausbaugh and Core (1978) indicated that the species “... was not reported by Millspaugh [for West Virginia] in 1913, which may be an indication that it has spread widely since that time.” It was, however, reported early in the century for Ohio by Robinson and Fernald (1908). A relatively late spread to the west is supported by Steyermark’s (1963) statement that the species was first known from Missouri in 1932. In addition to the eastern United States, Lactuca saligna has been reported from the Great Plains (Iowa, Kansas, Nebraska, South Dakota—Great Plains Flora Association 1977; Barkley 1986) and California (Stebbins 1993).
is also known from Oklahoma (Taylor & Taylor 1994), with forma ruppiana (Wallr.) Beck [entire-leaved form] having been first reported from that state in 1972 (McGrath & Weedon 1974). In fact, *Lactuca saligna* is known from Bryan County, Oklahoma, just north of the Red River border with Texas (*J. Taylor 29740, 28 Aug 1980, BRIT*). However, despite this proximity, the species has not been previously reported from Texas (Correll & Johnston 1970; Stanford 1976; Hatch et al. 1990; Jones et al. 1997).

As part of the collecting effort for the forthcoming *Shinners & Mahler's Illustrated Flora of North Central Texas* (Diggs et al.), a collection made in 1998 in Fort Worth (Tarrant County) is apparently the first documented occurrence of this species for Texas.

Voucher specimen: TEXAS. Tarrant Co.: weedy area in landscape, 301 Crestwood, Fort Worth, 21 Aug 1998, *O'KeruioH /4252 (BRIT)*.

At the collection locality a single large individual was observed as a landscape weed. This plant was nearly two meters tall and more than a meter wide. Other populations have not been found in North Central Texas, and it is unclear whether the species will become more widely established. However, given that the species is known just north of the Red River and that in some areas of the Great Plains it is rather frequent (Great Plains Flora Association 1977; Ted Barkley, pers. comm.), it would not be surprising if
Lactuca saligna were already widespread but unnoticed in the state of Texas. 

Lactuca saligna can be recognized by the following description (from original observations and from Radford et al. 1968; Feráková 1976; Barkley 1986; Stebbins 1993): Taprooted herbaceous annual (or rarely biennial?) 0.3–1(–2) m tall; latex white; stems erect, branched, usually glabrous or with remote bristles; cauline leaves linear to linear-lanceolate, entire to pinnatifid with 1–2(–3) pairs of narrow, sometimes slightly toothed lobes, with sagittate-clasping base; midrib of leaf white, glabrous or with remote bristles abaxially; inflorescences spike-like panicles with numerous heads; involucres 10–18 mm high in fruit; corollas yellow (with bluish or purplish on the abaxial side), drying blue; ligules 4.5–5 mm long; body of achenes 3–3.6 mm long, ca. 1 mm wide, with 5–9 nerves on each face; beak of achenes filiform, usually 1.5–3 times as long as achene body; pappus white, the bristles ca. 4 mm long; 2n = 18; flowering Jul–frost. The accompanying illustration (Fig. 1) is reprinted from Britton and Brown (1913).

While the Tarrant County individual has mostly pinnatifid lower and middle leaves and entire upper leaves, leaves in this species can vary greatly. According to Barkley (1986), “Three phases of L. saligna based on leaf morphology occur throughout its range. The phase with all leaves linear and entire, referred to by Fernald as f. [forma] rupiana (Wallr.) G. Beck, will often occur in the same population with the phase that has all leaves pinnatifid. The phase with lower cauleine leaves pinnatifid and upper cauleine leaves linear and entire may be found with one or both of the other phases.”

The six species of Lactuca occurring in the eastern two-thirds of Texas (excluding the two species limited to the Trans-Pecos) can be distinguished using the following key modified from those in Radford et al. (1968), Correll and Johnston (1970), Barkley (1986), and Stebbins (1993):

1. Beak of achenes (connecting achene body and pappus) stout, 0.5–1(–2) mm long OR absent; corollas blue or white; body of achenes 4–5 mm long .............................................................L. floridana (L.) Gaertn.
2. Beak of achenes thread-like, 2–10 mm long; corollas usually yellow (rarely cream to pink or pale lavender); body of achenes of various lengths.
3. Beak of achenes equal to or conspicuously longer than body of achenes; body of achenes ca. 1 mm wide, ca. 1/3 as thick as wide, 5- to 9-nerved on each face; plants annuals (or rarely biennials) with taproot; latex white.
4. Leaves linear to linear-lanceolate, 0.3–5 cm wide, with narrow lobes OR lobes absent (except for basal lobes); margins of leaves or leaf lobes entire or remotely prickly-toothed; body of achenes without conspicuous bristles at base of beak; flowers 8–15 per head; abaxial midrib of leaves and lower stems glabrous or remotely bristly ..........L. saligna L.
5. Leaves lanceolate to ovate, oblong-elliptic, or obovate, 1–10(–15+) cm wide, with broad lobes; margins of leaves or leaf lobes usually conspicuously prickly-toothed; body of achenes with conspicuous bristles at base of beak; flowers 14–25 per head; abaxial midrib of leaves and lower stems usually with stiff bristles ..............................L. serriola L.
2. Beak of achenes equal to or shorter than body of achenes; body of achenes 1.6–3 mm wide, very flat, 1- to 3-nerved on each face; plants biennials with abundant, tufted, branching roots; latex brownish.
4. Corollas very pale yellow to cream, pink, or pale lavender; lower leaves usually pinnately lobed; upper midstem leaves usually without a clasping base; body of achenes 2–2.5 times as long as wide; infrequent in sandy woods in eastern Texas

L. hirsuta Muhl. var. albilora (Torr. & A. Gray) Shinners

4. Corollas usually yellow; lower leaves pinnately lobed OR not so; body of achenes 1.5–2 times as long as wide; widespread in various soils in Texas.
5. Body of achenes 4.5–5 mm long, the achenes including beak 7–10 mm long; pappus bristles 7–10 mm long; involucres 13–22 mm long in fruit; upper leaf blades pinnately lobed, the margins conspicuously prickly-toothed...........

L. ludoviciana (Nutt.) Riddell

5. Body of achenes 3.5–4.5 mm long, the achenes including beak 4.5–6.5 mm long; pappus bristles 5–7 mm long; involucres 10–15 mm long in fruit; upper leaf blades usually not lobed, the margins entire to toothed but usually not prickly-toothed

L. canadensis L.

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BOOKS RECEIVED


Contenido: Introduccion, Directorio, Indice de nombres en orden alfabetico (Gobierno/ Government; Organizaciones no gubernamentales/non; Governmental Organizations; Negocios/ Business; Universidades/Universities; Estados/States; Instituciones/Institutions; and Miscelánea/ Miscellaneous.


Contents: Preface; Acknowledgment; Introduction; Format; Scientific Names: Species and Infraspecific Rank; Authors of Taxa; Common Names; Abbreviations and Special Designations; Conserved Names; Cultivated Plants; Endangered and Threatened Taxa; Federal Noxious Weeds; Hybrid Taxa; Misapplied Names; Orthography; State Symbols; Synonyms; Unpublished Names; Summary of Taxa; Summary Table; Checklist; Bibliography; and Index.
In 1905, O.B. Metcalfe collected a Penstemon under spruce at the Lookout Mine in upper Trujillo Canyon in the Black Range of southern New Mexico (Metcalfe 1605, NMC!, NY!). Wooton and Standley (1909a) described it as *Penstemon puberulus* Woot. & Standl. Then, realizing that the specific epithet was previously used, they (1909b) proposed the new name, *Penstemon metcalfei* Woot. & Standl. Keck (1945) decided that *P. metcalfei* was synonymous with *Penstemon whippleanus* Gray, based on his examination of the NY specimen cited above. His only reservation was that the stem was puberulous, which differed from the typically glabrous stem of *P. whippleanus*.

In 1967, I collected a *Penstemon* under spruce beside the Black Range Crest Trail on Cross O Mtn (Todsen s.n., NMC) and determined it to be *P. metcalfei* using Wooton and Standley’s “Flora of New Mexico” (1915). This was the second time the taxon had been collected. Only later did I become aware that Keck had submerged it under *P. whippleanus*.

In the summer of 1995, I collected plants from the Cross O Mtn. Location (Todsen 95-7-1, NMC) and compared the live material with the type and isotype sheets at NMC. There was no significant morphological difference in plants from the two locations. At the same time, I collected *P. whippleanus* (Todsen 95-7-7, NMC) from the Sandia Mountains, the type

<table>
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<tr>
<th>Characteristics</th>
<th><em>P. metcalfei</em></th>
<th><em>P. whippleanus</em></th>
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<tbody>
<tr>
<td>Stem</td>
<td>Puberulous</td>
<td>Glabrous</td>
</tr>
<tr>
<td>Leaves</td>
<td>Entire</td>
<td>Toothed</td>
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<tr>
<td>Corolla</td>
<td>Pale blue-lavender</td>
<td>Deep red-purple</td>
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<td></td>
<td>Slightly gibbous</td>
<td>Abruptly gibbous</td>
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<tr>
<td>Lower Lip</td>
<td>Wider than long</td>
<td>Longer than wide</td>
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<td>Staminode</td>
<td>Not or slightly exserted</td>
<td>Well-exserted</td>
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<tr>
<td></td>
<td>Bearded 1/2 its length</td>
<td>Glabrous or with tuft</td>
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<td>Stamens</td>
<td>Not explanate</td>
<td>Explanate</td>
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Table 1. Morphological differences between *P. metcalfei* and *P. whippleanus*.

locality, and compared that with the Cross O Mtn. Plants. Differences between
the two are shown in Table 1. These characteristics put *P. metcalfei* in Keek’s
subsection *Graciles* rather than in subsection *Humiles* where he had placed
*P. whippleanus*.

Later, when Crosswhite (1965a) was revising *Penstemon* section *Penste-
mon*, approximately equivalent to Keek’s *Penstemon* section *Spermunculus*,
he placed *P. whippleanus* in series *Whippleani* and retained series *Graciles*,
equivalent to Keek’s subsection *Graciles*. Crosswhite (1965b) also addressed
a situation in series *Graciles*, where he divided the series into two “alliances,”
*Graciles* and *Oliganthi*, based on differences in distribution, habit, and habitat.
*Penstemon metcalfei* falls within “alliance” *Oliganthi* as Crosswhite defined it.

I thank Richard Spellenberg for his many comments and suggestions.

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9:145.
COMMENTS ON THE DISTRIBUTION OF
SEDUM PULCHELLUM (CRASSULACEAE)
IN TEXAS

H.L. WHITE, J.R. BRANCH and W.C. HOLMES

Department of Biology
Baylor University
Waco, TX 76798-7388, U.S.A.

J.R. SINGHURST
Wildlife Division
Texas Parks and Wildlife Department
Austin, TX 78744, U.S.A.

Sedum pulchellum Michx. is usually a succulent annual, but may occasionally be a perennial due to the production of secondary roots (Clausen 1975). Leaves of rosettes, when present, are spirally arranged, spatulate-linear, obtuse and slightly papillose at the apex. Leaves of floriferous stems are linear and subterete. Among the North American species, S. pulchellum is unique in that the leaves of floriferous stems have basal sagittate spurs (Clausen 1975). Flowers are pale pink, purplish-white, or white, 4-merous, sessile or subsessile, and occur primarily in 3-branched cymes. Peak flowering takes place in May and June, but sometimes as early as March.

According to Clausen (1975), Sedum pulchellum occurs on flat rock formations (typically limestone, sandstone, or chert) from NC Kentucky south to NW Georgia, west through N Alabama to Arkansas, Texas, Oklahoma, SE Kansas, Missouri, and S Illinois. Northern Mississippi is not included in Clausen’s distribution, but the species is known from Oktibbeha County [Brent 181 (IBE!); Stauffer s.n. (MISSA!)]. Recent collections of the species in the central part of the state and the lack of satisfactory documentation of its occurrence have prompted us to investigate the distribution in Texas. Correll and Johnston (1970) state that S. pulchellum occurs “In seepage on and about calcareous rocks in e. Tex…,” while Hatch et al. (1990) list the species as a native plant of the Pineywoods and Blackland Prairies vegetational regions of the state. The species is not included in Shinners’ Manual of the Flora of North Central Texas (Mahler 1988), although Clausen (1975) indicated its occurrence within the area treated by the work.

Clausen’s (1975) distribution map gives the most thorough account of Sedum pulchellum in Texas. Unfortunately, his treatment presents certain
problems. Foremost is the lack of an exsiccatc list used in preparation of the map. He mentions that “A person desiring accurate information about species in any area not surveyed in detail in the present study should go to the area himself. The indication on maps that a species occurs in such an area should be sufficient notice.” The scale of the map is such that it is difficult to determine the location of the sites. Additionally, points that could have been included, based upon dates of collections and presence in herbaria that were cited as being consulted, do not appear. This includes the Weches formation of San Augustine and Sabine counties in east Texas, an area from which the species is well known, and Grayson County in NC Texas. Nonetheless, after canvassing the herbaria cited by Clausen, it was possible to later verify all but two of the locations indicated on his map (see Fig. 1). A search of Clausen’s documents in the Cornell University Archives yielded no additional information. These undocumented locations include one point in NE Texas, which, as best can be determined, is either in Red River or Bowie County. Considering the species documentation in nearby Lamar County and adjacent Oklahoma [McCurtain, Choctaw, and Bryan Counties (McGregor et al. 1977)], this particular occurrence is of minor significance. The other undocumented location given by Clausen, however, appears to be either in Burnet County or Llano County (or Blanco County?), an area visited by Clausen in 1970 (Clausen 1975). This unconfirmed record is far more notable because it appears to be on the Edwards Plateau, and therefore may be the most western point in the distribution of the species.

Additional field collections, a survey of herbarium specimens, and Clausen’s (1975) distribution map in The Sedum of North America were used to document the expansion of the known distribution of Sedum pulchellum to include other counties of the Blackland Prairies and Pineywoods as well as the Post Oak Savannah, Cross Timbers and Prairies, and the Edwards Plateau.

Specimens examined: **TEXAS. Bell Co.:** Owl Creek Mts., ca. 0.8 air mi SSW of jct. of Preachers Creek and Owl Creek, Ft. Hood, 4 Jun 1992, Carr 11984 (TEX); N side of Leon River ca. 0.7 mi ESE of center of Belton Dam, 1 May 1992, Carr 11868, Enquist & McNeal (TEX). **Bosque Co.:** at intersection of Brazos River & Cedar Creek, 97.32808 lat. 31.78761 long., 31 May 1998, Branch 300 (BAYLU). **Coryell Co.:** Bluff over Leon River ca. 200 m W of Mother Neff State Park on property of Charlotte & Larry Weiss, 18 May 1996, Holnbes 8240 (BAYLU). **Grayson Co.:** E of Denison in field near creek running into Smith Creek, 18 May 1950, Gentry 51-1430 (TEX). **Lamar Co.:** 2.25 mi N of Roxton, 21 May 1937, Cory 23107 (GH). **Limestone Co.:** Hwy 14 and Pk. Rd. 35, Jun 1993, Singhurst 1665, Jones, & Blair (BAYLU). **Palo Pinto Co.:** 3.3 mi N of jct. Hwy 287 & FM 3027 on Hwy 287, 1.7 mi WSW of Grantham Cemetery, 11 Apr 1998, Singhurst 6593 (BAYLU). **Sabine Co.:** Weches formation ca. 4 mi W of Milam, 9 Apr 1964, Correll & Correll 29088 (L.L.); ca. 1 mi W of jct. Hwy 21 and FR 226 on Hwy 21, 31 Mar 1980, Nixon 10116 (ASTC); 1.4 mi E of jct. of Hwys 21 and 330, 12 May 1980, Nixon 10534 (ASTC); on W side of TX 21 ca. 1.5 mi S of Geneva, 22 Apr 1987, Orzel 5104 & Bridges (TEX). **San Augustine Co.:** Weches formation ca. 1 mi SE of San Augustine, 20 Apr 1962,
Fig. 1 Documented distribution of *Sedum pulchellum* by county in Texas. The closed circles represent locations cited by Clausen (1975) that could not be verified (see text for additional comments).

*C. 25003* (LL); old Hemphill Rd. just E of San Augustine, 10 May 1969, *Correll 37202* (LL); ca. 0.5 mi E of San Augustine on Hwy 21, S on a dirt road ca. 1.0 mi, 11 May 1979. *Nixon 9473, Marietta & Matos* (ASTC); ca. 1.0 mi S of Chapel Hill on Sanitary Landfill Rd., 15 Apr 1985, *Nixon 14423* (ASTC); 0.2 mi SW of road to Sunrise, 0.9 mi SE of jct. TX 21 at point 1.1 mi E of center of St. Augustine, 22 Apr 1987, *Orzell 5109 & Bridges* (TEX). Travis Co.: near Jester Blvd., Jester Estates, Austin, 1 May 1995, *Miller s.n.* (TEX); Bull Creek, 11 Apr 1914, *Young s.n.* (TEX).

We wish to thank the curators of the following herbaria for supplying the specimens and other information that made this study possible: ASTC, BH, BM, CHRB, CLEMS, DUKE, F, GA, GH, IBE, K, MISSA, NLU, NY, NYS, PH, TEX, and US. Assistance provided by Thomas Clausen, the son of the late R.T. Clausen, and Nancy Dean of the Cornell University Archives was also greatly appreciated.
REFERENCES


**AGAVE PETROPHILA GARCÍA-MEND. & E. MARTÍNEZ, NOM. NOV. (AGAVACEAE)**

ABISAI GARCIA-MENDOZA

_Jardín Botánico, U.N.A.M._

_A.P. 70-614, Del Coyoacán_

_04510 México, D.F., MEXICO_

ESTEBAN MARTINEZ SALAS

_Depto. de Botánica, Instituto de Biología, U.N.A.M._

_A.P. 70-233, Del. Coyoacán_

_04510 México, D.F., MEXICO_


Agave gracilis García-Mend. & E. Martínez es un homónimo posterior a las propuestas del mismo nombre por Jacobi, 1871 y Berger, 1915, por lo que con base en el artículo 58.1 del International Code of Botanical Nomenclature (1994), se reemplaza este nombre con un nuevo epíteto.

REFERENCIA


_Sida_ 18(2): 627. 1998
AMELIA ANDERSON LUNDELL (1908-1998)
BOTANICAL ARTIST AND FRIEND

RUTH ANDERSSON MAY

4920 Mangold Circle
Dallas, TX 75229, U.S.A.

Amelia Anderson Lundell, born December 21, 1908 in Fort Worth, who passed away in Dallas in her 90th year on August 27, 1998, gave much to the world of art and science. The Botanical Research Institute of Texas (BRIT) has many of her renditions of shells and wildflowers that she donated after the death of her husband, Cyrus Longworth Lundell, the posthumous recipient of BRIT's International Award of Excellence in 1994. She drew all the insects pictured in the Dallas Planting Manual. Amelia's Sand-Verbena (*Abronia ameliei* Lundell, Verbenaceae) is named for her. She and Cyrus found the undescribed endemic *Abronia* near the Texas coast on a collecting trip years ago. Many of her paintings of wildflowers are in a suite of rooms near the Rare Book Library of UT Austin. Amelia made exquisite needlework embroideries and enjoyed sewing for her granddaughters when they were babies. Her home was adorned with her artwork and she loved to cook. The following is one of her favorite recipes, always included in her collection of home baked Christmas cookies that were shared with friends.

AMELIA'S BUTTER FINGERS

2 cups flour
1 cup butter
1/2 cup whipping cream (not whipped)

Blend flour and butter. Add cream. Roll out and fold over, dusting lightly with sugar, four or more times. Cut in sticks. Brush top with egg white and sprinkle with sugar. Bake at 300 degrees for at least 20 minutes or more.

She was an honorary member of Founder's Garden Club (GCA) of Dallas, the Dallas Woman's Club, and the Dallas Garden Club. Her generosity made possible the handsome gift of the *Wildflowers of the United States* (Rickett 1966–1973, vols. 1–6) series of books to the Woman's Club library. This is a lasting memorial to a beloved, knowledgeable, and talented friend of botany.

Obituary


Abronia ameliae / Amelia’s Sand-Verbena. Photograph by Robert J. O’Kennon.

Amelia Anderson Lundell at BRIT’s International Award of Excellence in 1994 where her late husband was honored.
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VILLASENORIA (ASTERACEAE: SENECIONEAE): A NEW GENUS AND COMBINATION FROM MEXICO

BONNIE L. CLARK

Herbarium, Division of Biology
Kansas State University
Manhattan, KS 66506-4901, U.S.A.

ABSTRACT

A new genus, Villasenoria (Asteraceae: Senecioneae), is described and a new combination, Villasenoria orcutti (Greenm.) B.L. Clark, comb. nov., is proposed.

RESUMEN

Se describe un nuevo género, Villasenoria (Asteraceae: Senecioneae), y se propone una nueva combinación, Villasenoria orcutti (Greenm.) B.L. Clark, comb. nov.

During the course of revising the traditional section Terminales Greenm. of the genus Senecio (Clark 1996), I had the opportunity to see an under-collected entity originally described by Greenman (1912) as Senecio orcutti. This entity was subsequently included in the segregate genus Telanthophora by Robinson & Brettell (1974). With the collection of more specimens and better habitat information, it became evident that the entity is sharply distinct from the rest of Telanthophora and other groups of Senecio, s.l., and that it should be placed in its own genus. Villasenoria is described herein as a new genus to accommodate Senecio (Telanthophora) orcutti.

The plants of the traditional section Terminales are shrubs and small trees mostly of middle elevations and the highlands of Mexico and Central America. As conceived by Greenman (1901), this section is distinguished by plants with stems that are abruptly contracted or foreshortened just below the terminal capitulescences, which are pedunculate clusters of corymbiform cymes. Studies by Robinson and Brettell in the 1970s led them to suggest that the Mexican and Central American species of the super-genus Senecio should be split into several segregate genera, and Senecio sect. Terminales Greenm. was split into two genera, Pittocaulon and Telanthophora (Robinson & Brettell 1973, 1974). Though slow to receive support in the literature, recent synthetic publications, e.g., Jeffrey (1992), Bremer (1994), and Barkley et al. (1996), have adopted these segregate genera.

Senecio orcutti is an anomaly in either Telanthophora or Pittocaulon in that it has large principal leaves (to 7 dm long) that are pinnately compound, and the stems merely taper to the capitulescence. Moreover, the capitulescence

1Present Address: 8201 Hauser Drive, Lenexa, KS 66212-2542, U.S.A.

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is a loose, elongate cluster of numerous heads, without the distinctive corymbose or dome-shaped aspect of the capitulescences of *Telanthophora* and *Pittocaulon*. The species is known only from limestone karst outcrops in rainforests from 100 to nearly 2000 m elevation in Chiapas, Oaxaca, and Veracruz, Mexico. On the other hand, species of *Pittocaulon* occur in seasonally dry scrublands of central and southern Mexico at 300–3250 m, while species of *Telanthophora* occur in cloud forests or mixed hardwood forests from central Mexico southward to Honduras, at 600–5000 m.

*Pittocaulon*, *Telanthophora*, and the new genus *Villasenoria* are separated by the following key:

**KEY TO GENERA**

1. Leaves pinnately compound, the largest to 7 dm long overall; capitulescences elongate and neither corymbose nor dome-shaped; plants single-stemmed, the stems tapering to the capitulescences; plants tree-like, achene surfaces papillate; .......................................................... *Villasenoria*

1. Leaves variously entire to lobed but not compound, rarely more than 4 dm long overall; capitulescences of terminal, dome-shaped corymbose cymes; plants single-stemmed or multi-branched, with stems abruptly foreshortened below the capitulescence; shrubs or small trees; achene surfaces smooth, glabrous.

2. Leaves palmately veined, seasonally deciduous, mostly absent at flowering time; stems rubbery and subsucculent, with subepidermal resin ducts; pith chambered; .......................................................... *Pittocaulon*

2. Leaves pinnately veined, persistent; stems woody, without evident subepidermal resin ducts; pith continuous; .......................................................... *Telanthophora*

**Villasenoria** B.L. Clark, gen. nov. Type species: *Villasenoria ovattii* (Greenm.) B.L. Clark.

Herba lignescentes, caule radicibus fasciculatis fibrosis emisco. Apiem versus in inflorescentiam terminalem, corymbiformem vel paniculatum abeunti. Folia pinnatim decomposita, intra inflorescentiam conferta. Capitula numerosa radiata; phyllaria (plus/minus) 8, inter se aequilonga, biseriata; flosculi quadrum structuram macroscopiam cum is subtribui Tussilagineorum tribui Senecionearum congrui, superficie stigmaeae trans interiorem styli; ramulum faciem contineat; aurararum collum parum impressum sed cellularae basi haud auctae.

Plants erect, to 3.5 m tall, stems single, arising from a cluster of fibrous roots; leaves present just below the capitulescence, lower leaves deciduous. Stems terete with solid pith, glabrous but with circular to horseshoe-shaped leaf scars; bases of recently dropped leaves persistent; stems tapering to the capitulescence and not conspicuously foreshortened. Leaves alternate, pinnately compound, petiolate; blades oblong to ovate in outline, leaflets ovate or obovate to broadly lanceolate; adaxial surface lightly stromose-papillate to lightly pubescent. Capitulescences terminal, open-paniculiform to loosely corymbose clusters of capitula, peduncles multibranching, with scattered linear-subulate bracts. Capitula numerous, radiate. Involucre narrowly campanulate to cylindrical; receptacle flat, naked or but shallowly alveolate, fistulose;
phyllaries 8(–9), biseriate, in an inner and an outer series, linear-lanceolate, slightly swollen or thickened at the base, inner phyllaries with scarious margins; calyculate bracts few and inconspicuous, linear. Ray florets 2–5, ligulate, pistillate, corollas yellow, tube cylindrical, lamina apex with 3 minute teeth, veins unbranched. Disk florets 16–23, corollas yellow, gradually to sometimes abruptly expanded upward, lobes 5. Anther bases sagittate, anther collars slightly swollen but the cells not basally dilated; endothecial cell walls with radial thickenings. Styles with stigmatic areas entire or weakly transitional, with morphologically distinctive cells in triangles at the bases of the stigmatic areas; apices unappended, truncate to conical, with fringing papillae of uniform length; stylopodia free. Achenes cylindrical, glabrous but with papillate projections; epidermal cells of pericarp oblong in surface view; carpopodia of 5–17 rows of thickened quadrate cells, margins regular to irregular; ovary walls with heterohexagonal and occasionally with acerate crystals. Pappus of numerous white, uniform, capillary hairs. Chromosome number unknown.

Etymology.—The genus name honors Dr. José Luis Villaseñor, a dedicated botanist of the Instituto de Biología, Universidad Nacional Autónoma de México, in Mexico City.


Additional specimens examined: MEXICO: Chiapas: de Tuxtla G. a Montecristo (NTuxtla G.), 17 Nov 1949, F. Miranda 5695 (MEXU). Oaxaca: San Felipe Usila, en cerro Casa de San Felipe de Usila, tipo veg. Selva alta perennifolia, suelo negro rocoso, elev. 250 m, 17 Oct 1989, J.L. Calzada 1477 (KSC); 5 km N of Huatla de Jiménez on road to Santa María Chicholóla, on steep slopes of calcareous rock, in rainforest remains along edge of coffee plantations, 18°09'N, 96°52'W, elev. 1200 m, 25 Mar 1992, B.L. Clark, A. Salinas & J.L. Calzada 53 (KSC, MEXU); 5 km N of Huatla de Jiménez on road to Santa María Chicholóla, on steep slopes of calcareous rock, in rainforest remains along edge of coffee plantations, 18°09'N, 96°52'W, elev. 1200 m, 16 Mar 1994, B.L. Clark & A. Campos V. 148 (KSC, MEXU), 149 (KSC, MEXU), 151 (KSC, MEXU); along road from Teotitlán del Camino to Chichocta, 4.4 mi beyond turn-off to Huatla de Jiménez, steep slopes with huge boulders, a few native trees persisting in a coffee plantation, elev. 1980 m, 23 Feb 1979, T.B. Croat 48378 (KSC, MO); Chicholóla, Huatla de Jiménez, bosque de encinos, suelo pedregoso, pardo-obscuro, 1200 msnm, 6 Apr 1975, R. Hernández 2105 (MEXU). Veracruz: Acoxapán, selva media subperennifolia, elev. 450 m, 30 Dec 1988, M. Chávez, L. Robles, & J.L. Tapia 5793 (VIS); Jesús Carranza, km 6 del Camino Cedillo-Río Alegre, selva alta perennifolia, primaria y secundaria, suelo café claro arcilloso rocoso, 17°10'N, 94°40'W, elev. 150 m, 18 Jan 1975, B. Dorantes 3905 (MEXU); Hidalgoltitlán, km 5 del Camino Cedillo-La Laguna, selva alta perennifolia, primaria, suelo café claro arcilloso rocoso, elev. 150 m, 19 Jan 1975, B. Dorantes 3971 (MEXU); Atoyac, 13 May 1937, E. Mata 1594 (MEXU, MIC); Hidalgoltitlán, 3 km SW of Campamento La Laguna, selva alta perennifolia, original forest on isolated small fills of extreme limestone karst, surrounded
by flat pastures with scattered remnant trees, 17°16'N, 94°32' W, elev. 100 m, 6 Mar 1984, M. Nee 30011 (KSC, MO, NY); Motzorongo, mountain side, 11 Feb 1982, J.G. Smith 135 (MO); Hidalgotitlán, 300 m W Campeamento Hermanos Cedillo, part alta cantiles Río Solosúchil, selva alta perennifolia, primaria, suelo cártico, sobre suelo rocoso por completo, 17°16'N, 94°36'W, elev. 150 m, 1 Nov 1975, B. Vásquez 1632 (MEXU); Coetzal, por el camino a Coetzapotitlán, selva alta subperennifolia, secundaria, suelo rojo amarillento con rocas aflorantes, 25 Apr 1976, V. Vásquez 400 (MEXU); Córdoba, San Rafael, bosque de encino in ladera de cerro, elev. 900 m, 28 Mar 1979, F. Ventura 15949 (MEXU); Hidalgotitlán, 0.6 km al E del Poblado 7, sobre camino a La Rayata, afloramiento cártico con selva perturbada de Spandias, Barrera Daliae, etc., rodeada por acabul, 17°19'N, 94°31'20" W, elev. 130 m, 31 Mar 1981, T. Wendl. et al. 3122 (MEXU); Minantlán, 13.7 km al E de La Laguna, sobre la terracería a Uxpanapa, luego 6.2 km al N sobre el camino nuevo (no completo) a Belisario Domínguez, selva mediana con Daliae, en área cártica con afloramientos de piedra, 17°19'30"N, 94°23'W, elev. 130 m, 11 Feb 1981, T. Wendl. A. Villalobos. & D. Obustead 2838 (MEXU).

ACKNOWLEDGMENTS

This study is a portion of a doctoral dissertation prepared at Kansas State University under the supervision of T.M. Barkley. I wish to thank the curators of the following herbaria that lent specimens to herb. KSC for this study: ASU, CAS, DAV, DS, F, GH, KANU, LL, MEXU, MICH, MO, MSU, NMC, NY, UC, UMO, US, and WIS. Studies of collections at BM, K, MEXU and US helped form a broader picture of the assemblage. I am indebted to Dr. José Luis Villaseñor and the staff of the Herbario Nacional (MEXU) at Universidad Nacional Autónoma de México for their kind advice and for their assistance with collecting trips in México. Thanks also to Rupert Barney of the New York Botanical Garden for preparing the Latin diagnosis.

REFERENCES


PACKERA SUBNUDA COMB. NOV.,
A CORRECTED NAME FOR PACKERA BUEKII
(ASTERACEAE: SENECIONEAE)

DEBRA K. TROCK AND THEODORE M. BARKLEY

Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060, U.S.A.
dtrock@brit.org; tbarkley@brit.org

ABSTRACT

The new combination, Packera subnuda (DC.) D.K. Trock & T.M. Barkley is proposed, based upon Senecio subnudus DC.

RESUMEN

Se propone la nueva combinación Packera subnuda (DC.) D.K. Trock & T.M. Barkley, en base a Senecio subnudus DC.

The North American entity once known as Senecio subnudus DC. and later as Senecio cymbalarioides H. Buek has a tangled nomenclatural history, especially when transferred to the segregate genus Packera. We reviewed these complexities (Trock & Barkley 1998) and proposed the new name, Packera buekii D.K. Trock & T.M. Barkley for this plant. Drs. K.N. Gandhi and John Strother have both pointed out that the nomenclatural session of the recent International Botanical Congress (Saint Louis, 1999) passed a rule which pertains to our nomen novum. The new rule is an addition to the present art. 53.6, & ex. 17, to be included in the forthcoming International Code of Botanical Nomenclature (ICBN). According to the concept of the new rule, a renamed legitimate homonym has priority over its nomen novum during a transfer to another genus. In this case, the basionym Senecio subnudus is legitimate in the segregate genus Packera and, therefore, the replacement name, Packera buekii is superfluous. The following new combination is proposed:


REFERENCE

BOOK NOTICE


This book provides color photographs for the common cacti of this important national park. After a brief introduction and glossary, the book is divided into 12 chapters, arranged by genus, including Ariocarpus, Coryphantha, Echinocactus, Echinocereus, Echinomastus, Epithelantha, Ferocactus, Glandulicactus, Mammillaria, Neolloydia, Opuntia, and Thelocactus. Finally, the book ends with a list of cacti historically reported but not recently seen, or cacti that one would expect but have not as yet been found in the park.

The photographs are excellent, and the high quality, glossy paper accentuates their aesthetic value. The descriptions are pointed at the hobbyist but are practical and useful to everyone. Both common and scientific names are given for each species, and no precise localities are given, presumably to inhibit poachers. For some species, details about the ecological life history and elevational range is also given.

This is a wonderful, thrifty "coffee table" and field guide, and I highly recommend it to plant enthusiasts planning to visit the park, or working with the flora of Texas.—John J. Pipoly III.
A NEW SPECIES OF PHASEOLUS (FABACEAE) FROM WEST-CENTRAL MEXICO

RAYMUNDO RAMÍREZ-DELGADILLO
Instituto de Botánica, CUCBA
Universidad de Guadalajara
Apartado Postal 139, C. P. 45110
Zapopan, Jalisco, MÉXICO

ALFONSO DELGADO-SALINAS
Departamento de Botánica
Instituto de Biología, UNAM
Apartado Postal 70-367, C. P. 04510
México D.F. MÉXICO

ABSTRACT

We report the existence of a new species, Phaseolus albescens, from western Mexico, with close affinities to P. vulgaris, P. cocineus, P. costaricensis, and particularly to P. polyanthus, and describe plants commonly occurring in wild habitats, examine morphological and anatomical characters and give notes on observations made on its floral biology. An illustration of the plant, photographs of its pollen, and stem anatomy are provided. Also, a key to the species of the Phaseolus vulgaris group is presented.

RESUMEN

Se reporta la existencia de una nueva especie, Phaseolus albescens, del occidente de México, especie afín a P. vulgaris, P. cocineus, P. costaricensis, y en particular a P. polyanthus y se describen plantas de esta especie de hábitats silvestres, se examinan caracteres morfológico y anatómicamente y se presentan notas sobre observaciones efectuadas a su biología floral. La especie se ilustra y se provee de figuras de su polen y anatomía del tallo. También, una clave de las especies del grupo Phaseolus vulgaris es presentada.

INTRODUCTION

Populations of Phaseolus albescens have been recognized as morphologically distinct for a decade (Delgado-Salin as 1988; Ramírez-Delgadillo 1991). Some of the differences were clearly detailed by McVaugh (1987), who treated this species as Phaseolus, aff. P. cocineus for the Flora Novo-Galici ana. Indeed, McVaugh (1987) recognized Phaseolus albescens as different, but not convincingly so from P. cocineus. According to him, this plant is easily distinguished from sympatric wild plants of P. cocineus by the color of its flowers ["pale-lavender," "old-rose," or "pale rose-pink, fading yellowish"], and by "... less tendency for the flowering axes to be crowded towards the tip." He also compared it with P. polyanthus Greenman (also recognized as P. cocineus
subsp. darwinianus or also as P. coccineus subsp. polyanthus), stating that this Nueva Galicia plant has shorter, ovate to lanceolate bracteoles and glabrate foliage.

During the course of a phylogenetic study of the genus Phaseolus, inferred from molecular data and non-molecular data (Delgado-Salinas et al. unpublished), three collections of P. albescens from west-central Mexico were shown to be clearly different from three samples of P. polyanthus, one wild collection from Guatemala, one cultivated from Puebla, and one escaped from Peru. Phaseolus albescens collections differ from those of P. polyanthus, by at least 51 pairwise base mutations, 7 of which are transversions, and one deletion of 3 base pairs. In addition to these molecular characters, morphological differences observed during previous studies were shown to be distinguishing. Such characters included the floral bracteoles, flower color, and glabrate foliage. Also the P. albescens clade was restricted to a region north of the range of P. polyanthus.

In this paper information on the anatomy of the stem and on the floral biology of this species is brought into consideration and thus, the species is described and finally formalized below:


Phaseolus polyantho Greenman sylvestri affinis, sed diverso bracteolis calycinis brevioribus, floribus lilacinis, postea albescentibus, demum lutescentibus, ovulis 4–5, et distributione geographica in Mexico occidentali.

Perennial herbaceous and woody vine, with secondary growth developed in basal stems, 2–3 cm in diameter, with corky appearance and displaying conspicuous rows of lenticels; root long and lignescent, non-tubercous; stems up to 10 m long, terete, leaning or twining, sparingly branched, covered with sparsely appressed and uncinate hairs. Leaves membranous and large, up to 30 cm; stipules triangular, ca. 5 mm long, ca. 3 mm wide at base, striate, lately caducous, horizontal to reflexed; petioles striate, sparsely strigose, up to 10 cm long, sometimes longer than leaflets, rachis up to 3.5 cm long; stipels ovate to lanceolate, ca. 5 mm long; leaflets entire, terminal ones, ovate to widely ovate, slightly oblique (lateral leaflets) at base, acute or acuminate at apex, apiculate, 8–15 cm long, ca. 10 cm wide, the lateral leaflets sometimes with domatia within its basal veins, sparsely strigose on both surface. Inflorescences in axillary pseudoracemes, glabrate or covered with uncinulate or appressed, antrorse hairs, 10–50 cm long, with 10–40 flowering nodes; buds 1–3 in each fascicle, 2 buds commonly flowering; primary bracts nar-
rowly triangular to lanceolate, striate, persistent, 3–5 mm long, ca. 1 mm wide at base; secondary bracts narrowly triangular, horizontal or reflexed, ca. 2 mm long, 1 mm wide, subpersistent; pedicels thin, thicker at fruiting, 1.5–2 cm long; bracteoles shorter than the calyx, lanceolate, never falcate, slightly auricled at the base, 1–5-nerved, subpersistent, 3–4.5 mm long, ca. 1 mm wide; flowers ca. 2 cm long, with calyx obliquely campanulate, sometimes with a bulged upper base, tube sparsely strigillose on the outer and the inner surfaces, 5–6 mm long, upper lip emarginate, lower lip with 3 subequal, triangular lobes, ca. 1 mm long; corolla lilac fading to white, and later to yellow; standard oblong to orbicular, often little wider than long, 1–1.4 cm long, 0.9–1.2 cm wide, distal portion of outer surface setose, covered with appressed, minute hairs, on the inner surface the lamina shows a thickening at the point of reflexion, the surface between the bending point and the claw covered with micro-papillae, with two swollen appendages at each side of this basal portion, claw ca. 2 mm long; wings oblongate, ca. 2 cm long, ca. 1 cm wide, constricted toward the base, upper basal margin round-auricled with a lamellate surface, claw of wing ca. 5 mm long; keel ca. 1.5 cm long, claws 3 mm long, on distally 1.5 coiled, diameter ca. 3 mm; staminal tube biciliatured towards the base, with sub-basifixed anthers, vexillary or free stamen ca. 1.5 cm long, with a trapezoid-shaped appendage toward the base, its edge undulated; pollen tricolporate, brevicolpate, edge of the colpi reinforced by a margo, ectoaperture membrane granulated, endoaperture (on non-acetolyzed pollen) covered with a smooth operculum; exine with a distinctive sculpturing between the mesocolpium (foveolate-pisilatated) and the apocolpium (rugulated)(Figs. 4–5, 8–9); ovaries with 4–5 ovules, strigose, pollen brush short and laterally-placed on the last coil of the style; stigma apical, sometimes slightly introrse. Pods linear, slightly curved, 7–9 cm long, ca. 1.2 cm wide, short tapered to tapered at base, and with a ca. 1 cm straight beak at the apex; valves chartaceous with narrowly thickened sutures, dehiscent, with a slightly glossy epicarp, light brown-yellowish coloured at maturity, sometimes purple-pigmented, striate, glabrate, (3) 4–5 seeded. Seeds 1–1.3 cm long, 7–8 mm wide, ca. 3 mm thick (weight of 100 seed, ca. 20 grams), reniform to sometimes quadrangular, compressed; testa glossy and tan to dark brown mottled and streaked; hilum ovate with a persistent ephiloc, ca. 3 mm long, ca. 1.5 mm wide, rim aril prominent, micropylar area lighter than testa color; lens prominent, slightly divided in two. Seedling with epigal germination; epicotyl pubescent; stipules bifid, petiole with basal and apical pulvini (3-portioned); eophyls simple, ovate with a cordate-truncate base, next leaves trifoliolate. Chromosome number, 2n = 22, in root-tip cells, voucher: Ramírez-Delgadillo 2553 (IBUG) (P. Mercado-Ruaro, pers. comm.).
PARATYPES. MEXICO. Colima: Municipio de Colima. Rancho El Jabali, aprox. a 20 km al N de la Cd. de Colima, cerca de la Hacienda San Antonio, 19° 26' N; 103° 40' W, 1,300 m, 7 Feb 1992, Rico 921 y Martinez (MEXU). Guerrero: Municipio de La Unión, 73 km al NE de Zihuatanejo, carretera Zihuatanejo-Ciudad Altamirano, 1,770 m, 2 Feb 1983, Tenorio et al. 3237 (MEXU). Jalisco: Municipio de Cuautitlán, Sierra de Manantlán, (15–20 m) SE of Autlán on the bajada south and west of the divide between Aserradero San Miguel and Durazno, 2,000–2,350 m, 6 Nov 1952, McVaugh 13943 (MEXU; MICH); Arroyo San Miguel, 1.5 km al E de su desembocadura, ca. 1 km al S de Rincón de Manantlán, 19° 35' N; 104° 12' 30 W, Sierra de Manatlán Occidental, 1,600–1,800 m, 5 Jan 1985, Jadziewicz et al. 5113 (MEXU; WIS); Sierra de Manantlán, en el Rancho El Lamial, carretera para el Rancho de la Jofa, 2,050 m, 10 Dic 1982, Cazadora 9466 y Nieto (MEXU; XAL); Municipio de Jocorepec, Barranca del Agua, al N de Zapotitlán, 18 Dic 1994, Alcibea N. 4708 (IBUG); Ramirez-Delgado 2553, 3600 (IBUG); Municipio de Tecomitlán, Sierra del Golfo, primitive road to San Isidro above the junction SSW of Tecomitlán, 2,000–2,200 m, 20 Nov 1959, McVaugh & Koelz 1240 (MICH); 20 km SE of JCT with Route 110, on the way to Jalotlán via San Isidro, 2,130 m, 3 Dec 1995, Kajitah et al. 95 120310 (MEXU). Michoacán: Municipio de Coalcomán, W of Aguillilla, 12 km SE of Aserradero Dos Aguas, 1,600–1,700 m, 27 Nov 1970, McVaugh 24754 (MEXU; MICH).

Distribution, habitat, and phenology.—*Phaseolus albuscens* is restricted to western Mexico, where the genus *Phaseolus* is well-represented (Delgado-Salinas 1985). Sparse populations of *P. albuscens* occur mainly in montane forests of the Sierra Madre del Sur (i.e., Sierra de Manantlán and Sierra del Golfo). Also on the isolated mountain range known as the Sierra del Madroño, located in the center of the state of Jalisco, with geological links with the Trans-Mexican Volcanic Belt. In Colima, Michoacán, and Guerrero it is distributed on mountains of the Sierra Madre del Sur. The species grows in pine, pine-oak, and deciduous forests, on brown and light-brown clay soils, always in humid and protected environments at 1,300–2,100 m.

*Phaseolus albuscens* its a late-fall and early winter bloomer (Oct. to Jan.), and sets pods from November to March. In cultivation on the Universidad de Guadalajara grounds, *P. albuscens* grew to be a large and vigorous vine, climbing up to ca. 10 meters high. It produced leaves every year and all year round, flowering profusely from October to December, when *Xylocopa* bees were observed visiting its flowers. However, few fruits were set by this plant each year. The plant lived for six years, until a severe drought killed it.

Common name and uses.—While people in Colima are aware of these plants, which they called ‘frijolillo’, they do not eat them.

Wood anatomy of *Phaseolus albuscens* (Figs. 2–3).—Wood is diffuse porous, with shape of pores oval to angular, in distribution of radial multiples of 2–10 vessels, aggregated in multiples chains or clusters; solitary vessels are of uncommon occurrence. Numerous narrow vessels with 61 pores per mm² mixed with the fewer wider vessels with 10 pores per mm². Vessel elements are short, with length that ranges from 174 to 192 μm. There is a considerable range of variation, however, in vessel diameter, ranging from a mean
Figs. 2–3. Anatomical features of the stem of *Phaseolus albus*. Fig. 2. Cross-section (× 2.5) showing the secondary xylem with a diffuse arrangement of its vessels; also the presence of a sclerenchymatous ring of fibers adjacent to the primary xylem. Fig. 3. Tangential section (× 10) showing radial wood parenchyma composed of homocellular rays, with the presence of nodules (typical of this species), indicated by an arrow. Fibers are located around vessels, excluding the parenchyma cells, which contain abundant polyhedron crystals. Figs. 2–3. Delgado *et al*. 1705.
Figs. 4–9. Pollen grains of *Phaseolus albescens* and *P. polyanthus*. Figs. 4–5. Light microscopic photographs of *P. albescens*: Fig. 4 showing rugulate ornamentation on the apocolpium. Fig. 5 showing the brevicolpus with a margo surrounding the furrow. Figs. 6–7. Light microscopic photographs of *P. polyanthus*: Fig. 6 showing the finely-reticulated ornamentation on the apocolpium. Fig. 7 showing the short colpus. Figs. 8–9. Scanning electron micrographs of acetolyzed pollen grains of *P. albescens*. Fig. 8 showing at equatorial view one of the three short colpus. Fig. 9. Colpus covered with a finely granulated membrane, and with a slightly lalongate pore, without operculum present due to acetolysis process. Scale bars = 10 μm. Figs. 4–5. Machuca N. 4708. Figs. 6–7. Dehouck & Soto 1608. Figs. 8–9, Delgado et al. 1705.
tangential diameter of 42 μm in the narrow vessels to a tangential diameter of 198 μm in the wider vessels. Perforation plates are all simple, the ones from wider vessels elements are predominately transversal, while those of narrower vessels are oblique. Intervessel and vessel-ray pitting is alternate, with minute pits from 5 to 8 μm.

Axial wood parenchyma is abundant and apotracheal, with 2 to 3 cells per segment. Polyhedron crystals frequently forming long chains are abundant in parenchyma cells that surround strands of fibers.

Radial wood parenchyma are composed of scanty homocellular rays, with 3 to 4 rays per mm². Ray cells are usually square to upright, where nodules can be observed in tangential section.

The average length of the libriform fibers ranges from 741–1,667 μm (with a mean of 1,310 μm), with a tangential diameter of 25 μm. Fibers are located around vessels, their secondary walls reinforce the wall of the vessels, but also excluding the parenchyma cells.

*Pollen description* (Figs. 4–9).—Tricolporate, semitectate, spheroidal, P=(40–)51.3(–55) μm length; E=(40–)55(–60) μm width. P:E=1.05. Polar view subcircular, (47.2–)53.3(–60) μm. Exine thickness of 2.4–3 μm. Colpi, brevicolpate, covered with a finely granulated membrane, (19.2–)29.8(–30.4) × (16.8–)21.7(–28.0) μm. Pori slightly lalongate, 5 μm in diameter, the pore is covered with a conspicuous operculum (non-acetolyzed pollen grains).

*Observations on the floral biology of Phaseolus abscens.*—Flowers of this species were observed in Jalisco (N 19 36° 59″; W 103 30° 54.7″; 1,640 m) in mid November where high visitation rates were registered, with numerous intraloral movements made by bees (Xylocopa guatemalensis, Bombus pullatus, Bombus sp., and Apis mellifera). Observations occurred between 9:00 am and noon. The color of flowers in this population was lilac fading to white and later to yellow. White flowers were ignored and visits were confined to the lilac-colored flowers, whose standard petal was normally raised and not almost fully reflexed as happens in the white-yellowish ones. The color change (lilac to white) is accompanied by a change in the position of the standard, which the bees probably perceived, so they are able to distinguish between the young and older flowers, apparently there is both an optical and position change to aid the insect in its visit.

Although flowers of a wild plant of *Phaseolus vulgaris* were close-by, no visitation of bees between both species were detected. Also, plants of wild *P. coccineus* were seen growing within two hundred meters, no hybrids between them or with *P. vulgaris* were found.

*Relationships with the wild P. polyanthus.*—As noted in the introduction, McVaugh (1987) recognized differences between plants corresponding to *Phaseolus abscens* and plants of wild *P. coccineus* and cultivated plants of *P.*
polyanthus. Recently, the wild progenitor of the cultivated *P. polyanthus* has been identified in Guatemala by Schmidt and Debouck (1991), although still not completely described, observations made on its general morphology (*Deboutte & Soto* 1608; WIS) and on its seeds (CIAT # 35877) show consistent differences between the two.

Indeed, *P. albescens* is superficially very similar to the wild *P. polyanthus* in fruit, but the number of seeds in the fruit of each taxon differ, mainly having 4–5 seeds in *P. albescens*, while pods with 3–4 seeds are present in the Guatemalan plants. Also the flowers of the two species differ in a number of ways, most noticeably in the form and size of the bracteoles, which in *P. polyanthus* are longer and broadly lanceolate, in addition to the contrasting floral coloration, and change in position of the *P. albescens* standard petal. The pollen of *P. albescens* can be distinguished from *P. polyanthus* by larger dimensions (P:E ratio > 0.13) and foveolate-rugulate exine ornamentation instead of a finely-reticulated one. Furthermore, their actual disjunct distribution (*P. albescens* restricted to west-central Mexico and wild *P. polyanthus* mainly to Guatemala), apparently endures from a fairly old separation from each other in the past. This can be assumed comparatively by the number of molecular changes presented by *P. albescens* different from the cultivated and wild *P. polyanthus*.

The specific epithet 'albescens' refers to the flower color of this species being lilac at anthesis, then turn in, white and later yellow when older.

**KEY TO PHASEOLUS ALBESCENS AND WILD RELATIVES**

1. Inflorescences few-flowered, commonly with 8 or less flowering nodes; flowers small to medium size, standard-petal 1 cm or less long; pods narrow, ca. 1 cm wide; seedlings with epigeal germination.
   2. Pedicels in flower 3-7 mm long; bracteoles linear-ovate to lanceolate, shorter than calyx, less than 1 mm wide, 1–5 veined; petioles of first seudding leaves (eophylls) subsessile ........................................... *P. acutifolius* A. Gray
   3. Pedicels in flower 0.5–1.2 cm long; bracteoles broadly ovate, prominent, equaling the calyx, 2.5–4 mm wide, 5–10 veined; petioles of first seedling leaves (eophylls) elongated, not sessile ........................................... *P. vulgaris* L.
1. Inflorescences many-flowered, commonly with 10–30 flowering nodes; flowers medium to large size, standard-petal more than 1 cm long; pods broader, more than 1 cm wide; seedlings with epigeal or hypogeal germination.
   3. Plants developing of a thick, often branched, tuberous root; corolla commonly red, rarely purple or white; stigma apical-intronse; seedlings with hypogeal germination ........................................... *P. coccineus* L.
   4. Plants not developing of a tuberous root, main root lignified or fibrous; corolla dark pink, purplish, lilac or white; stigma terminal or introrse; seedlings with epigeal germination.
4. Corollas dark pink or lilac to purple, wing-blades at anthesis not fully expanded, clasping; bracteoles broad, 2.5–8 mm wide; plants from Costa Rica and Panama ........................................... *P. costaricensis* Freytag & Debouck
4. Corollas lilac-white or white, wing-blades at anthesis fully expanded; bracteoles narrower, 1–1.5 mm wide; plants from western México and Guatemala.

5. Bracteoles broadly lanceolate, sometimes falcate, commonly exceeding the calyx, 6–8 mm long; pods with 3–4 seeds. \textit{P. polyanthus} Greenman

5. Bracteoles lanceolate, never falcate, shorter than calyx, 3–4.5 mm long; pods with 4–5 seeds. \textit{Phaseolus albescens} McVaugh ex R. Ramírez & A. Delgado

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REFERENCES


THE RELATIONSHIPS OF THE AMERICAN BLACK-FRUITED HAWTHORNS
CRATAEGUS ERYTHROPODA, C. RIVULARIS, C. SALIGNA AND C. BRACHYACANTHA TO C. SER. DOUGLASIANAE (ROSACEAE)

J.B. PHIPPS

Department of Plant Sciences
The University of Western Ontario
London, Ontario, N6A 5B7, CANADA

ABSTRACT

A group of black-fruited Crataegus (Rosaceae) from the western United States is analysed. Crataegus erythroponda, a species with previously poorly understood affinities, is shown to be closely related to C. rivularis. The affinity of C. rivularis and C. saligna is reconfirmed. The three species form a clade subtended by C. brachyacantha and different from the clade containing C. douglasii and C. okenmonii when analyzed by PAUP using 38 morphological characteristics. Crataegus rivularis and C. saligna are lectotypified.

RESUMEN

Se estudia un grupo de Crataegus (Rosaceae) con frutos negros del oeste de los Estados Unidos. Crataegus erythropoda, una especie con afinidades pobremnete conocidas, se muestra que está muy relacionado con C. rivularis. Se reconfirma que C. rivularis es también muy afín a C. saligna. Las tres especies forman un clado en cuya base se encuentra C. brachyacantha y que es diferente del clado que contiene a C. douglasii y C. okenmonii cuando se analiza mediante el PAUP usando 38 características morfológicas. Se lectotipifican Crataegus rivularis y C. saligna.

Black-fruited Crataegus are in a substantial minority worldwide, as also in North America where perhaps seven species are black-fruited. Numerous authors have pointed out the significance of fruit color in relation to frugivor dispersal and this topic has even received a little attention for North American hawthorns (e.g. Sallabanks 1993). It is not known whether North American black-fruited hawthorns form a natural clade and without undertaking an exhaustive examination that potentially includes many red-fruited species, this fact cannot be determined. However, it had appeared to me that they fell into at least two groups, the first being all members of series Douglasianae (Rehd. ex Sarg.) Rehd. (this includes C. douglasii Lindll., C. suksdorffii (Sarg.) Kruschke and C. okenmonii J.B. Phipps) together with a second group (C. brachyacantha Sarg. & Engelm., C. erythropoda Greene, C. rivularis Nutt. ex Torr. & A. Gray and C. saligna Greene) which might have
some loose interrelationship. I test this hypothesis of two clades with a clada-
listic analysis using 38 morphological characteristics.

Series *Douglasianae* has been the subject of a substantial amount of re-
cent research and is more northerly than the group of species on which I
focus in this paper, with a southern limit of about 43° N except in Califor-
nia where it is farther south. Love and Feigen (1978) showed that *C. douglasii*
could hybridize with the distantly related and introduced *C. monogyna* Jacq.,
Brunsfeld and Johnston (1990) provided solid grounds for raising *C. suksdorfii*
(Sarg.) Kruschke from a variety of *C. douglasii* to specific rank while Dickinson
*et al.* (1996) contrasted the breeding systems in the 20-stamen *C. suksdorfii*
and the 10-stamen *C. douglasii* to good effect. Dickinson and students are con-
tinuing their biosystematic and morphometric analyses of ser. *Douglasianae.*
Recently, I described a new species, *C. okennoui,* from this group (Phipps &
O’Kennon 1998). Due to this recent activity and the continuing researches
of the Dickinson group on ser. *Douglasianae,* I restrict coverage of the series
in this paper to the cladistic analysis merely to discover if ser. *Douglasianae*
is a separate clade from the other species considered.

Here, therefore, I direct attention to the more southerly, and allopatric,
component of the ‘black-fruited’ *Crataegi,* the group of *C. rivularis,* *C. erythropa-
da,* *C. saligna* and *C. brachyacantha.* The relationships of these species has al-
ways been much more controversial. *Crataegus saligna* was placed with *C.
brachyacantha* by Palmer (1925), a supposition that I followed without study
in the Maloid checklist (Phipps, *et al.* 1990). Then, particularly influenced
by field observations, I recognized its probable affinity to *C. rivularis,* a rel-
ationship in fact explicitly noted by Greene (1896) when he described *C.
saligna.* With regard to *C. erythropa-da,* as recently as this year (Phipps 1999),
I included this species among the western red-fruited species. Neverthe-
less, the existence of a few intermediate specimens noted since that paper was
prepared, together with the detailed examination for this paper, and prepa-
ration of the draft description for the *Flora of North America,* showed con-
clusively that it was actually close to *C. rivularis.* Also recently, Welsh (1982)
placed both *C. rivularis* and *C. saligna* under *C. douglasii,* a solution that I do
not believe that any current student of *Crataegus* would consider tenable.

I therefore resolved to investigate the cladistic interrelationships of the
North American black-fruited species and, in the cases of *C. saligna,* *C. rivularis*
and *C. erythropa-da,* which have never received any independent taxonomic
study since their original descriptions, in contrast to ser. *Douglasianae,* to
carefully characterize and typify them. In addition, *C. rivularis* and *C. saligna*
are provided with detailed distribution maps for the first time. Finally, I
need to comment on my cautious ‘black fruited’. Species in this group either
have black, purple, or burgundy fruit when fully ripe, the particular color,
and its changes during ripening, having taxonomic significance. The term ‘black-fruited’ in the title therefore refers to a group of related hawthorns that are predominantly, but not entirely, black-fruited at full maturity.

METHODS

An extensive sample of herbarium specimens of the taxa to be studied has been assembled by my own fieldwork in recent years, assisted by R.J. O’Kennon, together with many examples of loan specimens. As this paper is not aimed at assessing specific limits, no morphometric phenetic analysis of large samples was conducted. However, the samples were used to determine the characteristics of synthetic OTU’s, one for each species, that would be analyzed by PAUP 2.4.1. The 38 characteristics used for this purpose are listed in Table 1. Distribution maps for previously unmapped or inadequately mapped species were created by Range-Mapper, a program created by the firm Tundra Vole of Fairbanks, Alaska. For this purpose, where sufficiently precise location data existed on the herbarium label this was converted into latitude/longitude coordinates accurate to the nearest minute. Files for each species were then mapped. Typification followed standard procedures. Syntypes or potential lectotypes were located, occasionally with great difficulty, and hololectotypes or neotypes selected on the basis of goodness of fit to the protologue, citation in the protologue (if pertinent), and specimen quality, when a choice was available. No specimens are illustrated due to the existence of excellent illustrations elsewhere. The characterizations presented here of the species outside ser. Douglassianae are in fact somewhat detailed diagnoses because this work does not purport to be a taxonomic revision, because excellent descriptions exist elsewhere and because, in my view, they represent four well-marked species even by conservative criteria.

INTERRELATIONSHIPS

The possible and intriguing relationship between C. saligna and C. rivularis has already been suggested. If these two proved to be sister species then a new series ‘Rivulares’ could be created to accomodate them. However, on reflection, it seemed that C. rivularis might be even closer to C. erythopoda on the basis of identical floral and inflorescence characteristics and fruit differing only in fully ripe color. A series that included both C. saligna and C. erythopoda is perhaps a little broader than most series in North American Crataegus. We need also to pay attention to Palmer’s (1925) view that C. saligna was closely related to C. brachyacantha and therefore should be placed in ser. Brevispinae (Palmer used the nomen nudum Brachyacanthae), where I had provisionally placed it (Phipps et al. 1990) following convention and without study. Crataegus brachyacantha is very similar to C. saligna in flower and leaf characteristics
but differs greatly in the thorns (curved, ≤ 1.5 cm long), color of overmature inflorescence (yellowish orange), fruit size (generally larger), smooth lateral faces of the pyrenes, and lack of copper-colored bark. Also Welsh had made both C. saligna and C. rivularis varieties of C. douglasii, in what seemed to me to be an untenable association. It therefore seemed pointless to conduct a numerical taxonomic study to throw light on these contrasting possibilities and to establish whether any of these taxa were especially close to members of ser. Douglassianae.

For this, I scored 38 characters (Table 1) for 9 synthetic OTUs, one for each species, which included all the black-fruited Crataegus species that are the particular subjects of this paper (C. saligna, C. rivularis, C. erythropoda and C. brachyacantha) plus C. douglasii s.s., C. subalpinus and C. okkonii of ser. Douglassianae as well as the red-fruited outgroups C. mollis (Torr. & A Gr.) Scheele and C. monogyna Jacq.

Using PAUP 2.4.1, C. erythropoda and C. rivularis are shown to be sister species in the three shortest trees (Fig. 1). The douglasii group, consisting of Cc. douglasii and okkonii, always formed one sub-clade while C. brachyacantha, C. saligna, C. rivularis and C. erythropoda always formed another in all shortest cladograms. However, C. saligna and C. brachyacantha were by no means very close in these cladograms although C. rivularis and C. erythropoda were

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Table 1. Thirty-eight morphological characteristics scored for cladistic analysis.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>31. Fruit: color at full ripeness</td>
<td>32. Fruit: shape, 1</td>
<td>33. Fruit: shape, 2</td>
<td>34. Fruit: pubescence</td>
</tr>
<tr>
<td>Autumnal foliage</td>
<td>38. Color</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
shown in all analyses to be sister species. The two unpublished trees only differ in the location of *C. suksdorfii* which is either basal to *C. douglasii / okennonii* (published tree), basal to (B(Sa(R,E))), using their epithet abbreviations, in one unpublished tree or basal to both (D,O) and (B(Sa(R,E)) in the other.

The union of all seven black-fruited species inside the red-fruited outgroups *C. mollis* and *C. monogyna* does not, however, indicate that the black-fruited group is monophyletic. An analysis using all the red-fruited species would be required to generate such a finding and that is not the function of this exercise. Rather, it is to locate the position of *C. erythropa*, *C. rivularis*, *C. saligna* and *C. brachyacantha* relative to the immediate *C. douglasii* group. The cladogram endorses the view that neither *C. saligna* nor *C. rivularis* are part of the species *C. douglasii*. The following key summarizes the differences among the four species in *rivularis* clade.

**KEY TO RIVULARIS-CLADE OF BLACK AND BURGUNDY-FRUITED CRATAEGUS**

1. Stamens 20; anthers cream; flowers 10–12 mm diam.
2. Thorns 1–1.5 cm long, decurved, grayish; twigs grayish; overmature flowers orange-yellow; nutlets with lateral faces plane ...................... *C. brachyacantha*
3. Leaves evidently about 3-lobed per side; usually ca. 1.5 times as long as broad, usually widest in the basal third; fully ripe fruit usually burgundy
   ........................................................................................................... *C. erythropa*

1. Stamens 10; anthers pink; flowers 15–17 mm diam.
2. Thorns 2–4 cm long, straight, black; twigs copper-colored; overmature flowers white to dirty white; nutlets with lateral faces pitted ................. *C. saligna*
3. Leaves evidently about 3-lobed per side; usually ca. 1.5 times as long as broad, usually widest in the basal third; fully ripe fruit usually burgundy

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**Fig. 1.** Cladogram of North-American black-fruited *Crataegi* created by PAUP using 38 morphological characters.
TAXONOMIC AND NOMENCLATURAL NOTES ON INDIVIDUAL SPECIES

**CRATAEGUS ERYTHROPODA**—Characterization


*C. bakeri* Greene, nomen nudum

This species has been described, illustrated and mapped in my recent paper (Phipps 1999) where it was entered into a new monotypic series, *Ceratomes* J.B. Phipps, on account of its distinctness from other red-fruited species. *Crataegus erythropoda* may be briefly characterized by its ovate-rhombic, ± glabrous, shallowly-lobed, smallish leaves; glabrous inflorescences with 10-stamen flowers having pink-purple anthers; suborbicular fruit which is burgundy at maturity (I have never once seen 'orange' as described in the protologue by Ashe (1900) and Holmgren (1997)); shiny coppery bark on 2–5 cm thick stems and thorns mainly 2–4 cm long. *Crataegus erythropoda* occurs in sites with groundwater available, or otherwise mesic, mainly in intermountain Colorado and adjacent New Mexico, where it is quite common. Holmgren (1997) also records it from eastern Utah and northeastern Arizona. The 'orange' fruit color cited may refer to immature fruit since the type was collected in August, but I have not myself seen this color even in mid-August. *Crataegus erythropoda* has presented no serious problems in delimitation or recognition though its relationships have been hitherto obscure. See the protologue (Ashe 1900) for another full description. Interestingly, Palmer (1925) assigned *C. erythropoda* to ser. *Douglasiana*, an idea taken up by none else, but nevertheless the closest approximation to date. Observations made for this paper indicate that at anthesis *C. erythropoda* is almost indistinguishable from *C. rivularis* in floral/inflorescence characteristics. Significant differences in leaf shape and ripe fruit color exist, however, as indicated in the key.

A specimen of Greene's from the Lower Cimarron River, Colorado (NDG), collected in 1896 and labelled 'C. bakeri', a name never published, is actually a perfectly adequate specimen of *C. erythropoda* Ashe.

**CRATAEGUS RIVULARIS**—Synonymy, Characterization and Typification


As with *C. erythropoda*, there have not been serious problems in taxon recognition or delimitation although some floristic authors have followed Sargent (1889) in relegating *C. rivularis* to varietal rank under *C. douglasii*.

*Crataegus rivularis* is a locally common, even locally abundant, species of intermountain USA, found in many locations in this generally dry area where there is a high water-table. I map this widespread species (Fig. 2) which
occurs from southern Idaho to northern New Mexico and from south-central Utah east to the Rocky Mountains. It reaches 6–7 m in favorable sites where it may form extensive thickets. The bark of 2 cm diameter branches is copper-colored like *C. erythropoda* and the generally fine thorns are mainly 2.5–4 cm long. The normally elliptic leaves are tapered at each end, subglabrous, 4–6-veined and quite unlobed on short-shoots, being beset with many sharp, forward-pointing fine marginal teeth. The glabrous inflorescence bears large 10-stamened flowers with pink anthers and can hardly be differentiated from that of *C. erythropoda*. The numerous, often large, subbaccate fruit pass through a striking deep reddish-burgundy color to deep purple and finally black. See also Sargent (1890) for a detailed characterization and excellent plate by Faxon. Intermediates with *C. douglasii* are not known and *C. rivularis* is essentially allopatric with that more northern species which facts reinforce the findings of the cladistic analysis. However, because Welsh (1982), Holmgren (1997), and Sargent (1889, 1890) have included *C. rivularis* in *C. douglasii*, I would like to emphasize their distinction with the following key couplet.

1. Thorns fine, little recurved, usually 2.5–5 cm long; bark of 1–2 cm diam. branches shiny coppery brown; flowers 14–18 mm diameter, calyx lobes 5–8 mm long, long-attenuate from a broad base; leaves narrow elliptic, unlobed or rarely with 1–2 very small lobes per side, tapered at both ends, acute to acuminate at the apex, the venation semi-camptodromous; fruit subglobose, 11–14 mm diam., crimson-lake ripening to shiny black ......................... *C. rivularis*

1. Thorns stout, often recurved, usually 1.5–3 cm long; bark of 1–2 cm diam. branches tan to gray-brown; flowers 12–15 mm diam., calyx lobes 3–4 mm long, narrow-triangular from a broad base; leaves much broader, most commonly broad elliptic to narrow-obovate in general shape, usually lobed (unlobed in rare narrow-leaved specimens), the venation clearly craspedodromous except in rare narrow-leaved specimens, usually obtuse to subacute at the apex; fruit generally ellipsoid, usually ≤ 9 mm diameter, ripening dull purple to purple-black or black, generally with rather strong bloom ......................... *C. douglasii*, s.s.

The suite of differences is so large, together with the lack of intermediates and different distribution, that one cannot reasonably place *C. rivularis* in the same species as *C. douglasii*.

In making *C. rivularis* a variety of *C. douglasii* Sargent's overall understanding of this taxon was poor, illustrated by his providing (1890) an inaccurate range extension from northwestern California to Puget Sound and his statement, "usually a low intricately branched.....shrub." This perhaps helps to explain the cautious rank chosen by Sargent, a notorious splitter by modern criteria.

*Crataegus rivularis* has not been typified, therefore, I lectotypify it here. The type description for *C. rivularis* (Torrey & Gray 1843) is of characteristic brevity and imprecision for the period and might at first sight refer to
C. douglasii or even C. saligna, as well as to the taxon normally associated with the name.

The protologue for *C. rivularis* cites "Oregon, rivulets in the Rocky Mountains" as the type area with Nuttall as collector. It is hard to know exactly where this is, because of the extensive nature of the Oregon Territory in 1843. What we call *C. rivularis* today is a distinct, well-collected taxon with a well-established range (Fig. 2) which just reaches southern Idaho, part of which is an acceptable area for "Rocky Mountains." Putative sytype ma-
terials of *C. rivularis* from BM, GH and PH were borrowed in order to lectotypify this species.

Of the two PH specimens sent (both on the same sheet) one (on the right-hand side) can be rejected directly as it is a Canby-collected *C. douglasii* from 1873, while the left-hand specimen, labelled 'Rocky Mountains', is a leafy twig without reproductive material that requires comparison with the protologue. Both the BM and GH sheets have specimens collected by Nuttall that are a reasonable match for the somewhat poor description in the protologue and are clearly the same species as each other. In view of the indifferent quality of the protologue and the consequence that a species other than what is conventionally called *C. rivularis* might have been described, I provide in Table 2 critical comparisons between the protologue and putative types (cols. 1, 2), between the protologue and *C. douglasii* (col. 3) and between the protologue and standard interpretation of *C. rivularis* (col. 4).

Several points in the protologue cannot be assessed from the putative syntypes from BM and GH. These are the arborescent nature of the plant (not recorded on the collection label) and flowering characteristics (the putative syntypes are post-flowering). Also, Nuttall in describing the leaves as "ovate, obovate" poses something of a problem, as these are not terms that we would apply today to the putative syntype leaves, which are clearly nearer to narrowly elliptic. In fact, in examining many prototypes for *C. series Coccineae* drawn up by C.S. Sargent in the first and second decades of this century, I have observed that "ovate" is almost a generic leaf-shape. In my opinion, having also examined many other *Crataegus* type descriptions from the nineteenth century and earlier, the term "ovate" was not used with its present precision and therefore, with regard to leaf-shape, the protologue may be said to describe the material of the putative syntypes in question with adequate accuracy for the period. The other characters match the protologue. As to the PH putative syntype (col. 2), the matches between it and the protologue are so few as to be almost meaningless. Moreover, the specimen possibly belongs to *C. crus-galli*, as previously stated by Eggleston in an annotation on the sheet, but this is a species never found in the Rocky Mountain area. However, the specimen also resembles *C. saligna*, but because it is sterile, conspecificity is uncertain. The final two columns in the table compare the protologue with typical *C. douglasii* and what is normally called *C. rivularis* (alternatively *C. douglasii* var. *rivularis*). Because *C. douglasii* has lobed leaf-blades and "short" thorns, whereas *C. rivularis* has longer thorns and unlobed leaves, the latter constitutes the better match for the protologue. Thus, the choice of lectotype lies between inadequate vegetative material of what is possibly *C. saligna* at PH and adequate specimens clearly representing what is normally called *C. rivularis* at BM and GH. Therefore, I lectotypify
Table 2. Comparison of protologue characteristics with putative syntypes of *C. rivularis* (see text) and with plants of *C. douglasii* and *C. rivularis*.

<table>
<thead>
<tr>
<th>protologue characteristics</th>
<th>match for putative syntypes at BM, GH</th>
<th>match for putative syntype at PH</th>
<th>match for <em>C. douglasii</em></th>
<th>match for <em>C. rivularis</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Arborescent</td>
<td>?</td>
<td>?</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Nearly glabrous</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Not glandular</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>- ovate or obovate</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>- obtuse or sometimes acute</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>- simply or somewhat incisely serrate</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>- attenuate into a short petiole</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Thorns</td>
<td>?</td>
<td>?</td>
<td>•</td>
<td>+</td>
</tr>
<tr>
<td>- &quot;spines&quot; long</td>
<td>+</td>
<td>?</td>
<td>•</td>
<td>+</td>
</tr>
<tr>
<td>Corymb</td>
<td>?</td>
<td>?</td>
<td>±</td>
<td>±</td>
</tr>
<tr>
<td>- many flowered</td>
<td>?</td>
<td>?</td>
<td>±</td>
<td>±</td>
</tr>
<tr>
<td>- glabrous</td>
<td>?</td>
<td>?</td>
<td>± , us</td>
<td>+</td>
</tr>
<tr>
<td>- flowers small</td>
<td>?</td>
<td>?</td>
<td>± , ±</td>
<td>+</td>
</tr>
<tr>
<td>- segments of calyx obtuse and very short</td>
<td>±</td>
<td>±</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Fruit</td>
<td>?</td>
<td>?</td>
<td>±</td>
<td>±</td>
</tr>
</tbody>
</table>

? = cannot determine a match
+ = perfect match
± = reasonable match
us = usually a match
• = not a match

*C. rivularis* with the Nuttall specimen "Rocky Mountains" (holotype BM; isotype GH) and retain the usual interpretation of this taxon.

**CRATAEGUS SALIGNA—Synonymy, Characterization and Typification**


*Crataegus saligna* is a medium-sized to large thicket-forming bush growing along streams and other locally moist areas in intermountain Colorado and northeastern Utah (Fig. 3). Its range is the most restricted of the four species dealt with in this paper. In many respects it is like *C. rivularis* but it has smaller leaves, thorns, flowers and fruit and 20 cream instead of 10 pink anthers. The fruit is more fully black (darker than *C. rivularis* when sub-ripe in late August) and the leaf-teeth are quite different from *C. rivularis*, being small, numerous and obtuse, rather than longer and sharp. Moreover
there are usually 6–9 lateral veins on one side of a leaf, compared to 4–5 in the much larger leaf of *C. rivularis*. Indeed, the leaves are remarkably similar to those of *C. brachyacantha*. *Crataegus saligna* has sometimes been confused with *C. douglasii* from which it has even more differences than *C. rivularis* and it was erroneously called *C. douglasii var. duchesnensis* by Welsh (1982). It is similar to *C. rivularis* in its coppery bark on 2–5 cm diameter branches, and slender, ± straight thorns usually 2–4 cm long [except recurved and 0.75–1.5 cm long in *W.W. Robbins 6972* from Newcastle, Colo. (COLO)], narrow leaves, intermountain distribution and similar habitat.

*Crataegus saligna* was described by Greene (1896) from the Lower Cimarron River, Colorado, without citation of type material, a situation that has not been remedied to date. My search for potential lectotype material involved the main Greene herbarium at Notre Dame University, Indiana (NDG), WIS and NA where remnants of the remainder of Greene’s herbarium had been dispersed from LCU, and CAS, COLO, NY, UC, and US. Only one herbarium generated a putative lectotype, the specimen being *E.L. Greene s.n.*, Colo., Cimarron, 31 Aug 1896 (NY). I therefore lectotypify *C. saligna* by this specimen. Fortunately, the type description of *C. saligna* is entirely adequate for species recognition, such that this taxon has become a well-accepted element in the Colorado flora (Harrington 1964; Weber & Wittmann...
1992). Sargent (1902) provided a more extensive description of *C. saligna*, together with the citation of specimens dating back to 1845 and a fine illustration by Faxon.

Crandall’s 1896 collection of *C. saligna* (at RM) from the Lower Cimarron River also became a potential lectotype for this species because the Lower Cimarron River, Greene’s type location for *C. saligna*, enters the Black Canyon of the Gunnison. However, there is no indication that Crandall’s specimen was ever studied by Greene, and therefore it is rejected for this purpose.

Wheeler also collected several hawthorn specimens from the same area, but in 1898, too late to be lectotype material of *C. saligna* but which it is convenient to comment on here. From among these, Aven Nelson (1902) described *C. wheeleri* which I lectotypify by H.N. Wheeler 523, Black Canyon of the Gunnison (RM). As this is identical to *C. saligna*, *C. wheeleri* becomes a synonym of that species.

Complicating the taxonomic picture was S.L. Welsh’s description (Welsh 1982) of a new variety of *C. douglasii*, var. *duchesnensis* S.L. Welsh, from northeastern Utah. From the type description, though very brief, this new taxon appeared to me to resemble *C. saligna* rather then *C. douglasii*. Loan of relevant material from BRY proved this suspicion to be correct, consequently *C. douglasii* Lindl. var. *duchesnensis* S.L. Welsh is here synonymized under *C. saligna*. Also, some of Welsh’s specimens annotated as his new variety of *C. douglasii* proved to be *C. rivularis* and I therefore supply hereunder a list of Utah specimens cited by Welsh (1982) as *C. douglasii* var. *duchesnensis* that I identify as *C. saligna*:


These records, and others of my own generated by this discovery, represent quite a significant range extension for *C. saligna*, a species hitherto known only from intermountain Colorado. I therefore offer what I believe to be the first published range map (Fig. 3) of *C. saligna*.

**CRATAEGUS BRACHYACANTHA** Sarg. & Engelm.—Characterization


*Crataegus brachyacantha* lies among the select group of hawthorns without synonymy, this fact alone attesting to its distinctiveness. It is one of the largest North American hawthorns, occasionally reaching 14 m tall, though it is more usually a bush or small tree at maturity 4–8 m tall. It occurs naturally throughout Louisiana and the adjacent parts of all surrounding states reaching its best growth on moist bottomlands. The twigs are beset
with few to numerous very short (ca. 1 cm long) recurved thorns, unique in _Crataegus_ to my knowledge. The short-shoot leaves are elliptic, unlobed, very glossy, glabrous with numerous secondary veins and crenate margins. They resemble the leaves of _C. saligna_ and color brilliantly in autumn. The multi-flowered inflorescence is glabrous and turns orange-yellow when over-mature, also apparently unique in _Crataegus_. The small flowers have 20 stamens. The fruit, dead-black at full maturity, is covered by a dense bloom before the bloom is abraded, and together with a more purple-black sub-mature skin, the fruit may look 'blue', hence the vernacular name 'blue-berry haw'. The fruit is somewhat bitter and has five plane-sided nutlets. Full descriptions and illustrations may be found in Phipps (1998) and Sargent (1902). The species is also mapped in detail in Phipps (1998). A white-fruited variant, unique to _Crataegus_ in this respect, was seen in 1922.

There is no problem in delimiting this species and it has never been thought to be especially closely related to, or a part of, _C. douglasii_.

ACKNOWLEDGMENTS

I thank the curators of BM, BRY, CAS, COLO, GH, NDG, NY, PH, RM, UC, US, and WIS for loans of specimens and/or cooperation in the search for lectotype material. I also thank the National Sciences and Engineering Research Council of Canada for funding that supported this work and an anonymous reviewer for the suggestion that NY might possess a potential lectotype of _C. saligna_, a circumstance that prevented neotypification.

REFERENCES


THE SEGREGATES OF SENECIO, S.L., AND CACALIA, S.L., IN THE FLORA OF NORTH AMERICA NORTH OF MEXICO

THEODORE M. BARKLEY

Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060, U.S.A.
barkley@brit.org

ABSTRACT

The traditional, broadly conceived genera Senecio, s.l., and Cacalia, s.l., will be divided into several segregate genera in the forthcoming Flora of North America North of Mexico, (FNANM). Provided here are a synoptical key and annotated catalog for the genera, and a nomenclator for the specific and infraspecific epithets for Senecio, s.l., and Cacalia, s.l., that have been commonly used in North American floristics.

RESUMEN

Los géneros, tradicionalmente concebidos ampliamente, Senecio, s.l., y Cacalia, s.l., serán divididos en varios géneros segregados en la Flora of North America North of Mexico, (FNANM) de próxima aparición. Ofrecemos aquí una clave sinóptica, un catálogo anotado de los géneros y un índice de los epítetos específicos e infraspecíficos de Senecio, s.l., y Cacalia, s.l., que han sido usados normalmente en las floras norteamericanas.

In 1978, an account of the Senecioneae in North America north of Mexico was published in the North American Flora series (NAF) of The New York Botanical Garden, and therein Barkley (1978) and Pippen (1978), respectively, treated Senecio and Cacalia in the traditional, inclusive senses that derive from the works of Bentham (1873a, b) and Hoffmann (1892). In so doing, they were in agreement with the floristic botany of North American tradition. Since the time of the NAF publication, new information and rigorous phyletic notions of genera have combined to justify the acceptance of a greater number of more narrowly circumscribed genera. The notions leading to these narrower generic concepts are noted in Bremer (1994) and in several papers that were presented at the Compositae Conference at Kew in the summer of 1994 (Hind & Beentje 1996), particularly the paper by Barkley et al. (1996). Preparation of the treatments of Senecio, s.l., and Cacalia s.l., for Flora of North America North of Mexico (FNANM) has drawn attention to the matters of generic concepts, for a goal of the FNANM is to reflect current understanding as best as possible. In this paper I describe how the native and

1Professor emeritus, Kansas State University, Manhattan, KS 66506.

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naturalized members of Senecio, s.l., and Catalia, s.l., will be treated generically in the FNANM. Included is a key to the genera that are being recognized in the FNANM, an annotated catalog of the genera, plus a list of the species and infraspecific names that have been commonly used in recent floristic works, with their dispositions among the recognized genera.

Some of the genera recognized here are similar to infrageneric groups that have been used in the past, e.g., Bentham (1873 a, b) Greenman (1901), Pippen (1968), and Barkley (1978). What is new in North American floristic work is treating them as genera, rather than as subgenera or sections, or as informal groups within Senecio, s.l., or Catalia, s.l. Morphological intergradation among many species of Senecio, s.l., has been documented repeatedly (cf. Barkley 1988 for species here treated in Packera); so far as I am aware, however, there is no intergradation between any pair of species that are treated here in different genera, i.e., the genera are biologically discrete.

Apart from the small and distinct subtribe Blennospermatinae Rydb., the Senecioneae appear to be naturally divisible into two evolutionary lineages, the Tussilagininae (Cass.) Dumort. and the Senecioninae (Cass.) Dumort. The distinctions between these two lineages are noted in the first couplet of the key, and they are summarized by Bremer (1994). The Tussilagininae ("tussilaginoids") have been called the "cacioido" and the "tephroseroids" in the past. Application of the name Catalia has been confusing, with some consensus that it is best used for a group of Eurasian plants that are senecionoid in their affinities. Continued uncertainty about Catalia has led to its formal rejection (Wagenitz 1995; Brummitt 1998), and so referring to the group as "cacioid" is also rejected.

The key to genera presented here is essentially a synopsis rather than a practical key for identifying a plant-in-hand. No one doubts the biological significance of the first couplet in the key, but the characters used there are impractical for routine plant identification (Barkley et al. 1996). A key for easy identification will need to be a "collective key" that is admittedly artificial and that includes species of several genera. Such a key will be similar in structure to the species keys for Senecio, s.l., and Catalia, s.l., in traditional floristic works of the recent past.

KEY TO GENERA

1. Stigmatic areas confluent on adaxial faces of style branches; anther collars cylindrical and cells not inflated; mostly n = 30 or polyploid/dysploid derivatives. (Tussilagininae)
2. Shrubs with leaves concentrated distally on branches; AZ, NM. 1. Barkleyanthus
3. Herbs with principal leaves basal and on proximal half of stem.
4. Capitula radiate; phyllaries yellow; WY: ...................... 2. Yermo
5. Capitula discoid; phyllaries notably yellow; WY: ...................... 2. Yermo
6. Capitula discoid; phyllaries green or grayish green to dirty white.
5. Principal leaves with blades lanceolate to ovate, pinnately veined and tapering to a winged petiole; boreal, WY and northward.

3. Tephrosieris

5. Principal leaves with blades rounded to reniform, palmately or subpalmately veined and abruptly contracted to an unwinged petiole.

6. Flexible, soft herbs, rarely exceeding 3 dm tall; blades of principal leaves 1–2.5 cm across; BC

4. Sinosenecio

6. Coarse, weakly ligneous herbs to 12 dm tall; blades of principal leaves 8–16(–20) cm across; AZ (NM)

5. Roldana

3. Corollas white, dirty white, or ochroleucus to slightly pinkish or greenish; capitula discoid.

7. Capitulescences elongate, racemiform clusters; Aleutian Islands.

6. Parascenecio


8. Corolla lobes parted the whole length of the limb, the throat indistinct; leaf blades deeply pinnatisect; AZ

7. Psacalium

8. Corolla lobes separate less than half the length of the limb, the throat cylindrical or funnelform, distinct; leaf blades subentire to merely toothed.

9. Florets 20–40; high Appalachians (above 1400 m) NC, TN.

8. Rugelia

9. Florets 5. Widespread in southeastern quarter of the region, below 1400 m

9. Arnoglossum

1. Stigmatic areas marginal and distinct on distal, adaxial faces of style branches; anther collars swollen (balusterform) with basal cells inflated; n = (10) 20, or 22–23, or polyploid derivatives (n = 30 in Pericallis). (Senecioninaceae).

10. Scandent, scrambling vines.

11. Capitula radiate; corollas orange to brick-colored; apices of style branches with distinctive, elongate central appendages; FL

10. Pseudogynoxys

11. Capitula discoid; corollas yellow; apices of style branches truncate-penicillate; CA

10. Delairea

12. Corollas white or dirty white; capitula discoid

12. Hasteola

12. Corollas variously yellow to orange or anthocyanic, rarely white and then capitula radiate; capitula discoid or radiate.

13. Principal leaves with blades palmately veined and petioles with clasping, stipule-like bases; corollas anthocyanic, sometimes white, or both; capitula radiate; CA

13. Pericallis

13. Principal leaves with blades not both palmately veined and with expanded-clasping petiole bases; corollas mostly yellow, sometimes orange or ochroleucus, rarely anthocyanic; capitula discoid or radiate; widespread.

14. Herbs with stems arising singly or clustered from a taproot, caudex, or rhizome and with abundant, thin, branching fibrous roots; principal leaves in a basal cluster, cauline leaves progressively reduced distally, margins without conspicuous callose denticles; n = 22 or 23, or polyploid derivatives

14. Packera

14. Herbs, subshrubs or shrubs of various habits and leaf dispositions, but if herbs with stems arising from a cluster of
basal leaves and with cauline leaves progressively reduced distally, then the roots are fleshy and unbranched and/or the leaf margins have abundant callose denticles; n=(10) 20, or polyploid derivatives. ........................................ 15. Senecio (s. str.)

THE TUSSILAGINOID GENERA

1. Barkleyanthus H. Rob. & Brettell
One species; a semi-weedy, hairless shrub that occurs from Honduras northward through Guatemala and Mexico and barely enters the FNANM range in southern Arizona and New Mexico. Barkleyanthus salicifolii/s (H.B.K.) H. Rob. & Brettell was widely known as Senecio salignus DC. in the past (Robinson & Brettell 1974). Included in Senecio by Barkley (1978).

2. Yermo Dorn
One species, Yermo xanthocephala Dorn, is known only from barren desert sites in central Wyoming. It was discovered and described in the past decade (Dorn 1991) and its phyletic affinities are not yet well understood. Superficially, it rests easily in the tussilaginoid assemblage. This distinctive species was given a color photograph on the cover of the magazine "Science News" 155(1), January 2, 1999. It was not treated by Barkley (1978) or Pippen (1978).

3. Tephroseris Rchb.
A group of some 40–50 boreal and alpine herbs, centered in Eurasia but with at least four species in the FNANM region. The group was revised by Cufodontis (1933), and since his time it has been treated chiefly in floristic studies with differing species concepts (e.g., Barkley 1978; Cody 1996, Hultén 1950 & 1968; Schischkin 1968; Scoggan 1979; Welsh 1974). The taxonomy of the group is complicated by intergradant species and unresolved nomenclatural problems. The species of Tephroseris superficially resemble certain species of Senecio, s. str., but the microcharacters are clearly tussilaginoid and the basal chromosome number is x=24, a number otherwise unknown in the Senecionoid lineage. Included in Senecio by Barkley (1978).

A group of about 30 species of low herbs, mostly of eastern and southeastern Asia, but with a single species in the New World, Sinosenecio newcombei (Greene) J.P. Janovec & T.M. Barkley. It is apparently restricted to the Queen Charlotte Islands, British Columbia (Janovec & Barkley 1996). Included in Senecio by Barkley (1978).

5. Roldana LaLlave
Fifty or more species of coarse herbs, shrubs, and small trees, most of which have broad, palmately or subpalmately veined leaves. The group is centered in the Trans-Mexican Volcanic Belt; it ranges through much of Mexico and

6. Parasenecio W.W. Sm. & J. Small
A group of about 50 species, centered in eastern Asia, but one species, *Parasenecio auriculata* (A. DC.) J.R. Grant, barely enters the FNANM range on five islands at the western end of the Aleutian Island chain in Alaska. Our plant has been variously included in the past within *Cacalia, Koyamacalia, Ligularia*, or *Parasenecio* (Grant 1993). It was not treated by either Barkley (1978) or Pippen (1978).


A single species, *Rugelia nudicaulis* Shuttlew. ex Chapm. occurs in the high mountains of central Appalachia along the Tennessee-North Carolina border. It has been treated as *Senecio rugelia* A. Gray in many floristic works of the past, but was included in *Cacalia* by Pippen (1978).

Eight species of tall herbs of the southeastern quarter of the FNANM region. They form the traditional core of *Cacalia*, as that genus has been conceived in North American floristics. A new species was recently described by Anderson (1998). Included in *Cacalia* by Pippen (1978).

THE SENECIONOID GENERA

10. Pseudogynoxys (Greenm.) Cabrera
A dozen or so species; scandent, scrambling vines with showy, orange or brick-colored corollas. They are native to the Caribbean region and southward as far as eastern Brazil. They are cultivated as ornamentals, and one species, *Pseudogynoxys chenopodioides* (Kunth) Cabrera, escapes from cultivation and persists in southern Florida and perhaps elsewhere along the Gulf Coast. It has been called *Senecio confusus* Britten in floristic works and the horticultural literature. The group was catalogued and a key was presented by Robinson and Cuatrecasas (1977), but the relationships among the species remain poorly understood and a revision is needed. Included in *Senecio* by Barkley (1978).
11. Delairea Lem.
One species; a scandent vine, Delairea odorata Lemaire, is native to southern Africa but is now established as an aggressive weed in coastal California. This plant has been known as Senecio mikanioides Otto, and was included in Senecio by Barkley 1978.

Two species; one is of the east-central U.S and the other was recently described from Florida. These plants have eradiate capitula and white corollas, which places them in the traditional concept of Cacalia, but they have the microcharacters and cytology of the Senecionoid lineage, cf. Anderson (1994). Included in Cacalia by Pippen (1978).

13. Pericallis D. Don
About a dozen species; native to the Canary Islands, Madeira, and the Acores, and some species are ancestral to the horticultural complex called “the florists’ cineraria.” A cultivar from the complex escapes and persists in favored sites in coastal California. Under current taxonomic concepts our plant is best treated as Pericallis hybrida B. Nord., but it has been widely known in the past as Senecio cruentus DC. Pericallis is alone among the Senecionoid genera in having n = 30, a number that is typical of the Tussilaginoid lineage. In all other characters, however, it fits comfortably among the Senecionoids (Nordenstam 1977, 1978). Included in Senecio by Barkley (1978).

14. Packera Á. Lóve & D. Lóve
About 60 species; centered in the western temperate half of North America but extending into southern Mexico and into the Arctic. Two arctic-alpine species extend into northern Siberia and central Asia. The group has been known as the “aureoid complex” of Senecio, s.l., and although its members are superficially similar to many species of Senecio, it forms a distinct lineage. Intergradation among Packera species is well known (Barkley 1988), but there is no morphological intergradation or putative hybridization between any Packera and any species of Senecio, s.str., or segregate of Senecio. In addition to the characters used in the key, Packera is further distinguished from Senecio by having pollen grains of a helianthoid ultrastuctural type rather than of a senecionoid type (Bain & Walker 1995). An ITS-based phylogeny has been estimated for Packera by Bain and Jansen (1995). Included in Senecio by Barkley (1978).

15. Senecio L.
Senecio, in the broadest sense, is a nearly world wide genus of some 3,000 species, and even after the exclusion of the currently accepted segregates, it still encompasses some 1,300 species. Clearly, Senecio, s.str., is a “mixed bag”
that is defined largely as what remains after the rather precisely circum-
scribed segregate genera are removed. It includes numerous species of un-
known affinity, and presumably the concept of “Senecio” will change as more
is learned about the relationships of the currently included species. About
50 species of Senecio, s.str., occur in the FNANM region; some are native,
some are introduced, and a few are notable weeds.

SENECIO AND CACALIA NAMES OF TRADITIONAL USE IN NORTH AMERICAN
FLORISTICS AND THEIR DISPOSITION IN THE FNANM

Epithets with no alternative name remain as listed

SENECIO

actinella Greene
amplectens A. Gray
var. amplectens
var. bolnii (Greene) H.D. Harr.
ampellacens Hook.
anonymus A.W. Wood ≡ Packera anonyma (A.W. Wood) W.A. Weber & Á. Löve
antennariifolius Britton ≡ Packera antennariifolia (Brriton) W.A. Weber & Á. Löve
aphanacth Greene
arizonicus Greene
arizonoides DC.
astephanus Greene
atratus Greene
atropurpureus (Ledeb.) Fedtsch. ≡ Tephroseris atropurpurea (Ledeb.) Holub subsp. atropurpurea
var. frigidus ≡ T. a. subsp. frigida (Richardson) Á. Löve & D. Löve
var. tomentosus (Kjellm.) Hultén ≡ Tephroseris kjellmanii (A.E. Porsild) Holub
aureus L. ≡ Packera aurea (L.) Á. Löve & D. Löve
bernardinus Greene ≡ Packera bernardina (Greene) W.A. Weber & Á. Löve
bigelovii A. Gray
var. bigelovii
var. hallii A. Gray
blackmaniae Greene
bolanderi A. Gray ≡ Packera bolanderi (A. Gray) W.A. Weber & Á. Löve
var. bolanderi
var. barfordii (Greenm.) T.M. Barkley ≡ P. b. var. barfordii (Greenm.) D.K. Trock & T.M. Barkley
breweri Burtt ≡ Packera breweri (Burtt Davy) W.A. Weber & Á. Löve
californicus DC.
cannabifolius Less.
canus Hook. ≡ Packera cana (Hook.) W.A. Weber & Á. Löve
cardamine Greene ≡ Packera cardamine (Greene) W.A. Weber & Á. Löve
castorens S.L. Welsh (a Packera?)
darkianus A. Gray
clevelandii Greene ≡ Packera clevelandii (Greene) W.A. Weber & Á. Löve
confinis Britten ≡ Pseudogynoxys cheopodioides (Kunth) Cabrera
congestus (R.Br.) DC.
conterminus Greenm. ≡ Packera contermina (Greenm.) J.F. Bain
crassus A. Gray

crocatus Rydb. = Packera crocata (Rydb.) W.A. Weber & Á. Löve
crassus DC. = Pericallis hybridus B. Nord.

cymbalaria Pursh = Packera cymbalaria (Pursh) W.A. Weber & Á. Löve
cymbalaroides Buek = Packera buckii D.K. Trock & T.M. Barkley
cymbaloides Greene = Packera cymbaloides (Greene) W.A. Weber & Á. Löve
debilis Nutt. = Packera debilis (Nutt.) W.A. Weber & Á. Löve
dimorphophyllus Greene = Packera dimorphophylla (Greene) W.A. Weber & Á. Löve

t.var. dimorphophylla

var. intermedius T. Barkley = P. d. var. intermedius (T.M. Barkley) D.K. Trock & T.M. Barkley

t.var. paysonii T. Barkley = P. d. var. paysonii (T.M. Barkley) D.K. Trock & T.M. Barkley
douglasii DC. = Senecio flaccidus Less.

t.var. douglasii = S. f. var. douglasii (DC.) B.L. Turner & T.M. Barkley

t.var. longifolius (Benth.) L.D. Benson = S. f. Less. var. flaccidus

var. monoensis (Greene) Jeps. = S. f. var. monoensis (Greene) B.L. Turner & T.M. Barkley

elegans L.

elemeri Piper
cernophyllus Richardson

var. cernophillus

var. kingii (Ryddb.) Greene

var. macdougallii (A. Heller) Cronquist
crassus T.M. Barkley
eurycephalus Torr. & A. Gray = Packera eurycephala (Torr. & A. Gray) W.A. Weber & Á. Löve

t.var. eurycephala

var. lewisirosi (J.T. Howell) T.M. Barkley = P. eurycephala. var. lewisirosi (J.T. Howell)

J. F. Bain

tendleri A. Gray = Packera tendleri (A. Gray) W.A. Weber & Á. Löve

flaccidus Less.

var. flaccidus

var. douglasii (DC.) B.L. Turner & T.M. Barkley

var. monoensis (Greene) B.L. Turner & T.M. Barkley

ttiti Wiegand = Packera ttiti (Wiegand) W.A. Weber & Á. Löve

footulis Howell = Senecio hydrophiloides Rydb.

footulis var. hydrophiloides (Rydib.) T.M. Barkley ex Cronquist = Senecio hydrophiloides Rydb.

franciscanus Greene = Packera franciscana (Greene) W.A. Weber & Á. Löve

fremontii Torr. & A. Gray

var. fremontii

var. blitoides (Greene) Cronquist

var. ocidentalis A. Gray

var. inexpectans Cronquist

frigida Less. = Tephrosia atripappurea subsp. frigida (Richardson) Á. Löve & D. Löve

fuscatus Hayek = Tephrosia lindstroemi Á. Löve & D. Löve

ganderi T.M. Barkley & R.M. Beauch. = Packera ganderi (T.M. Barkley & R.M. Beauch.)

W.A. Weber & Á. Löve

glabellus Poir. = Packera glabellula (Poir.) C. Jeffrey

greenii A. Gray = Packera greenii (A. Gray) W.A. Weber & Á. Löve

harrissi A. Heller = Packera harrissi (A. Heller) W.A. Weber & Á. Löve

harrissii Benth. = Roldana harissii (Benth.) H. Rob. & Brettel

tesperius Greene = Packera esperius (Greene) W.A. Weber & Á. Löve

hauchucanus A. Gray = Senecio multidentatus var. hauchucanus (A. Gray) T.M. Barkley
Barkley, Segregates of Senecio and Cacalia

hydrophyloides Rydb.
hydrophila Nutt.

hyperborealis Greenm. = Packera hyperborealis (Greenm.) Á. Löve & D. Löve

imparipinnatus Klatt = Packera tampicana (DC.) C. Jeffrey

indecors Greene = Packera indecora (Greene) Á. Löve & D. Löve

integrifolius Nutt.

var. integrifolius

var. exaltatus (Nutt.) Cronquist

var. major (A. Gray) Cronquist

var. schroedermanus (A. Gray) Cronquist

var. scribneri (Rydb.) T.M. Barkley

ionophyllus Greene = Packera ionophylla (Greene) W.A. Weber & Á. Löve

jacobsae L.

kjellmanii A.E. Porsild = Tephroseris kjellmanii (A.E. Porsild) Holub

laynii Greenm. = Packera laynii (Greenm.) A. Love & D. Love

lemonii A. Gray

lindstromii A.E. Porsild = Tephroseris lindstromii (A.E. Porsild) Holub

lngens Richardson

lyonii A. Gray

macounii Greenm. = Packera macounii (Greene) W.A. Weber & Á. Löve

malnustii S.F. Blake ex Tidestr. (a Packera ?)

megacephalus Nutt.

mikanioides Orto ex Walpers = Delavreia odorata Lem.

millefolium T.& G. = Packera millefolia (Torr. & A. Gray) W.A. Weber & Á. Löve

millelobatus Rydb. = Packera millelobata (Torr. & A. Gray) W.A. Weber & Á. Löve

mohavensis A. Gray


(cBalder & R.L. Taylor) J.F. Bain

multicapitis Greenm. = Senecio spatuloides var. multicapitus (Greenm.) S.L. Welsh

multidentatus var. huanacuanaus (A. Gray) T.M. Barkley

multilobatus Torr. & A. Gray ex A. Gray = Packera multilobata (Torr. & A. Gray ex A. Gray)

W.A. Weber & Á. Löve

multisius S.L. Welsh (a Packera ?)

neomexicans A. Gray = Packera neomexicana (A. Gray) W.A. Weber & Á. Löve

var. neomexicans = P. n. var. neomexicana

var. metalcf (Greene) T.M. Barkley = P. n. var. metalcf (Greene) D.K. Trock & T.M. Barkley

var. mutabilis (Greene) T.M. Barkley = P. n. var. mutabilis (Greene) W.A. Weber & Á. Löve

var. tonneyi (Greene) T.M. Barkley = P. n. var. tonneyi (Greene) T.M. Barkley & D.K. Trock

mutabilis S.L. Welsh (a Packera ?)

newcombii Greene = Sinosenecio newcombii (Greene) J.P. Janovec & T.M. Barkley

obovatus Muhl. ex Willd. = Packera obovata (Muhl.ex Willd.) W.A. Weber & Á. Löve

ogtorunikensis Packer = Packera ogtorunikensis (Packer) W.A. Weber & Á. Löve

parryi A. Gray

pattersonensis Hoover

panciflorus Pursh = Packera panciflora (Pursh) W.A. Weber & Á. Löve

panperculal Michx. = Packera panperculal (Michx.) W.A. Weber & Á. Löve

plattensis Nutt. = Packera plattensis (Nutt.) W.A. Weber & Á. Löve
porter Greene = Packera porter (Greene) C. Jeffrey
pseudoarenus Rydb. = Packera pseudoarenus (Rydb.) W.A. Weber & Á. Löve
var. pseudoarenus = P. p. var. pseudoarenus
var. flavulus (Greene) Greenm. = P. p. var. flavula (Greene) W.A. Weber & Á. Löve
var. semicordatus (Mack. & Bush) T.M. Barkley = P. p. var. semicordatus (Mack. & Bush)
T.M. Barkley & D.K. Trock
pseudo-arminca Less.

pubidus Greene
quaerens Greene = Packera quaerens (Greene) W.A. Weber & Á. Löve
querctorum Greene = Packera quercororum (Greene) C. Jeffrey
rapifolius Nutt.
resedifolius Less. = Packera cymbalaria (Pursh) W.A. Weber & Á. Löve
riddellii Torr. & A. Gray
robbinii Oakes ex Rusby = Packera schweinitziana (Nutt.) W.A. Weber & Á. Löve
rugelia A. Gray = Rugelia nudicaulis Shuttlew. ex Chapm.
sacramentanus Wooron & Standl.
salgina DC. = Barkleyanthus salicifolius (Kunth) H. Rob. & Brettell
sanguisorboides Rydb. = Packera sanguisorboides (Rydb.) W.A. Weber & Á. Löve
schweinitzianus Nutt. = Packera schweinitzianus (Nutt.) W.A. Weber & Á. Löve
sorzonella Greene

serra Hook.
var. serra
var. admirabilis (Greene) A. Nelson
sheldonensis A.E. Porsild
smallii Britt. = Packera anonyana (A.W. Wood) W.A. Weber & Á. Löve
soldanella A. Gray
sppodioides Torr. & A. Gray
var. sppodioides
var. multicapitatis (Greenm.) S.L. Welsh
spellenbergii T.M. Barkley = Packera spellenbergii (T.M. Barkley) C. Jeffrey
sphaerocephalus Greene
streptanthifolia Greene = Packera streptanthifolia (Greene) W.A. Weber & Á. Löve
subnuda DC. = Packera breckii D.K. Trock & T.M. Barkley

sylvaticus L.
tampicanus DC. = Packera tampicana (DC.) C. Jeffrey
taraxacoides (A. Gray) Greene
tomentosa Michx. = Packera tomentosa (Michx.) C. Jeffrey
triangularis Hook.
triodonticuIatus Rydb. = Packera tridenticulata (Rydb.) W.A. Weber & Á. Löve
viscosu L.
vulgis L.
warneckii Shinners
wermerifolius A. Gray = Packera wermerifolius (A. Gray) W.A. Weber & Á. Löve
wootenii Greene

yukonensis A.E. Porsild = Tephrosia yukonensis (A.E. Porsild) Holub

CACALIA
atripliLifolius L. = Arnoglossum atripliLifolium (L.) H. Rob.
auriculata DC. = Paracneus auriculata (DC.) J.R. Grant
deLcomposita A. Gray = Psoraleum decompositum (A. Gray) H. Rob. & Brettell
Barkley, Segregates of Senecio and Cacalia


suaveolens L. = Hasteola suaveolens (L.) Pojark. sulpita Fernald = Arnoglossum sulcatum (Fernald) H. Rob.

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REFERENCES


U.S.A.


A NEW VARIETY OF PHYSARIA NEWBERRYI (BRASSICACEAE) FROM NEW MEXICO

ROBERT C. SIVINSKI

New Mexico Forestry Division
P.O. Box 1948
Santa Fe, NM 87504, U.S.A.
bsivinski@state.nm.us
and
Herbarium
Department of Biology
University of New Mexico
Albuquerque, NM 87131-1091, U.S.A.

ABSTRACT

The new variety Physaria newberryi var. yesicola is described and illustrated. It is readily distinguished within *P. newberryi* by its very long styles. Variety yesicola occurs upon the gypseous Yeso Formation in the Sierra Lucero of west-central New Mexico.

RESUMEN

Se describe y se ilustra una nueva variedad Physaria newberryi var. yesicola. Se distingue fácilmente de *P. newberryi* por sus estilos muy largos. La variedad yesicola aparece en suelos gipsícolas de la Formación Yeso en la Sierra Lucero del centro-oeste de Nuevo México.

Physaria newberryi A. Gray var. yesicola Sivinski, var. nov. (Fig. 1). Type: U.S.A. NEW MEXICO. Valencia Co.: NE side of Sierra Lucero ca 37 km W of Los Lunas, T6N R3W Section 2 NW1/4 NW1/4, 34°46'54"N 107°7'48"W, elev. 1800 m, 4 May 1998, R. Sivinski & C. McDonald 4335 (HOLOTYPE: UNM; ISOTYPES: ARIZ, BRY, CAS, GHI, MO, NY, US).

A Physaria newberryi A. Gray var. racemosa Rollins stylis filiformibus (5–9 mm longis) et racemis fructiferis brevibus (2.5–5 cm longis) differt.

Long-lived caespitose perennial with diffusely branching caudex forming wounded clumps 10–30 cm in diameter; caudex branches thickly clothed with marcescent leaf bases and terminated by clusters of ascending to erect leaves; stems and leaves densely covered with overlapping stellate-discoid trichomes, trichome rays confluent for at least 1/2 their length and often to near their apex; basal leaves narrowly oblanceolate to broadly spatulate, 3–8 cm long (including petiole), acute to obtuse, margins entire or with a few broad teeth, the winged petiole less than to 2 times as long as the expanded blade; cauline leaves few, sessile, 1–1.5 cm long, linear-oblanceolate; stems numerous and arising from the axils of basal leaves, ascending to erect; mature racemes 2.5–5
Fig. 1. *Physaria nevadensis* var. *yesicola* Sivinski var. nov., (A) growth form (one-half of caespitose mound), (B) detail of plant and latitudinal cross-section of silicle from Sivinski & McDonald 4335.

cm long; fruiting pedicels straight, ascending or divergent, 6–11 mm long; sepals greenish yellow, pubescent, lanceolate and somewhat cucullate, 6–7 mm long and 1.0–1.5 mm wide; petals yellow, oblanceolate to spatulate, 7–8 mm long and 1.5–2.0 mm wide; *silicles* papery, pubescent, becoming purplish at maturity, deeply cleft at the apex with a V-shaped sinus and with little or no basal cleft, fruit cross-section X-shaped with concave valve sides and dorsal surface, valve margins and sinus crests sharply keeled, each valve 6–9 mm long and 4–7 mm wide; *replum* 2.5–3.5 mm long, narrow to nearly closed, acute at the apex; fruiting styles thread-like. 5–9 mm long, surpassing the apical cleft of the silicle; ovules 2 per valve; seeds ovate, slightly compressed.


*Distribution and Habitat.*—*Variety yesicola* is presently known only from the Sierra Lucero Range (including Mesa Lucero) of Cibola and Valencia
counties in west-central New Mexico (Fig. 2). This population is the extreme southeastern range limit for the species. It occurs on sandy gypsum and other silty strata of the Permian age Yeso Formation. The Yeso Formation is 200 to 300 meters thick in the Sierra Lucero. It is comprised of a soft, silty sandstone interbedded with gypsum, limestone, shale and siltstone strata of various thicknesses (Weber & Kottlowski 1959). Variety yesicola occurs on silty sand substrates that contain obvious quantities of gypsum. It is also locally abundant on adjacent siltstone and silty limestone strata which may be mildly gypseous, but have not been analyzed.

The habitat is nearly barren badlands and canyon sides of various slopes and exposures between the elevations of 1700 and 2100 m. Juniperus monosperma (Engelm.) Sarg. trees are scattered across this formation and the shrubby and herbaceous vegetation varies with the geologic strata. Common associates on sandy gypsum are Tiquilia hispidissima (Torr.) A. Richardson, Selinocarpus lanceolatus Wooton, Calylophus hartwegii subsp. filifolius (Eastw.) Towner & Raven, Cryptantha fulvocanescens S. Wats., Artemisia bigelovii A. Gray, Tetradyinia filifolia Greene, Lycium pallidum Miers, Sporobolus nealleyi Vasey and Stipa comata Trin. & Rupr. The most frequent gypsum habitat associate is an undescribed Phacelia that is in preparation for publication by Tim Lowrey and Paul Knight (UNM) with Dwane Atwood (BRY). Associates on silty limestones or siltstones are more variable, but often consist of Ephedra torreyana S. Wats., Rhus trilobata Nutt., Eriogonum corymbosum Bentham., Nolina greenei S. Wats., Aristida purpurea var. fendleri ana (Steud.) Vasey and Schizachyrium neomexicanum Nash.

Taxonomic Relationships.—Physaria newberryi is broadly, but sporadically, distributed through northwestern New Mexico, northern Arizona and southern Utah (Rollins 1993). It is closely related to Physaria acutifolia Rydberg (Montana to New Mexico and Utah) and Physaria chambersii Rollins of the Great Basin (Mulligan 1967). These three species can usually be distinguished with the following key:

1. Dorsal margins of silicle valves acutely angled (nearly winged); replum apex acute to acuminate (observable after valves have shed); trichome rays confluent for 1/2 or more their length ................................................. P. newberryi
2. Dorsal margins of silicle valves obtusely angled or broadly rounded; replum apex obtuse or rounded; trichome rays confluent or free ................................................. (2)

2. Silicles apically cleft with a deep, narrow or V-shaped sinus and with a shallow or no basal sinus at the point of pedicel attachment, valves often obtusely angled; trichome rays usually free (confluent in var. membracina) .................................................. P. chambersii
2. Silicles narrowly cleft at both the apex and base, valves broadly rounded; trichome rays free or confluent for nearly 1/2 their length .......... P. acutifolia

The taxonomic boundaries among these species are notably blurred by intergrading polyploid races, especially in central and southern Utah (Mulligan
1967; Welsh et al. 1993). The distinctively angled silice valves of *Physaria newberryi* make it the most well-marked and distinguishable species of this group (Fig. 1).

**KEY TO THE VARIETIES OF PHYSARIA NEWBERRYI**

1. Styles filiform, 5–9 mm long, surpassing the crest of the apical silice sinus; repla 2.5–3.5 mm long; racemes 2–5 cm long ........................................... var. yesicola
2. Styles stout, <4 mm long, usually shorter than the silice sinus; replum and racemes lengths not combined as above .................................................. (2)

2. Repl 4–10 mm long; racemes usually 2–5 cm long (rarely up to 10 cm)

........................................................................................................................................................................... var. newberryi

2. Repl 2–3.5 mm long; racemes 5–10 cm long ....................... var. racemosa

Variety *yesicola* and var. *racemosa* both have short repla and the latter has also been collected from gypseous substrate (*Gierish 4214*, ARIZ, BYU). Variety *racemosa* is a minor peripheral variant in northwestern Arizona and southwestern Utah that possesses a unique combination of replum and raceme lengths, but no single distinguishing morphological characteristic. Welsh (1993) considers *racemosa* an insignificant phase that grades into var. *newberryi*. In contrast, var. *yesicola* is an isolated disjunct with long, filiform styles that are unique within this species.

The combination of confluent trichome rays and V-shaped apical silice sinus in var. *yesicola* is also similar to *P. chambersii* var *membranacea* Rollins (syn. *P. lepidota* Rollins) of south-central Utah. Yet the long slender styles and short repla of var. *yesicola* are nearly as unusual for *P. chambersii* as they are for *P. newberryi*. In this case, I place the utmost taxonomic importance on silice shape. The valve margins of var. *yesicola* are sharply keeled from the silice base to the crest of the apical sinus and the valve surfaces are concave and less inflated than *P. chambersii*. These silice features are characteristic of *P. newberryi* and clearly place *yesicola* close to that species. The long styles of *P. newberryi* var. *yesicola* are a conspicuous departure from the usual circumscription of this species and further obscures the taxonomic boundaries between it and other related taxa. Additional study of this species group is needed and may find justification for reducing some species to infraspecific status within *P. newberryi* or else elevating var. *yesicola* to species level.

At present, var. *yesicola* is known only from the Sierra Lucero and appears to be geographically isolated from other *Physaria* taxa (Fig. 2). It is locally abundant and morphologically consistent in this 50 km range of low mountains. This unique plant is another addition to a growing list of taxa endemic to the gypsum formations of New Mexico.

**Etymology.**—This new variety dwells upon the Yeso Formation in the Sierra Lucero, hence the name *yesicola*. Yeso is the Spanish word for 'gypsum' which is a fitting name for this geologic feature.
Sivinski, A new variety of Physaria newberryi

Fig. 2. Distribution of Physaria newberryi var. newberryi, P. newberryi var. yesicola, and P. acutifolia in New Mexico.

ACKNOWLEDGMENTS

The field surveys that initially located this new taxon were funded by grants from the U.S. Fish and Wildlife Service and the New Mexico State Land Office. I thank the curatorial staffs at ARIZ, ASC, BRY, NMC, RM, and UNM for making their collections available to me. John Strother and Alan Smith kindly reviewed the Latin diagnosis. Tim Lowrey and Charlie McDonald provided valuable field assistance and companionship.

REFERENCES

BOOK NOTICE


This book "was published by The Field Museum, Chicago, on the occasion of "Vanishing Treasures of the Philippine Rain Forest" and "Voyage a Nation: The Philippines"—two exhibitions celebrating the biological diversity and culture of the Philippines."

As a semi-popular work, the book provides a wonderful introduction to the diversity, origins and prospects for survival of the highly endemic biota of the Philippines. Through highly illustrative examples, and fantastic photographs, the reader is led through some of the most striking elements of the remaining few extant forests. Most importantly, the balance of botanical and zoological examples of endangered taxa, and the economic consequences of their habitats' destruction, are illustrated in a practical way previously not seen in popular books. Every reader will be impressed with the extent of forest destruction, the catastrophic effects of deforestation on rural human populations, and mass extinction of species that were locally common in the past. While geographic and species coverages are slanted toward the Visayan and Mindanao regions of the country, examples are provided from all major faunistic areas in a well-balanced manner, complete with historical and present-day statistics. I have seen no better "coffee table" book that clearly and succinctly explains the horrific consequences of forest destruction, endangerment of species, and degradation of the environment. The case for the Philippines as the hottest of the "hot spots" is made in a striking manner. While I disagree that the Philippines is "megadiverse," (sensu Colombia or Brasil), it is certainly "mega-endemic" and the state of its forest cover is akin only to the that of Madagascar or Haiti. After serious reading of this book, I can scarcely imagine anyone who would not be ready to support research in basic systematics, conservation biology and sustainable development programs in the country. It is a book that should be on the bookshelf of every field biologist, conservationist and environmental enthusiast.—John J. Pipoly III.
SYNOPSIS OF NEW WORLD COMMICARPUS (NYCTAGINACEAE)

NEIL A. HARRIMAN
Biology Department
University of Wisconsin-Oshkosh
Oshkosh, WI 54901, U.S.A.
harriman@uwosh.edu

ABSTRACT

Two new species of Commicarpus from México (C. coctoris and C. praetermissus) are described. A key to the five New World species is presented.

RESUMEN

Se describen dos nuevas especies de Commicarpus (Nyctaginaceae) de México. Se ofrece una clave para las cinco especies del Nuevo Mundo.

Commicarpus Standley, predominantly an African genus of 25–30 species (Meikle, 1978), was segregated from Boerhavia L. by Standley (1909), along with Anulocaulis Standley (1909) and Cyphomeris Standley (1911).

Fosberg (1978) reduced Standley's genera to subgenera under Boerhavia, though the combinations were never formally made and therefore have no nomenclatural standing (ICBN Art. 33.2). In modern floristic treatments, opinion is divided as to whether the segregate genera (or at least Commicarpus) deserve recognition. Commicarpus is recognized by, e.g., Breedlove 1986; González Elizondo et al. 1991; Liogier 1985; Brako and Zarucchi 1993. However, Acevedo-Rodríguez (1996) reduces Commicarpus to Boerhavia, as does Bogle (1974); Kellogg (in Howard 1988) likewise treats Boerhavia in the broader sense, to include Commicarpus, but acknowledges that cladistically there is no reason to choose one placement over the other—"We therefore include them in the same genus for convenience." I choose to recognize Commicarpus, but I have chosen specific epithets for the two new species which will not form homonyms if they are someday transferred to Boerhavia.

Study of some general collections from southwestern México, one communicated by courtesy of Paul A. Fryxell, the other long overlooked in herbaria, has revealed two novelties.

Commicarpus coctoris N.A. Harriman, sp. nov. (Fig. 1). Type: MÉXICO, OAXACA: Municipio San Agustín Arenango, 14 km al SO de San Marcos Arteaga, carretera Huajuapan-Juxtlahuaca; laderas con matorral tropical caducifolia con unos encinos, Brachia, Otatea, Barrera, etc., suelo calizo, somero, alt. 1770 m, hierba pegajosa con ramas principales hasta 50 cm de largo, extendidas sobre el suelo, cálices guindas;

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Fig. 1. Holotype of Commicarpus ectoris N.A. Harriman.
HARRIMAN, New World Commicarpus

Haec species ob pilos glandulosos et perianthia rubra 12–16 mm longa et lata inter omnes species americanas peculiaris est.

Perennial herb, stems pink, to 50 cm long, sprawling over the ground, viscid, densely beset with multicellular, spreading, gland-tipped hairs, these mostly less than 0.5 mm long but some to 1 mm long. Leaves opposite, entire, isophyllous, blades 30–55 mm × 15–40 mm, ovate, basally cuneate to rounded, apically acute and cupulitate, without evident internal crystals, marginally glandular ciliate, adaxially glabrous, abaxially glandular hairy on the main veins only, on glandular-hairy petioles 8–12 mm long. Flowering branches hairy like the main stems, terminal and from the upper axils, with pedunculate, 4–6 flowered, simple umbels. Flowers on glandular-hairy pedicels 8–18 mm long, the portion near base of anthocarp without stipitate glands. Perianth funnelform, cherry red, 12–16 mm high and wide, glandular-hairy externally, glabrous internally; stamens 4, filaments glabrous, exserted; style glabrous, exserted well beyond the stamens, the stigma capitate. Fruits thickly clavate, glabrous, striate but not ribbed, 6–7 mm long, the pustular glands irregularly arrayed in the upper 1/2–2/3 of the fruit (anthocarp).

Flowering and fruiting.—November, so far as known.

Distribution and habitat.—Known solely from the type collection, in tropical deciduous forest. Possible paratype, the information communicated by Richard Spellenberg, the specimen not seen by me: México. Oaxaca. Laguna Encantada, ± 3 km al N de Justlahuaca, colinas yesosas con vegetación arbustiva dispersa de Agave, Dasylirion, Compositae, alt. 1600 m, S. Zamudio & G. Ocampo 10951, 22 Nov 1998 (IEB, NMC).

Etymology.—The epithet honors Stephen D. Koch (1940—), German for “cook,” “coctor” in Latin, one of the collectors of the type material and most valued friend of Botany and botanists in México.

Commicarpus praetermissus N.A. Harriman, sp. nov. (Fig. 2). Type: MÉXICO.

MICHOCÁN: Tizapan, Coaúcomán, woods, 0.5 m high, flower red, alt. 50 m, 4 Sep 1941, Hinton et al. 15911 (holmotype: LL; isotypes: K, NY, US and elsewhere).

A speciebus alis pilis eglandulosis flexis, fere uncinatis, et perianthiis rubris glabrisque recedit.

Perennial herb, the slender stems probably sprawling, to 0.5 m tall or long, thinly to densely eglandular hairy, the hairs hooked and appearing almost uncinate, antrorsely inclined. Leaves opposite, isophyllous, blades 25–40 mm × 15–25 mm, ovate, apically retuse or rounded or acute, basally cuneate to rounded, with evident internal crystals, indistinctly ciliate, with a few hairs on the veins abaxially, otherwise glabrous, on hairy
Fig. 2. Holotype of Commicarpus praetermissus N.A. Harriman.
petioles 2–4 mm long. Flowering branches from the upper axils and terminal, bearing numerous pedunculate umbels, the peduncles and pedicels glabrous. Perianth above the ovary red, funnelform, 9 mm high and 12 mm broad, glabrous; stamens 2, the anthers exserted on glabrous filaments; style exserted, stigma capitate; fruit (anthocarp) slenderly clavate, 7.5–9 mm long, striate, glabrous, the prominent glands in 3–5 well-defined horizontal bands.

Flowering and fruiting.—September, so far as known.

Distribution and habitat.—Known solely from the type collection; from the Pacific coast at 18°11' N, 103°2' W (Hinton & Rzedowski 1972).

Etymology.—The epithet refers to the fact that the specimens have lain overlooked and neglected in numerous herbaria for over half a century; C.V. Morton in preparing the labels remarked that it was a new species; Meikle (1978) likewise remarked that it was a new species, though the material he had at hand from K was insufficient for a proper description.

KEY TO THE NEW WORLD SPECIES OF COMMICARPUS

1. Perianth above the developing fruit white or greenish-yellow, at most pink-veined in the sinuses; stamens 2.

2. Perianth white or greenish-yellow, 3–4 mm long and wide, externally glabrous or obscurely puberulent; widespread from Texas to se Arizona and Baja California, s to Guatemala; West Indies; Bahama Archipelago; Colombia and Venezuela to Peru ......................... Commicarpus scandens (L.) Standley

2. Perianth white, pink-veined in the sinuses, 10–15 mm long and 7–8 mm wide, hirtellous externally; endemic to Baja California, México ......................................................... Commicarpus brandegeei Standley

1. Perianth above the developing fruit light purple to mauve to cherry red; stamens 2, 3, or 4.

3. Stems and leaves glabrous; perianth lilac, pink, or purplish red, puberulent at tip in bud, otherwise glabrous; stamens 3; Bolivia, Peru, Ecuador, and Galápagos Islands ..................................................... Commicarpus tuberosus (Lamarck) Standley, to include C. crassifolius Heimerl

3. Stems and leaves variously hairy; perianth red, stipitate glandular or glabrous

4. Stems viscid glandular with spreading hairs; perianth abundantly and shortly stipitate glandular externally, to 16 mm high and broad; stamens 4; thus far known only from Oaxaca, México ...................... Commicarpus coctoris N.A. Harriman

4. Stems with abundant short, non-glandular hairs, these hooked at the tip and antrorsely inclined; perianth glabrous externally, to 9 mm high and 11 mm broad; stamens 2; thus far known only from Michoacán, México ........................................ Commicarpus praetermissus N.A. Harriman

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Paul A. Fryxell, now “retired” to TEX, has been a continuous source of encouragement, help, and editorial acumen.
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MUHLENBERGIA JAIME-HINTONII
(POACEAE: CHLORIDOIDEAE),
A NEW SPECIES FROM NUEVO LEÓN, MEXICO

PAUL M. PETERSON
Department of Botany
National Museum of Natural History
Smithsonian Institution
Washington, DC 20560-0166

JESÚS VALDÉS-REYNA
Departamento de Botánica
Universidad Autonoma Agraria “Antonio Narro”
Buenavista, Saltillo
Coahuila 25315, MÉXICO

ABSTRACT
Mu/hlenbergia jaime-hintonii P.M. Peterson & Valdés-Reyna, sp. nov., is described and illustrated. The new species occurs in gypsum soils in southern Nuevo León, Mexico between the municipalities of Aramberri and General Zaragoza. Based on anatomical and morphological features Muhlenbergia jaime-hintonii is placed in subgenus Podospermum, section Epicampes. The new species seems most closely allied with Muhlenbergia pubigluma but differs by its shorter culms (44–82 cm long), shorter truncate ligules (0.4–1.0 mm long) with ciliolate apices, shorter spikelets (1.5–2.1 mm long), shorter glumes (0.7–1.2 mm long), shorter lemmas (1.5–2.0 mm long), shorter paleas (1.5–2.0 mm long), and shorter anthers (0.8–1.0 mm long).

RESUMEN
Se describe y se ilustra Muhlenbergia jaime-hintonii P.M. Peterson & Valdés-Reyna, sp. nov. Esta nueva especie se presenta en parte de las tierras gipsófilas en el sur del estado de Nuevo León, México, en los municipios de Aramberri y General Zaragoza. Basados en características anatómicas y morfológicas Muhlenbergia jaime-hintonii se ubica en el subgénero Podospermum, sección Epicampes. Esta nueva especie está fuertemente relacionada con Muhlenbergia pubigluma pero difiere de ella por sus culmes más cortos (44–82 cm de largo), ligulas más cortas (0.4–1.0 mm de largo) truncadas con ápices ciliolados, espiquillas más cortas (1.5–2.1 mm de largo), glumas más cortas (0.7–1.2 mm de largo), lemas más cortas (1.5–2.0 mm de largo), pálneas más cortas (1.5–2.0 mm de largo), y anteras más cortas (0.8–1.0 mm de largo).

While working on a catalogue of the grasses of Northeastern México (Valdés-Reyna, Davila, & Carranza Pérez, in prep.) and while preparing a revision of the perennial Muhlenbergia for México (Peterson, in prep.), JVR suggested to PMP that a collection by Mr. Jaime Hinton from southern Nuevo León might represent an undescribed species. At first glance the lemmas of this

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specimen appeared to be 1-veined and the ligule appeared to be a line of hairs, both characteristics of *Sporobolus*. Two specimens (*Hinton 22698 & Hinton 23766*) were previously sent to J.R. Reeder (ARIZ) who determined them to be *Sporobolus cryptandrus* (Torr.) A. Gray. However, upon closer inspection, the lemmas are usually 3-veined with faint lateral veins, these occasionally absent; and the ligule is very short with a membranous base and a truncate-ciliolate apex. The new species is clearly a member of the subfamily Chloridoideae, tribe Eragrostideae (Peterson et al. 1995, 1997). Therefore, we describe these specimens as a new species of *Muhlenbergia*, and name the species after the original collector, Jaime Hinton.

*Muhlenbergia jaime-hintonii* P.M. Peterson & Valdés-Reyna, sp. nov. (Figs. 1, 2). **Type** MÉXICO, NUEVO LEÓN: Municipio General Zaragoza: La Joya, Cuesta Blanca, approximately 15 km S of Aramberri on road towards Zaragoza (23° 59' 37.1" N—99° 47' 38.7" W), 1345 m, 31 Oct 1998, J. Valdés-Reyna & M. A. Carranza Pérez 2560 (HOLOTYPE: ANSM!; ISOTYPE: US!).

*A Muhlenbergia pubigluma* Swallen surculus extravaginalibus, rhizomatibus brevi-folius, culmis 44—82 cm altis, ligulis 0.4—1 mm longis apicibus truncatis et ciliatis, ramis inflorescentiae 0.5—6.0 cm longis, spiculis 1.5—2.1 mm longis, glumis 0.7—1.2 mm longis glabris, lemmatibus 1.5—2.0 mm longis leviter 3(1)-veenis, paleis 1.5—2.0 mm longis, antheris 0.8—1.0 mm longis, recedit.

Loosely caespitose perennial with short, densely leafy rhizomes and extravagal shoot initiation. Culms 44—82 cm tall, erect, compressed keeled near the base, densely white pubescence below the basal nodes, these hidden beneath the leafy sheaths, the hairs 0.8—1.3 mm long, upper nodes glabrous or puberulent; internodes puberulent below and mostly glabrous above. Sheaths 6—28 cm long, longer than the lower internode, puberulent to glabrous, stiff and brownish below, often curled; margins mostly smooth with a few short hairs near the summit. Ligules 0.4—1 mm long, membranous below; apex truncate, ciliolate. Blades 5—22 cm long, 1.8—5 mm wide, flat just above ligule to tightly conduplicate above, apically acuminiate, somewhat stiff, pubescent above and glabrous below. Panicles 13—34 cm long, 0.7—7 cm wide, narrow to somewhat open, the ascending densely flowered branches tightly appressed or loosely spreading up to 40° from the culm axis; pedicels 0.5—2 mm long, ascending, scaberulous; inflorescence branches 0.5—6.5 cm long. Spikelets 1.5—2.1 mm long, appressed to branches, 1-flowered, reddish-gray. Glumes 0.7—1.2 mm long, oblong, shorter than the lemma, usually equal in length, faintly 1-veined, reddish, glabrous, scaberulous along the midvein; apex acute to obtuse, occasionally minutely erose. Lemmas 1.5—2.0 mm long, oblong to elliptic, unawned, faintly 3(1)-veined, greenish mottled with reddish areas; midvein, margins, and proximal 1/2 to 3/4 loosely to densely appressed pubescent to villous, often these hairs more numerous along the margins and midvein below, the hairs up to 0.5 mm long; apex
acute, rarely minutely mucronate. Paleas 1.5–2.0 mm long, oblong, 2-veined, equal in length to the lemma, the proximal 2/3 to 3/4 densely appressed pubescent to villous between the veins and along the margins; apex acute to obtuse. Stamens 3; anthers 0.8–1.0 mm long, reddish at maturity, greenish when immature. Ovary 0.2 mm long; styles 2, separate, glabrous; stigmas 2, feathery, whitish. Caryopsis not seen.

Phenology.—Flowering in October through November.

*Distribution.*—Muhlenbergia jaime-bintonii is known only from southern Nuevo Leon between 1300–1850 m in the Municipio’s Aramberri and General Zaragoza, and can be found growing in whitish, alkaline soils derived from gypsum with Lepophyllum bintoniorum G.L. Nesom, Scutellaria latilabia T.M. Lane & G.L. Nesom, Galium denipterae B.L. Turner, Lobelia gypsophila T.J. Ayers, Geniostemon gypsophilum B.L. Turner, Callisia bintoniorum B. L. Turner, Agave striata Zucc., and Hechtia glomerata Zucc.


**LEAF ANATOMY**

Cross-sectional leaf blade anatomy was determined from hand sections of fresh field collected material (Valdés-Reyna & Carranza Pérez 2560) on temporary slides. The sections were stained in 0.05% toluidine blue. A diagrammatic cross-section was made with the aid of a camera lucida (Fig. 2).

The blades (Fig. 2) are typically kranz- C₄, NAD-m (nicotinamide adenine dinucleotide co-factor malic enzyme)-like in Hattersley and Watson’s (1992) sense with tightly radiate arranged chlorenchyma and XyMS⁺ (presence of cells between the metaxylem vessel elements and laterally adjacent chlorenchymatous tissue, see also Hattersley and Watson 1976). The lamina are flat or conduplicate with primary and secondary vascular bundles about the same size. The primary vascular bundles are well differentiated into xylem with metaxylem, phloem, and a double bundle sheath (mestome and parenchyma bundle sheath). The phloem tissue is irregularly sclerosed. The ribs are flattened with angled sides (rectangular) and the furrows are 1/5 to 1/2 as deep as the width of the blade adaxially and usually less than 1/5 as deep abaxially. The medium vascular bundle structure consists of a simple keel with only a single primary vascular bundle. Per blade there are 9–15 primary vascular bundles and 16–24 secondary vascular bundles. There is one or two secondary or tertiary vascular bundles placed between each primary vascular bundle. All vascular bundles are situated in the median layer
of the blade and are rectangular in outline. The xylem of the primary vascular bundles contains two wide metaxylem vessels that are about the same size as the parenchyma bundle sheath cells. The mestome, or inner sheath, is always present in the vascular bundles surrounding the xylem and phloem. The mestome is composed of small cells with thick walls and in primary, secondary and tertiary bundles it is interrupted abaxially and adaxially by sclerenchyma fibers forming a girder. The parenchyma bundle sheath, or outer layer, contains large, thin walled cells that are interrupted by the abaxial and adaxial sclerenchyma girder in the primary, secondary, and tertiary bundles. Chlorenchyma cells radiate just outside the parenchyma bundle sheath cells and are interrupted by a column of colorless cells forming a tightly radiate arrangement (NAD-me-like). Five to eight rows of sclerenchyma fibers form the abaxial and adaxial girder which are wide near the epidermis and narrow toward the vascular bundle. A few fibers form a rectangular to round cap along the margin of blade. Thick-walled colorless cells form a continuous column separating each vascular unit, these are not differentiated into bulliform cells.

**DISCUSSION**

The new species seems most closely allied to species of subgenus *Podoseum*, section *Epicampes* since it has culms with compressed keeled bases, conduplicate blades, primary and secondary vascular bundles both about the same size with sclerosed phloem, and shallow adaxial furrows (Peterson, in press; Peterson & Herrera-Arrieta, in review). Muhlenbergia jaime-hintonii differs from *M. emersleyi* and *M. pubiflora* (see Table 1) by quite a few characteris

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**Fig. 2.** Leaf blade cross section of a primary vascular bundle (center) and two secondary/tertiary vascular bundles of *Muhlenbergia jaime-hintonii* (Valdés-Reyna & Carranza Pérez 2560). Scale bar = 25 μm; *chl* = chlorenchyma tissue; *f* = sclerenchyma fibers; *ms* = mestome sheath; *mx* = metaxylem vessel; *pbs* = parenchyma bundle sheath.
tics, most notably: extravaginal shoot initiation, the presence of short-leafy rhizomes, short ligules (0.5—1 mm long) with a truncate and ciliolate apex, spikelets ranging from 1.5—2.1 mm long, short glumes (0.7—1.2 mm long) that are glabrous, short lemmas (1.5—2.0 mm long) that are faintly 3(1)-veined, short paleas (1.5—2.0 mm long), and short anthers (0.8—1.0 mm long). *Muhlenbergia distans* Swallen is also morphologically similar to *M. jaime-hintonii* but differs by having longer ligules (usually 5—10 mm long) that are firm below, longer spikelets (2.7—3.6 mm long), and short-awned (the awn 1.5—5 mm long) lemmas (Soderstrom 1967). The closest sister to *M. jaime-hintonii* appears to be *M. pubigluma* since they both share several characteristics, such as: densely white pubescence below the basal nodes, short-leafy rhizomes, reddish-gray spikelets, faintly 3-veined lemmas that are pubescent to villous on the lower 1/2 to 3/4, and simple keels (compound keels are the predominant character state in sect. *Epicampes*). In addition, *Muhlenbergia pubigluma* and *M. jaime-hintonii* appear to be sympatric since the former species is known to occur just 10 km west of Aramberri between La Escondida and La Soledad [A.A. Beetle M-406 (UC, US!)], and again west of Doctor Arroyo, approximately 60 km southwest of Zaragoza [Shreve & Tinkham 9651 (GH)].
ACKNOWLEDGMENTS

Appreciation is extended to Alice R. Tangerini for providing the illustration and Dan H. Nicolson for correcting the Latin diagnosis and discussions pertinent to choosing the specific epithet. Stephan L. Hatch and Robert D. Webster are thanked for reviewing the manuscript on short notice. Miguel A. Carranza Pérez is thanked for his help in obtaining the field collections.

REFERENCES


BOOK NOTICE


This book is a bargain. Don't miss it!! After a nice introduction, a preface with a short biographical sketch of Henry Allan Gleason, and a crystal-clear explanation of how to use the book, Rabeler presents a nice bibliography, a very simple phytography section, a list of illustrations, and then keys to the major groups of "plants" in the flora. The groups of plants in the keys include woody plants, unusual plants, monocots and dicots. While these are not the groupings one would normally encounter, they are, nonetheless, extremely useful, especially for the amateur or hobbyist.

The book contains 49 pages of bracketed keys, straightforward, simple, and nomenclaturally harmonious with the magnificent technical Michigan Flora volumes by the other temperate floristian at MICHI, Dr. Ed Voss. Starting on page 93, there are descriptions for each family, and bracketed keys to the species within each family (ordered so the species of each genus are adjacent to each other). There are 45 simple line illustrations, judiciously chosen, an 11 page glossary, and finally, indices to subjects and plant names. There are also supplementary boxes scattered throughout the book, with extra information that the enthusiast will appreciate, such as that found on page 299 for Calium (Rubiaceae), the bedstraw, and for the infamous genus Solidago on page 331. These boxes explain points such as the difficulty of the group, recent changes in taxonomic concepts and other information that serve to encourage a user frustrated by notoriously complicated taxonomic groups. To top it off, the last page of the book is blank except for a handy metric ruler drawn on it along the edge. This is a wonderful field guide!

The cover is extremely attractive and sturdy, as is the binding. The paper is of high quality and I am sure it will weather significant use. It is obvious that the author has been a successful instructor for some time and has a knack for keeping someone interested even when keying out a difficult group. He is to be congratulated for revising Gleason's work and producing a field manual compatible with the Voss magna op. The practicality, simplicity and clarity of the book will ensure its use by every plant enthusiast in the Great Lakes State, and most likely, in the adjoining ones as well (Wisconsin, Minnesota, Illinois, Indiana, Ohio). I heartily recommend this book to everyone who contemplates visiting any area near the Great Lakes Region!—John J. Pipoly III.
A NEW SPECIES OF EMORYA (BUDDLEJACEAE)

MARK H. MAYFIELD

Plant Resources Center
University of Texas
Austin, TX 78713, U.S.A.

ABSTRACT

A new species of Buddlejaceae, Emorya rinconensis, is described here as the second species of the genus. The species is known from a single collection from the Serranías del Burro in northern Coahuila, Mexico. Although associated with a more mesic flora than Emorya suaveolens, morphological adaptations and associated species suggest that E. rinconensis may grow in edaphically xeric, steep rock outcrops. The racemose inflorescences of the new species are unique among New World Buddlejaceae and appear to represent a reduction from the open, few-flowered axillary cymes found in Emorya suaveolens. In the context of North American Buddlejaceae, the long tubular corollas in open inflorescences, long styles, linear calyx lobes, and prolate pollen support the present generic placement of the new species with Emorya, but future confirmation of the phyletic position of both species in a larger geographic context is needed.

RESUMEN

En este trabajo se describe una nueva especie de Buddlejaceae, Emorya rinconensis, como la segunda especie del género. La especie se conoce a partir de una sola colecta de las Serranías del Burro en el norte de Coahuila, México. Aunque asociada con una flora más mesólica que Emorya suaveolens, las adaptaciones morfológicas y especies asociadas sugieren que E. rinconensis puede crecer en afloramientos rocosos, escarpados y xéricos. Las inflorescencias racemosas de la nueva especie son únicas entre las Buddlejaceae del Nuevo Mundo y parecen representar una reducción de las cimas axilares abiertas de pocas flores encontradas en E. suaveolens. En el contexto de las Buddlejaceae Norteamericanas, las largas corolas tubulares en inflorescencias abiertas, estilos largos, lóbulos del cáliz lineares, y polen prolatado, apoyan la presente posición genérica de la nueva especie con Emorya, pero se necesita una futura confirmación de la situación filética de ambas especies en un contexto geográfico más amplio.

A set of plant specimens from northern Coahuila, Mexico distributed to TEX for identification included an undescribed species which closely resembles Emorya suaveolens Torr. of the Buddlejaceae (f. 1). The stellate-tomentose vestiture, superior ovary, and four-merous, tubular corolla of the new species are characteristic in Buddlejaceae, a family with only two genera in the New World: Emorya and Buddleja (excluding Polypremnum and Pelianthera which are better treated

1Current address: Herbarium, Department of Biological Sciences, Louisiana State University, Baton Rouge, LA 70803, U.S.A.
2Plants collected by S. Aguilar Ruiz in association with a study of populations of Black Bears in northern Coahuila, Mexico, at the Rancho El Rincón. The first set of specimens of the large collection from this study is at SRSC.

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outside of Buddlejeaee, [Eliane Norman, pers. comm.]). Its racemose inflorescences with solitary flowers in the upper axils are unique in the family in the New World and appear to represent a reduction from the open cymose axillary flowers of *E. saurolepis*. The species has not been collected again since its initial collection in 1992, and the present collection is lacking fruits. Thus, although fruits are expected to corroborate the present placement in *Emorya*, the species is formally described here to advance its rediscovery and thereby facilitate future research on the genus.

**Emorya rinconensis** Mayfield, sp. nov. (Fig. 1). **Type: MEXICO:** Municipio Villa Acuña, Rancho El Rincón, SW margin of Serranías del Burro, in Cañon El Becerro, 28°40' N 102°15' W, 8 Aug 1991. S. Aguilar Ruiz 164 with D.L. Doan-Crider (holotype MEXU; isotypes: SRSC, TEX).

Valde differt a *Emorya saurolepis* Torr. caulisibus decumbentibus, floribus e foliorum summissis axillis solitariis, corollis cinnabarinis exte trichomatibus stellatis multum densius vestitis inter pilosis, staminibus inclusis, stylitis viridibus, polline tricolporato.

Spreading subshrubs with a conspicuous dense vestiture of 4-branched, stellate trichomes on the young stems, leaves, and flowers. *Stems* ascending distally to ca. 25 cm high; older woody branches to ca. 3 mm thick, with a light gray exfoliating bark; young growth of stems ca. 1.2 mm thick and densely stellate tomentulose. *Leaves* to ca. 2 cm long, opposite, estipulate, the blades broadly oblanceolate to subsparulate or subrhombic, essentially sessile or with a brief petiole; apices obtuse to rounded, with 1 to 4 broad teeth along the margins; bases attenuate and entire; leaf surfaces densely stellate tomentulose below, subglabrous above. *Flowers* solitary in the axils of the upper leaves (i.e., paired at each node); pedicels ca. 4 mm long, the pedicels each with pair of opposite, linear-elliptic, ascending bracteoles ca. 7 mm long closely subtending the calyx. *Calyx* 7.0–7.5 mm long, narrowly campanuliform with four erect to slightly spreading linear lobes 2.2–3.7 mm long, the tube 3.8–4.5 mm long, tapered to the base, with weak nerves along the midribs. *Corolla* 27–30 mm long, tubular, four-lobed, cinnabarine, the color externally obscured by the vestiture of stellate trichomes; tube ca. 1.2 mm wide at the base, scarcely expanded to the base of a short amplexic throat which is constricted at the base of the lobes; lobes valvate in bud, rounded-obtuse, spreading upwards at anthesis to ca. 4 mm across the top, with scattered orange capitate resiniferous glands within; the interior of the tube brick red, with a scattered pilosity of delicate, simple, minutely papillose orange trichomes to 0.3–1.2–1.5 mm long. * Stamens* included within the throat or slightly surpassing in late anthesis; filaments ca. 2.0 mm long, inserted ca. four-fifths of the way up the tube (22–23 mm above the base); anthers 2 mm long, introrse, mucronate at the apex, the anther sacs separate below the attachment. *Ovary* narrowly oblong-elliptic, ca 4 mm long, glabrous on the lower third, stellate-pubescent above, borne on a short
Mayfield, A new species of Emorya

Fig. 1: A–D, *Emorya rinconensis*, from the type collection, Aguilar Ruiz 164. A. Branch showing probable habit B. Flowering branch; C. Flower with pedicel and subtending bracteoles; D. Corolla showing filament insertion; E. Flowering branch of *Emorya suaveolens* for comparison (from Nesom 7379).

stipe-like base ca 1.5 mm long; nectar disc present but inconspicuous; style 30–35 mm long, scarcely to evidently exerted from the corolla tube; stigma truncate, scarcely bilobate, the surface papillose. *Fruits* unknown. *Pollen* prolate, tricolporate, 31.5 μm × 18.5 μm.

*Distribution.*—The species is as yet known only from the type collection. *Emorya rinconensis* is associated with a flora similar to that of the Edwards Plateau area of Texas. Its xeromorphic features are similar to other petrophilous
species of Buddlejaceae (e.g., Buddleja racemosa, of central Texas), which inhabit dry limestone outcrops, often pendulous from steep slopes or ledges. Other potentially rock-outcrop-dwelling species collected by Ruiz at the type locality (“Cañon El Becerro”) include Ageratina potozina, Desmodium lindheimeri, Encide barbatoides, Geranium caespitum, Hedeoma costatum, Oenothera macroseles, Orbeia amicorum, Penstemon barbatus, Polygala scoparioides, Salvia regla, Salvia roemeriana, Solidago nemoralis, Solidago petiolaris, and Thelesperma simplicifolium. Future attempts to relocate Emorya rinconensis should be concentrated in areas with limestone faces or ledges having these species.

Emorya suaveolens Torr. is distributed in the northern Mexican states of Nuevo León and Coahuila and in the United States along the Rio Grande in closely adjacent Texas (Fig. 2; Norman & Moore 1968; Norman 1964; Warnock 1964). It is a shrub or small tree to 2 m tall with flowers in open thyres, with tubular, yellow corollas, exserted stamens with the filaments inserted on the lower half of the tube, deltoid leaves, and tetracolporate pollen (Norman & Moore 1968; Fig. 3). In contrast, E. rinconensis is a small spreading shrub with reddish-orange flowers in racemes, filaments inserted supramedially on the tube, included stamens, obovate to subspatulate leaves, and tricolporate pollen (Fig. 3b). These species share a combination of features that separate them from Buddleja in North America including: long tubular corollas, prolate pollen (Fig. 3), anthers on elongated filaments (vs. sub sessile), linear bracteoles on the peduncles, linear calyx lobes, hypogynous nectaries, and leaves with repand margins and non-clasping bases.

The new species is somewhat intermediate between Emorya suaveolens and some species of Buddleja. Indeed, authorities on Buddlejaceae and related groups have suggested that E. suaveolens could be included within the genus Buddleja (e.g., Leenhouts 1963; Norman 1967; Rogers 1986). Despite this, Emorya has never been formally transferred nor has any species or group of species within Buddleja ever been cited as a potential close relative. At least some lines of evidence suggest that Emorya may not be so closely related to Buddleja. Although viable hybrids between distantly separated species of Buddlejaceae have been produced (e.g., Nicotiana madagascariensis [Madagascar] x Buddleja globosa [Chile] by Van de Weyer [1920]), Norman & Moore (1968) reported an inability to produce viable hybrids between E. suaveolens and some species of Buddleja (notably, seeds and seedlings were produced in crosses with Buddleja alternifolia [Asian] and B. tubiflora [South American], but the seedlings died prior to elongation of the hypocotyl). Norman & Moore also pointed out morphological, anatomical, and palynological features that suggest that Emorya may be phylogenetically distinct from Buddleja in Mexico. Norman (1967) has also indicated that most of the New World species of Buddleja are functionally dioecious, whereas E. suaveolens has perfect flowers. Punt and Leenhouts (1967) assigned a distinct pollen type to Emorya stating that
the pollen morphology "strongly supports" continued generic recognition for the species. In 1980, Punt reaffirmed this position and emphasized the large size of the grains (ca. 40 µm vs. 25 µm for Buddleja), the tetracolporate exine, and unique features of the columella (rather than the prolate shape).
Without mature fruits and knowledge of the reproductive biology of the new species, its generic placement with *Emorya* will remain somewhat equivocal. Thus, the description rendered here for the new species places it with *Emorya*, the Buddlejaceae genus in North America to which it bears the greatest similarity.

**ACKNOWLEDGMENTS**

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**REFERENCES**


Mayfield, A new species of Emorya


BOOK RECEIVED


The Grasses of Missouri was first published in 1961. Significant changes have been made in grass classification since the first edition. Clair L. Kucera provides a complete and comprehensive classification of Missouri's vast grass flora. From the tallgrass prairies to forested Ozarks to Mississippi lowlands, the state offers an array of grasses that can be classified into six subfamilies of the Poaceae, eighteen tribes, and eighty-seven genera.

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- Synoptic List of Missouri Subfamilies, Tribes, and Genera
- Key to Tribes
- Keys to Genera
- Description of Genera and Species
- Glossary
- Bibliography
- Index
DISCOVERY OF THE INDO-MALESIAN GENUS
HYMENANDRA (MYRSINACEAE)
IN THE NEOTROPICS,
AND ITS BOREOTROPICAL IMPLICATIONS

JOHN J. PIPOLY III
Botanical Research Institute of Texas
509 Pecan Street, Fort Worth, TX 76102-4060, U.S.A.
jpipoly@brit.org; clusia@latinmail.com

JON M. RICKETSON
Missouri Botanical Garden
P. O. Box 299, St. Louis MO 63166-0299, U.S.A.
jon.ricketson@mobot.org; jrickerson@lehmann.mobot.org

ABSTRACT

The taxonomic revision of a neotropical group of taxa formerly placed by Lundell in Auricularidisia, Chontalesia, and Ipavera, resulted in the discovery that they were actually members of the otherwise Indo-Malesian genus, Hymenandra. The genus is defined by its filaments fused at least basally to form a staminal tube, the tube adnate to the base of the corolla tube and anthers connate along their longitudinal dehiscence sutures at least until anthesis. It is also noted that all species of the genus exhibit Fagerlind’s Architectural Model, a model that is otherwise extremely restricted, and one whose vegetative vs. reproductive shoot dimorphism has led to taxonomic overdescription. Nine species of Hymenandra are recognized in the Neotropics, bringing the total number of species in the genus to 16. Owing to a lack of complete material for Indo-Malesian species, and previous workers’ hesitancy to unequivocally assign all of those species to a subgenus, the neotropical group is transferred to the genus without circumscription of any subgenera. It is postulated that the geography of Hymenandra, now considered an amphipacific taxon, is consistent with that predicted by the Boreotropical Hypothesis, and its logical extension postulated by Wendt (1993) and Lavin and Luckow (1993), especially when viewed in light of the biogeography for the rest of the tribe Ardisieae. Each neotropical Hymenandra species is fully described, newly illustrated, and provided with citations for all taxonomic and nomenclatural synonyms. In addition to the general section on morphology, biogeography and ecology provided for the genus, each species is accompanied by a discussion of its distribution, ecology and conservation status, along with citation of specimens examined. Five binomials are newly relegated to synonymy, and one taxon, Hymenandra pittieri, is lectotypified. The following new combinations are made: Hymenandra stenophylla (Donn. Sm.) Pipoly & Rickerson, H. calycosa (Hemsl.) Pipoly & Rickerson, H. sordida (Lundell) Pipoly & Rickerson, H. squamata (Lundell) Pipoly & Rickerson, H. williamsia (Lundell) Pipoly & Rickerson, H. pittieri (Mez) Pipoly & Rickerson, H. callesiaii (Pipoly) Pipoly & Rickerson, H. acutissima (Cuatrec.) Pipoly & Rickerson, H. crobyi (Lundell) Pipoly & Rickerson. A complete list of exsiccatae is provided at the end for all collections examined.

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RESUMEN

Al llevar a cabo una revisión taxonómica de un grupo comprendiendo taxa anteriormente clasificados por Lundell como pertenecientes a los géneros Auriculardrisa, Chontalesia, y leacova, se reveló que todos pertenecen al género indo-malesiano, Hymenandra. El género se define por sus filamentos conados, formándose un tubo estaminal, por lo menos en su base, adnado a la base del tubo corolino y con anteras conadas a lo largo de las hendiduras longitudinalas de dehiscencia. Se note que todas las especies del género se caracterizan por exhibir el Modelo Arquitectural de Fagerlind, un modelo bastante sínico y cuyo dimorfismo entre ramas vegetativas y reproductivas se ha ocasionado sobre descripción taxonómica. Se reconocen nueve especies neotropicales de Hymenandra, sumando el total para el género hasta 16. Debido al hecho de que el material indo-malesio es muy incompleto, no se han podido asignar a un subgénero todas las especies. Por lo tanto, se transfieren las especies neotropicales al género sin circumscribir subgéneros. Se postula que la geografía del género está de acuerdo con el patrón fitogeográfico proveniente del Hipótesis Boreotropical, especialmente en vista de la distribución y relaciones con el tribu Ardisiceae. Ademas de la sección general sobre morfología, biogeografía, y ecología provista para el género, se discute la distribución geográfica, ecología y estado de conservación, y se lista pliegues examinados para todos los taxa. Se le da cinco binomiales a la sinonimia, y se lectoriifica Hymenandra pittieri. Las nuevas combinaciones se incluyen una continuación: The following new combinations are made: Hymenandra stenophylla (Donn. Sm.) Pipoly & Ricketson, H. calyosoa (Hemsfl.) Pipoly & Ricketson, H. sundida (Lundell) Pipoly & Ricketson, H. squamata (Lundell) Pipoly & Ricketson, H. wilburiana (Lundell) Pipoly & Ricketson, H. pittieri (Mez) Pipoly & Ricketson, H. callejastii (Pipoly) Pipoly & Ricketson, H. acutissima (Cuatrec.) Pipoly & Ricketson, H. crusbyi (Lundell) Pipoly & Ricketson. Se provee una lista completa de exsiccata al final del trabajo.

INTRODUCTION

The pantropical genus Ardisia Sw. is by far the largest in the family Myrsinaceae, containing perhaps as many as 500 species (Chen & Pipoly 1996). Its circumstantial has been problematic owing to a lack of comprehensive treatment since that of Mez (1902) in Engler’s Pflanzenreich, almost a century ago. Several genera have been separated from Ardisia sensu lato since the Mez monograph, including Chontalesia Lundell (1982), described as a monotypic genus to accommodate the Central American Ardisia calyosoa Hemsl. Ardisia calyosoa may be immediately recognized by its unique large, coriaceous, narrowly lanceolate to lorate sepals that are longer than the corolla. While examining Ardisia calyosoa to determine its relationships, we noted that its vegetative characters, such as the punctate and punctate-lineate, ntid leaves, the branchlet apices with varying amounts of furfuraceous lepidote scales, and most notably, the unusual leaf dimorphism between the floral and vegetative shoots (now known as an artifact of its morphogenic program that exhibits Fagerlind’s Architectural Model, sensu Hallé et al. 1978), were similar to a Central American suite of species that includes A. stenophylla Donn. Sm., A. oblancoelata Standl., A. callejastii Lundell, and A. wilburiana Lundell. Careful study of this group of species revealed that their androecia have filaments connate throughout their length to form a staminal tube (therefore mona-
delphous) basally adnate to the corolla, and anther thecae connate along the suture line, at least in the basal portion, prior to anthesis, at which time at least the distal (abaxial) portion of the theca opens to permit release of pollen, or the anthers split completely apart from each other. This structure was also reported by Pipoly (1992a) in the description of Ardisia callejasii. Pipoly, a species endemic to the Antioquian Chocó of northern Colombia. Careful reexamination of additional material of Ardisia callejasii has revealed that the anthers are also basally connate up to full anthesis, when they split apart completely. In addition, the combination of long-pedunculate panicles terminating in very long-pedicelled flowers in corymbs to subumbels and large fruits with thick, juicy exocarps common to all the aforementioned taxa indicated that other neotropical species with the same features, including Ardisia crosbyi Lundell, A. pittieri Mez, and A. acutissima (Cuatrec.) Lundell might also belong to the alliance. Finally, with the sole exception of Ardisia callejasii, it was striking to note that for all species, the inflorescence was borne terminally or subterminally (but behaving terminally) on the end of a long sylleptic shoot, bearing leaves similar in shape to those of the vegetative shoots, except much smaller in size. The latter phenomenon was noted by Mez (1902) in Ardisia subgenus Pyrgus (Lour.) Mez, and by Stone (1991) in the genus Hymenandra A. DC. ex Spach. All of the aforementioned species except Ardisia calycosa have been referred by Lundell (1981) to his genus Auriculardisia, defined principally by the asymmetric sepals auriculate in outline. While surveying the rest of the neotropical Ardisia species attributed to Auriculardisia, we noted that Ardisia squamata (Lundell) J. F. Morales and A. sordida (Lundell) J. F. Morales possess all the features of the aforementioned group of taxa, but in a more diminutive form because they are subshrubs.

Given that Ardisia has traditionally been separated from its close congeners by filaments considered free from each other and from the corolla tube (Lundell 1966, 1971; Mez 1902; Ricketson & Pipoly 1997), the aforementioned group of species posed a serious problem in the circumscription of what was admittedly already a parapyletic group (Ståhl 1996). On the other hand, members of Ardisia subgenus Graphardisia (Pipoly & Ricketson 1998) have filaments basally fused for less than 1/5 their length, to form a short staminal tube free from the corolla tube, that is inconspicuous because of its thinly membranaceous texture, and anthers that are totally free from each other. If Ardisia is defined by stamens with free anthers and filaments free or variously connate, but totally free from the corolla tube, the group of species related to Ardisia calycosa discussed above would still not fit. The inclusion of Ardisia calycosa and its relatives in Ardisia would significantly amplify the morphological circumscription of the genus. To answer whether further enlargement of Ardisia's circumscription was warranted to main-
tain *A. calyosa* and its relatives within *Ardisia*, a review of the related genera of the family was conducted. This led to the surprising conclusion that the relationships of this suite of species are clearly with the genus *Hymenandra*, heretofore considered an Indo-Malesian genus of seven species (Stone 1991).

**THE GENUS HYMENANDRA**

*Hymenandra* was described as a section of *Ardisia* by Alphonse de Candolle (1834, 1841) to accomodate two species, *A. hymenandra* Wall. and *A. glandulosa* Roxb., with filaments basally connate, but free apically, and anthers connate. De Candolle (1841) treated the group as a genus, a rank to which it had already been assigned by Spach (1840). Mez (1902) accepted the genus in his worldwide monograph of the family, using the same characters. Furtado (1958) transferred *Ardisia ietophylla* Ridley to the genus, on the basis of its fused filaments and anthers, but in the same paper described *A. calicola* Furtado, distinguishing it from its sister species in subgenus *Pyrgus* by the fused filaments and anthers. Nayar and Giri (1975) described one new species, *Hymenandra narayanaswamii* Nayar & Giri, endemic to Myanmar (Burma). Stone (1991) revised the genus, transferred *A. calicola* to *Hymenandra*, and described four new species, recognizing a total of seven species. Stone (1991) erected two subgenera, based on the degree of compaction of the inflorescence, the presence or absence of papillae on the adaxial calyx lobe surface, and general habit of the plants. *Hymenandra* subgenus *Lacrimophila* B. C. Stone was defined by caduous floral bracts, sepals hirtellous along the margins, glabrous or hirtellous (not papillose) within, but he included only *Hymenandra narayanaswamii* and *H. diamphidia* B. C. Stone in it, leaving the third species of the group from the second half of his key, *H. ietophylla* (Ridl.) Furtado, in subgenus *Hymenandra*. We have examined material of both groups and conclude that further material of the species will be necessary before accepting the subgeneric grouping.

*Hymenandra*, as defined by Stone (1991), is characterized by a staminal tube formed by filaments at least basally united and basally adnate to the corolla, concomitant with anthers connate, at least basally, by their longitudinal dehiscence sutures, until anthesis, at which time the distal flap of the theca may open or the anthers may split apart completely. All species have filaments basally connate and apically free, with anthers connate in anthesis along the entire length of the dehiscence sutures. In the Neotropics, the filaments are connate throughout their length, at least at first, and the anthers are connate in the basal half, separating early or just after the corolla lobes open, whereas in the paleotropical species, the filaments are connate in the basal half, free distally, and the anthers are connate along the
deshisces suture throughout their length. As far as is known, all members of the genus exhibit Fagerlind’s Architectural Model, as defined by Hallé et al. (1978). Given the uniqueness of the androecial structure, we here transfer the aforementioned Ardisia species to Hymenandra.

With the addition of the neotropical species transferred in this paper, the total number of species in Hymenandra reaches 16, distributed from Assam, Bangladesh, Myanmar, Malaya, Borneo, and Nicaragua through the Colombian Chocó. Given the scarcity of material available for study, we defer reexamination of subgeneric delimitation until a later time.

MORPHOLOGY

The following descriptions are based on the genus as a whole, with particular emphasis and detail among neotropical taxa.

Habit, Architecture, “Trunk” and Shoots
Most members of neotropical Hymenandra are shrubs or small trees to 8 m tall with a maximum known diameter at breast height (dbh) of 8 cm, with the exceptions of H. squamata and H. sordida, which are subshrubs less than one meter tall. This is much like the case among the Indo-Malesian species, where seven of the nine species are also subshrubs. Therefore, when we refer to a “trunk” in the following architectural model discussion, it is the principal axis of the plant, or “vegetative stem.” So far as is known, all species of Hymenandra are terrestrial (i.e., not epiphytes).

Careful study of herbarium specimens and examination of photographs lead us to postulate that all Hymenandra species exhibit Fagerlind’s Architectural Model (Hallé et al. 1978). Fagerlind’s Model describes those trees whose architecture is determined by a monopodial, orthotropic, readily distinguishable, rhythmically growing trunk that produces tiers of modular branches, each branch sympodial and plagiotropic by apposition, with spiral or decussate (never distichous) phyllotaxy. Branch modules are often hapaxanthic (dying after flower) or, as is the case in Hymenandra, they may exhibit sympodial growth by apposition, often branching several times without flowering. Deducing evidence we have pieced together from specimens, field observations, and collectors’ notes, we might explain the morphogenetic program of Hymenandra individuals as follows: a) A “trunk” (“vegetative shoot”) develops rhythmically, producing successive pseudoverticels of “vegetative” leaves until the apex loses dominance and latent lateral (“axillary”) buds are released, producing successive, monopodial pseudoverticels of shoots, each of which is sylleptic (and rarely attaining 5 mm in diameter), with a long hypopodium and exhibiting rapid extension growth. b) The sylleptic branch shoots produce first a prophyll, then pseudoverticels of “reproductive shoot” leaves (similar to the leaves of the “vegetative shoot” but nota-
bly smaller), and then may either lose dominance and once again branch sympodially by apposition growth (repeating the module) without flowering, or produce a terminal or pseudoterminal (acting as a terminal) inflorescence. Therefore, like the other species exhibiting Fagerlind’s Model, and unlike other models, inflorescence production is usually not acropetal along a set of modular plagiotropic branches (although it can be). c) When a shoot flowers, the apex of the reproductive shoot will gradually lose dominance and may produce the remaining flowers of the inflorescence, or support ongoing fruit development, or the remaining flowers may abort. Following flower, a branch sympodial by substitution growth may (or may not) be produced, that will very slowly generate leaves in a high phyllotactic spiral (a pseudoverticel) and eventually abort. It is interesting to note that the apical region of the principal plant axis (“trunk”, or “vegetative shoot”) does not produce an inflorescence, and as Hallé et al. (1978) noted, leaves associated with the trunk (here termed “vegetative shoot leaves”) are considerably larger than those of the branches (here termed “reproductive shoot leaves”). It is precisely this rare leaf dimorphism that caused us to further investigate the dynamics associated with Fagerlind’s Model to see if they were consistent with what we could surmise about the developmental biology (morphogenetic program) of Hymenandra species. Clearly, more intensive field studies are needed to determine if any other activity occurs in the plant body’s development among species of the genus.

Mez (1902) described the branching dynamics and flowering phenomena associated with Fagerlind’s Model when he discussed the “inflorescences on special branches, with the principal axis indeterminate, [the inflorescences] terminal on lateral apices, with large subtending leaves subverticillate” for Ardisia subgenus Pyrgus. Subgenus Pyrgus is Indo-Malesian in origin and its species often occur sympatrically with individuals of Hymenandra. Likewise, Stone (1991) made the same comparison when he described Hymenandra lilacinia distinguishing between vegetative and flowering shoots in that species. While both Mez and Stone noted that the leaves of the vegetative shoot (trunk) are usually slightly different from those of the flowering shoot, it was not correlated with a model for growth. During the period Mez worked, the concept of architectural models did not exist, and the herbarium material available to Mez was rather fragmentary or restricted to flowering shoots, at times accompanied from a single leaf from the trunk or an axis in vegetative state. Stone (1991) noted similarities in the “position and form of the inflorescence” between Hymenandra and Ardisia subgenus Pyrgus but did not state this in terms of architectural models. While there are several other architectural models present in Ardisia and within the tribe Ardisieae (Maasart’s, Scarrone’s, Roux’s, based on unpubl. data), very few taxa have been exam-
ined, and architectural models are not necessarily correlated with subgeneric or other taxonomic groups. While *Hymenandra* species may share the same architectural model with *Ardisia* subgenus *Pyrgus*, the free anthers with apical or subapical pores with minute filaments, and the numerous, pluriseriate ovules of *Pyrgus* clearly preclude inclusion of the *Hymenandra* species within it.

**Leaves**
The leaves of *Hymenandra* are alternate, exstipulate and simple. As previously stated, leaves on the trunks ("stems" for small-statured taxa, "vegetative shoots" otherwise) are much larger than those of the reproductive ones, and also have a smaller length-to-width ratio. While both the "trunk" (or stem) and branches have spiral phyllotaxis, it is presumably by secondary twisting of the branches that make them plagiotropic, rather than by dichotous arrangement. The blades may be chartaceous to coriaceous, elliptic, oblanceolate or oblong, apically acute to long-acuminate, basally cuneate to obtuse or rounded, decurrent on the petiole or not, conspicuously or inconspicuously black punctate and punctate-lineate, usually glabrous, but sometimes sparsely and minutely furfuraceous lepidote, the margins are entire, or rarely crenate (*Hymenandra calycosa*). The petioles are marginate and may bear the same tomentum as the branchlet apices, but they are glabrescent.

**Inflorescence, Flowers and Fruit**
The inflorescence may be terminal or pseudo-terminal (but behaving terminal), and variously bi- or tripinnately paniculate, with branches ending in loose to tight corymbs of flowers. The panicles are mostly pyramidal, but may be reduced to a columnar panicle of corymbs, thus appearing racemose in fruit (e.g., *Hymenandra sordida*). The inflorescence bract is foliaceous, membranaceous, nearly sessile and early caducous. The peduncle, primary rachis and branches are glabrous or furfuraceous lepidote, then glabrescent. The floral bracts are ovate, lanceolate or narrowly elliptic, and membranaceous, sparsely to densely furfuraceous at first, then glabrescent. The pedicels are cylindrical and bear the same vestiture as the inflorescence branch. The flowers are perfect, bisexual, homomeroous, and 5 (−6)-merous, and both perianth members may be membranaceous, chartaceous or coriaceous, with pellucid or black punctations and punctate-lineations. The calyx has lobes nearly free, lanceolate, linear-lanceolate, linear, oblong, or suborbicular, symmetrical or asymmetrical to slightly auriculate, apically acute, obtuse or rounded, the margin regular, irregular, or subapically notched, hyaline or scarious, sparsely glandular-ciliolate, minutely erose or entire (Fig. 1). The corolla is campanulate, the lobes nearly free, or free, ovate, lanceolate, oblong, or elliptic, symmetrical, apically acute or acuminate, erect or reflexed in anthe-
sis, glabrous, the margin hyaline, and entire. The stamens are connate at least basally by their filaments to form a staminal tube, and by their anthers along the dehiscence sutures. The filaments are connate throughout their length in the neotropical species, but only basally in the Indo-Malesian species. The anthers are basifixed, connate along their dehiscence lines, either basally at first, or throughout their length, and lanceolate or ovate, apically long-attenuate to an acute or emarginate tip, or rounded with an apiculate tip, basally cordate, dehiscent by longitudinal slits, and with connectives ventrally darkened or prominently black punctate dorsally in the basal portion.

The pistil may be obturinate or ellipsoid, the style longer than the ovary,
attenuate to a punctiform stigma. The placenta is subglobose to ellipsoid with relatively few to numerous, pluoseriate ovules in a high anthotactic spiral. The fruit is a globose to depressed-globose, one-seeded drupe, with a persistent style, sparsely or densely and prominently, conspicuously or inconspicuously pellucid or black punctate.

ECOLOGY

Neotropical *Hymenandra* species are mostly small trees, most commonly found along ridgetops in moist, wet, cloud or pluvial forests, from near sea level to 1,400 m elevation. Two species, *Hymenandra sordida* and *H. squamata*, are subshrubs less than one meter tall, but they are ecologically distinct, the former is known only from cloud forests, and the latter known from swamp forests. Only one species, *Hymenandra stenophylla*, is found in lowland moist forests. *Hymenandra wilbariana* and *H. pittieri* are both found in forests transitional between lowland and premontane wet forests, but the former species is restricted to ridgetops, while the latter is found along the forest margin, particularly along watercourses. In the Colombian Chocó, two species occur that are easily separated ecologically. *Hymenandra callejasii* is from the lowland pluvial forest of the northern Antioquian Chocó, while *H. acutissima* is a riparian species along major rivers along the shores of the Pacific Ocean. *Hymenandra calycosa* is known only from premontane wet forests, from Nicaragua to Panama.

In Mesoamerica, the altitudinal compression or expansion of life zones is largely a result of exposure to winds, rain and other meteorological events. Therefore, absolute altitude often has little to do with the life zone present at a given site. For example, many areas in Nicaragua support vegetation otherwise found only at much higher altitudes, because there are no taller mountains around. Fieldwork has shown that even a small mountain of 800 m can support cloud forest. Such appears to be the case of *Hymenandra croshyi*, which is restricted to the Caribbean Slope of Panama, at the junction of the premontane and cloud forest life zones, even though the altitudinal range of the species is only 100–850 m.

BIOGEOGRAPHY AND IMPLICATIONS FOR THE BOREOTROPICS HYPOTHESIS

*Hymenandra*, as now defined, is amphipatically distributed, occurring from Bangladesh eastward through Malaya to Borneo, and in the Neotropics from Nicaragua southward through Costa Rica and Panama to the Chocó of Colombia. A distribution such as this, in particular with the majority of the species centered in Central America, most closely fits those groups cited as partial evidence to support what Wendt (1993) discovered in his study of lowland Mexican wet forests, and what Lavin and Luckow (1993) attrib-
uted to the Boreotropics Hypothesis, proposed by Wolfe (1975) and Tiffney (1985a, b) to explain the distribution of the “boreotropical flora.” The hypothesis proposes that the biotas of North America and Europe, including tropical North America, were once more widespread in the northern hemisphere and transgressed the North Atlantic by direct land connections or over limited water gaps until the late Eocene or early Oligocene (Lavin & Luckow 1993). A logical extension to Wolfe’s and Tiffney’s concept, presented by Wendt (1993) and Lavin and Luckow (1993) is that the boreotropical flora not only existed in the Eocene, but also left a significant number of direct descendant lines in present lowland tropical floras of northern Latin America. Therefore, we would expect that many of the early Tertiary fossil taxa from both North America and Europe were most closely related to extant species from tropical southeast Asia, and to some extent, Central America and the Greater Antilles (Lavin & Luckow 1993). It is the latter notion that is congruent with the Amphipacific distributional pattern like that found in our new concept of *Hymenandra*. This extension to the boreotropics hypothesis was cited by Wendt (1988, 1989, 1993), in discussing the relationships of *Chiangiodendron* (Flacourtiaceae), and by Zona (1990) in discussing the biogeography of *Sabal* (Arecaceae). A similar distribution for the genus *Alstonia* (Apocynaceae) was cited by Gentry (1983), but he did not invoke the hypothesis *per se*. Conran (1995), in his study of the Liliiflorae, found that three taxa defining the Southeast Asian/northern Australasian clade (Stemonaceae, Hanguanaceae and Uvulariaceae) were widespread northern taxa that have spread southwards.

The geographic distribution of *Hymenandra* is entirely consistent with the area cladogram presented by Lavin and Luckow (1993, Fig. 1), where South American elements are ultimately derived from among diverse North American lineages, these lineages having a sister group relationship to Paleotropical groups. While Wolfe’s hypothesis could be correct even if no modern descendants of the boreotropical flora were found in the Neotropics owing to extinction, the three criteria proposed by Lavin and Luckow (1993) to test the hypothesis were: 1) a center of diversity in North America (including “tropical North America” as they define it), 2) an early Tertiary fossil record in North America, and 3) a pantropical distribution.

For the first test criterion, “North America” includes both tropical and temperate elements, the tropical ones south of the Tropic of Cancer. In the case of *Hymenandra*, it is clear that the majority of the neotropical members of the genus (*H. stemphylla*, *H. calyosa*, *H. sordida*, *H. squamata*, *H. wilburiana*, *H. erosbyi*) are centered in Nicaragua, Costa Rica, or the Caribbean slope of Panama, with only *H. pittieri* spanning the central montane of Costa Rica and Panama. *Hymenandra callejasii* and *H. acutissima* are restricted to the
Chocó of Colombia, a floristic province whose northern limit is southeastern Panama. Therefore, the pattern fits the first criterion.

Unfortunately, no data is available for use in the second test criterion owing to lack of fossils known for the group. As for the last criterion, a pantropical distribution, the closest related genus to *Hymenandra* appears to be the genus *Conmandrium* Mez, known only from New Guinea, on the basis of possession of anthers fused along the sutures. In connection with New Guinea and adjacent Australia as significant sources of biota related to that of North America, Dobson (1996) cites the distribution of the termite genus *Mastotermes* and the sister poison frog genera, *Pitobni* and *Phyllobates*, as further evidence, but without citing the boreotropics hypothesis *per se*. It is unfortunate that the preliminary cladogram for genera of the family by Ståhl (1996) did not include *Hymenandra*. The other neotropical genera of the tribe *Ardisieae* include *Ardisia*, pantropically distributed with major centers of diversity in Malesia and Mesoamerica, *Ctenardisia* Ducke, with species from northern Mesoamerica and the Amazon Basin, *Synardisia* (Mast.) Lundell, a monotypic genus ranging from southern Mexico to Nicaragua, and *Gentlea* Lundell, with the majority of species in Mexico and Mesoamerica (only one, *G. venossisima*, in the Andes from Venezuela to Peru). Until a phylogenetic analysis is complete for the tribe, a rigorous test cannot be performed. However, the pattern of distribution among the genera of the tribe *Ardisieae* fit the general pattern one would expect if the distribution was boreotropical.

In summary, we hypothesize that *Hymenandra* appears to fit the overall pattern consistent with a boreotropical distribution. However, we must emphasize that until a cladistic analysis among the genera of Myrsinaceae is complete, there is no reliable way to unequivocally determine if the group is boreotropical or Gondwanan. However, at this point in our work, we find it useful to point out the strong correlation and call attention to the value of examining generic limits on a worldwide basis when preparing treatments for a large flora such as *Flora Mesoamericana*.

**NOTES ON KEYS, DESCRIPTIONS, AND TERMINOLOGY**

The keys are artificial and designed to expedite identification of herbarium specimens. An attempt has been made to emphasize vegetative characters to increase the keys’ usefulness with sterile material. The numbers appearing before the taxa refer to their respective position in the key; any correlations with phylogenetic relationships are coincidental. Quantitative and qualitative data presented in keys and descriptions for floral parts and bracts were taken from organs rehydrated from herbarium specimens by boiling in water. Measurements from these range from 10% to 15% greater than those measurements taken directly from dried material. Data regarding shoot
diameters, inflorescence rachises, pedicels, leaf and fruit shape and size were taken from dried herbarium specimens.

Morphological terms in this treatment follow Lindley (1848) and Pipoly (1987, 1992a) for the inflorescence, rachis pedicels and floral parts. Description of leaf morphology follows Hickey (1984), trichome description follows Theobald et al. (1984) and basic cell and tissue terminology follow Metcalfe (1984).

Because of branchlet and leaf dimorphism between shoots in vegetative vs. reproductive phases, the primary orthotropic axes (stems if a small statured plant, trunks if a treelet), are shoots not bearing inflorescences and are termed “vegetative shoots,” while those plagiotropic branches actually or potentially bearing flowers or fruit are termed “reproductive shoots”. Likewise, the leaves on the trunk or on the branches when they are in a vegetative state, will be termed, “vegetative shoot leaves” while those leaves on the shoots while they are in the reproductive phase will be termed, “reproductive shoot leaves.”

All types cited here have been seen by the authors unless noted as “n.v.”

KEY TO GENERA OF MYRSINACEAE IN MESOAMERICA

1. Calyx closed in bud, irregularly opening into 2–8 lobes among flowers within the same inflorescence ................................................................. Geissanthus

1. Calyx open in bud, with (3–)4–5(–6) lobes, the number of calyx lobes per flower consistent within one inflorescence.

2. Calyx and corolla lobes valvate in bud; inflorescence axis never rufous glandular-papillate.

3. Flowers bisexual; inflorescences paniculate, longer than the petioles; shoots tomentose with stellate or dendroid trichomes; calyx and corolla tomentose and glandular-papilllose; anthers bright yellow; style elongate ................................................................. Parathesis

3. Flowers unisexual; inflorescences globose to umbellate or rarely in reduced corymbs, much shorter than the petioles; shoots glabrous or when tomentose, then with simple trichomes; calyx and corolla glabrous or the corolla sometimes glandular-papilllose along the margin within, anthers cream to white; style obsolete or reduced ............................ Myrse

2. Calyx and corolla quincuncial, imbricate (although sometimes inconspicuously so), contorted or rarely valvate in bud, when valvate, the inflorescence rachis rufous glandular-papillate.

4. Filaments connate basally to form a staminal tube adnate to the corolla tube.

5. Inflorescence lateral (axillary); corolla tube glandular-granulose within at least at the junction of the tube and lobes; staminal tube adnate to corolla at least 1/5 its length ........................................Cybianthus

5. Inflorescence terminal or pseudo-terminal functioning as terminal; corolla tube glandular-puberulent within at base; stamens free from or barely adnate to corolla at base.

6. Anthers connate at least at base; filaments connate in a tube at least 1/2 their length; corolla lobes nearly free ......................... Hymenandra
6. Anthers free; filaments connate less than 1/5 length; corolla lobes
united up to 3/4 their length ........................................ Synardisia
4. Filaments free from each other and free from or variously adnate to
the corolla tube, or filaments basally connate to form a staminal tube not
adnate to the corolla tube.
7. Filaments adnate to the corolla; anthers less than 3 times longer than
wide.
8. Filaments exerted, more than 6 times longer than the anthers; anthers
obcordate; plants of elfin and cloud forests ................................ Gentlea
8. Filaments included, shorter than or as long as the anthers; anthers
ovate, lanceolate, elliptic or oblone; plants of montane to low
land forests ................................................................. Stylogyne
7. Filaments free from the corolla; anthers at least 3 times longer than
wide.
9. Corolla lobes connate 1/4 their length; ovules uniseriate, the placentation
free-central ................................................................. Ctenardisia
9. Corolla lobes nearly free or connate to 1/5 their length; ovules
pluriseriate, the placentation basal ..................................... Ardisia

TAXONOMIC TREATMENT

**Hymenandra** (A. DC.) A. DC. ex Spach, Hist. Veg. Phan. 9:374. 1840; A.


**Subshrubs** to small trees exhibiting Fagerlind’s Architectural Model (Hallé
et al. 1978) up to 8 m tall. Leaves pseudoverticillate, dimorphic; the blades
of the orthotropic trunk or stem (i.e., primary axis) which are vegetative
shoots larger with cuneate bases, those of the plagiotropic branches which
are reproductive shoots basally obtuse to somewhat auriculate. Inflorescence
terminal or pseudoterminal, bi- or tripinnately paniculate, pyramidal or columnar,
the ultimate branches bearing flowers in loose to tight corymbis. Flowers
perfect, bisexual, 5–6-merous, punctate and/or punctate-lineate; calyx lobes
quincuncial, spreading at anthesis, nearly free, mostly papillose but sometimes
hirtellous (Paleotropics) or glabrous (Neotropics), densely and prominently
or conspicuously pellucid or black punctate, the margin glandular-ciliate;
corolla white or pink, the lobes short-connate, quincuncial, lanceolate or oblong
to ovate to narrowly ovate, glabrous or sparsely papillose within toward base,
densely and prominently black punctate or inconspicuously pellucid punctate,
the margin entire, erose or erose-fimbriate, sometimes subapically notched,
glandular-ciliate or glabrous; stamens connate, shorter than the corolla lobes,
the filaments monadelphous, fused basally 2/3 their length and reunited apically, fused basally but with apical portions free, or fused along entire length, adnate basally to the corolla tube, the anthers connate basally for 1/4–2/3, or along entire length along the thecal margins, narrowly oblong, linear-lanceolate or lanceolate, the connectives darkened or prominently black punctate abaxially; pistil obturinate, the ovary ovoid, the style slender, elongate, the stigma punctiform; placenta subglobose, 5–24 ovules, at times appearing uniseriate (but in a high anthotactic spiral), or clearly pluriseriate. **Fruit** 1-seeded, globose or depressed-globose, the exocarp densely and prominently or conspicuously punctate, the style base persistent.

**Distribution.**—A genus of 16 species, from Bangladesh eastward to Myanmar, south to Malaya and Borneo in the Paleotropics; Nicaragua southward through Costa Rica and Panama to the Chocó of Colombia in the Neotropics, from near sea level–1,400 m elevation.

**Ecology.**—Members of *Hymenandra* are subshrubs to small trees in the lowest level of the forest understory, from the lowland to premontane transition to cloud forest, frequently on ridge tops or steep slopes, and near small watercourses. They are at best locally common [see ECOLOGY section].

**Etymology.**—*Hymenandra* is a Greek compound, derived from the words *Hymen*, or membrane, and *androos*, of the anthers, to describe the membranaceous connective tissue joining the anthers at their dehiscence suture.

**KEY TO NEOTROPICAL SPECIES OF HYMENANDRA**

1. Calyx lobes oblong or narrowly oblong to narrowly lanceolate, at least 3–5 times longer than wide at maturity.

2. Calyx lobes shorter than the corolla lobes, 2.3–4.7 mm long, 0.9–1.1 mm wide, the margins erose, hyaline, densely glandular-ciliolate; corolla lobes 5–6.5 mm long ........................................ 1. *Hymenandra stenophylla*

3. Calyx lobes longer than the corolla lobes, 6–9 mm long, (1.6)–2–2.5 mm wide, the margins entire, glabrous; corolla lobes 7–8.2 mm long ........................................ 2. *Hymenandra calycosa*

4. Calyx lobes asymmetric, notched subapically. These terms are used for the following:

5. Subshrubs, 0.2–1 m tall; abaxial leaf surface densely and minutely furfuraceous lepidote, appearing velutinous; stamens 2.6–3 mm long, the anthers apically rounded, apiculate at tip, 1.6–1.8 mm long, 0.8 0.9 mm wide .................................................. 4. *Hymenandra squamata*

6. Trees, 1–8 m tall; abaxial leaf surface glabrous to sparsely and minutely furfuraceous lepidote, not appearing velutinous; stamens 6–9.5 mm long, the anthers apically long attenuate to an acute or cuneate -separated to an acute or cuneate -separated to an acute or cuneate-tip, 5.5–8 mm long, 1.4–2.2 mm wide.
5. Petioles petiolate, prominently lepidote, minutely or apically lepidote, early glabrescent; reproductive shoot blades 3.9–34.3 cm long, 1.2–11.8 cm wide ...................................................... 6. Hymenandra pittieri

4. Calyx lobes symmetric, not subapically notched.

7. Vegetative or flowering shoots 7–10 mm in diam.; petioles (0.6–)1–1.2 cm long; calyx lobes 2–2.8 mm long .............. 7. Hymenandra callejasii

6. Calyx lobes 1.4–1.8 mm long; stamens 6–6.5 mm long; anthers 5.5–5.8 mm long; vegetative shoot leaf blades 5.5–22.2 cm long, 1.3–7.8 cm wide, reproductive shoot leaf blades 7.2–17.3 cm long, 2.1–4.7 cm wide ...................................................... 5. Hymenandra wilburiana

6. Calyx lobes 2.2–2.8 mm long; stamens 8.7–9.5 mm long; anthers 7.5–8 mm long; vegetative shoot leaf blades 33.7–72.2 cm long, 5.3–16.5 cm wide; reproductive shoot leaf blades 3.9–34.3 cm long, 1.2–11.8 cm wide ...................................................... 6. Hymenandra pittieri


Tree 2–6.1 m tall, to 7.5 cm in diam. Trunk and vegetative shoots terete, 7–9.5 mm in diam., minutely scattered furfuraceous lepidote, early glabrescent; reproductive shoots similar, but 1.5–4 mm in diam. Vegetative shoot leaf blades chartaceous, oblong to elliptic, 21.2–30.5 cm long, 5.5–8.5 cm wide, apically long-acuminate, the acumen 1–1.9 cm long, gradually tapering to a cuneate base decurrent to base of petiole, midrib slightly raised above, prominently raised below, secondary veins 22–32 pairs, slightly depressed or not visible above, slightly raised below, prominently punctate, scattered minutely furfuraceous lepidote, early glabrescent, the margins entire, flat; petioles marginate, 0.5–1.5 cm long, minutely scattered furfuraceous lepidote, early glabrescent; reproductive shoot leaf blades similar to the vegetative ones but 6.1–22.5 cm long, 2.1–5.2 cm wide, secondary veins 7–28 pairs; petioles similar to vegetative ones but 0.5–2.2 cm long. Inflorescence terminal, pinnately or bipinnately paniculate 3–10 (–15.5) cm long, pyramidal, secondary branches 0.8–3(–6.2) cm long, minutely scattered furfuraceous lepidote, early glabrescent, the branches ending in 4–8-flowered corymb; inflorescence bracts early caducous, membranaceous, oblong, 5.6–8.8 mm
long, 0.6–1.2 mm wide, apically acute to rounded, midrib slightly raised above and below, secondary veins not visible, prominently punctate, scattered minutely furfuraceous lepidote, the margin entire, flat; floral bracts 0.5–2.2 mm long, 0.3–1.1 mm wide, otherwise as the inflorescence bracts; pedicels cylindrical, 0.6–1.2(–1.6) mm long, scattered minutely furfuraceous lepidote, early glabrescent. Flowers 5-merous, white or rarely pink; calyx lobes almost free, chartaceous, narrowly lanceolate to narrowly oblong, 2.3–4.7 mm long, 0.9–1.1 mm wide, symmetrical, apically very narrowly acute to subulate, densely and prominently black punctate and punctate-lineate, glabrous, the margin irregular, erose, hyaline, sparsely glandular-ciliolate; corolla lobes membranaceous, 5–6.5 mm long, the tube 0.2–0.5 mm long, the lobes lanceolate 4.5–6.3 mm long, 2–2.8 mm wide at base, apically acute, reflexed in anthesis, prominently pellucid punctate, the margins hyaline, entire, glabrous; stamens 3.5–5 mm long; filaments connate throughout their length into a chartaceous eoblate tube, the tube 0.3–0.8 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, lanceolate, 3–4.5 mm long, 0.7–1.1 mm wide at base, sessile on staminal tube, apically apiculate, basally cordate, longitudinally dehiscent by narrow, sublarrose slits, the connective densely and prominently black punctate; pistil obtrunca 5.3–7 mm long; ovary 1.2–1.5 mm long, glabrous; style 3.8–4.4(–5.8) mm long, erect, inconspicuously pellucid punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.4–0.7 mm long, 0.2–0.5 mm in diam., apically apiculate; ovules 13–17, pluri-seriate. Fruit obovoid to globose, 4.8–5.8 mm long, 3.8–4.5 mm in diam., densely and prominently punctate, the style base persistent.

**Distribution.**—Limón, Costa Rica and Bocas del Toro, Panama, from 25–500 m elevation.

**Ecology and conservation status.**—Known only from primary lowland tropical moist forests, collected from the understory along ridgetops, *Hymenandra stenophylla* should be considered threatened.

**Etymology.**—The epithet ‘stenophylla’ comes from the Greek “stenos” meaning narrow, and ‘phylus’ referring to the leaves. It describes the very narrow leaf blades of the taxon.

Specimens examined. COSTA RICA. Limón: Talamanca Valley, without elev., 1927 (ster.), G. Cooper 12 (US); 7 km SW of Bribri, 100–250 m, 4 May 1983 (fl), L. Gómez et al. 20415 (LL, MO); Sitio de exploración petrolera, Sureika, Talamanca, 250 m, 6 Jul 1983 (fr), J. Gómez-Laurito 9538 (F); Headwaters of Quebrada Mara de Limón, central fork, and hills between central and W forks, Finca Anai, Sixaola region, 09° 35' N, 82° 39' W, 25–40 m, 19 Nov 1984 (fr), M. Grayum et al. 4486 (MO, NY); Hitoy Cerere Reserve and vicinity in Valle la Estrella, S of Finca Concepción, from station to top of ridge Miramaror Los Jabillos, 09° 42' N, 83° 02' W, 140–500 m, 1 Aug 1985 (fr), B. Hamnel & M. Grayum 14342 (MO); Reserve Biol. Hitoy-Cerere, near the station, Valle de la Estrella, 09° 40' 30" N, 83° 01' 30" W, 100 m, 20 Sep 1991 (fr), A. Moreno 7 (MO); Forstes de Tsáki, Talamanca, 200 m,
Apr 1895 (fl) A. Tondrez 9586 (G 3-sheets, US). PANAMA. Bocas del Toro: Along oil pipeline road between continental divide and Chiriquí Grande, second bridge over Río Guabo, along dirt access road, 08° 50′–55′ N, 82° 9′–15′ W, 120–200 m, 1–2 May 1985 (fl), B. Hamnel 13717 (MO); Filo Almirante along trail to Risco Abajo, 3 km SW of town of Almirante, 100–200 m, 3 Jan 1975 (fr), M. Nez & B. Hamnel 14099 (MO); Vicinity San San River, Davao Farm, United Fruit Co., Almirante, 26 Aug 1940 (fr), R. Seibert 1572 (MO, US).

_Hymenandra stemophylla_ appears to be most closely related to _H. calycosa_ by virtue of its oblong or narrowly oblong to narrowly lanceolate calyx lobes. However, the erose and sparsely glandular-ciliate calyx lobe margins, the calyx lobes smaller than the corolla lobes, and generally smaller flowers, easily separate the two species.

Populations corresponding to the type of _Ardisia ob lanceolata_ are notable only for the slightly larger and more prominent punctations on the leaves and slightly shorter pedicels. It is otherwise identical to _Hymenandra stemophylla._

2. _Hymenandra calycosa_ (Hemsl.) Pipoly & Ricketson, comb. nov. (Fig. 1A, 3). _Ardisia calycosa_ Hemsl., Biol. Centr.-Amer., Bot. 2:292. 1882. _Chontalesia calycosa_ (Hemsl.) Lundell, Wrightia 7:42. 1982. TYPE. NICARAGUA. CHONTALES: Chontales, without elev., 1867–1868 (fl), R. Tate 239 (454) (HOLOTYPE: K; ISOTYPES: BM, P n.v.).

_Shrub or tree_ 1–4 m tall. _Trunk and vegetative shoots_ terete, 4–7 mm in diam., minutely and densely furfuraceous lepidote at first, early glabrescent; _reproductive shoots_ as in vegetative ones but 1–4 mm in diam., minutely scattered furfuraceous lepidote. _Vegetative shoot leaf blades_ coriaceous, narrowly elliptic, 7.5–20.3 cm long, 2.8–5.2 cm wide, apically long-acuminate, the acumen 0.5–2.2 cm long, gradually tapering to the cuneate base, decurrent to petiole base, midrib slightly raised above, prominently raised below, secondary veins 7–21 pairs, slightly depressed or not visible above, prominently raised below, prominently punctate, glabrous above, minutely scattered furfuraceous lepidote below, early glabrescent, the margins crenate; petioles marginate, 0.2–0.8 cm long, glabrous above, minutely scattered furfuraceous lepidote below, early glabrescent; _reproductive shoot leaf blades_ as in vegetative ones but 7.2–15.7 cm long, 1.6–4.1 cm wide, secondary veins 7–20 pairs; petioles like the vegetative ones but 0.3–0.9 cm long. _Inflorescence terminal_, pinnately or bipinnately paniculate, 4.5–14 cm long, pyramidal, secondary branches 2.7–4.3 cm long, minutely scattered furfuraceous lepidote, early glabrescent, terminating in 3–7-flowered corymb; _inflorescence bracts_ early caducous, membranaceous, oblong, 5.5–9 mm long, 0.7–1.1 mm wide, apically acute, basally sessile, midrib slightly raised above and below, secondary veins not visible, prominently punctate, mostly glabrous above, densely minutely furfuraceous lepidote below, the margins entire, flat; _floral bracts_ similar to _inflorescence bracts_ but lanceolate to narrowly elliptic 2.8–4.1 mm long, 0.4–1.2 mm wide; _pedicels_ cylindrical, 7–15
Fig. 3. *Hymenandra calycosa* (Hemsl.) Pipoly & Ricketson. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower. E. Detail of stamens, showing abaxial (left) and adaxial (right) surfaces. F. Ovules. G. Fruit. A–B drawn from BM isolecotype, *R. Tate* 239 (454). C–F drawn from *M. Chimbilla* 93. G drawn from *R. Villalobos* 37.
mm long, minutely scattered furfuraceous lepidote, early glabrescent. Flowers 5-merous, 6.9–8 mm long; calyx lobes almost free, coriaceous, narrowly lanceolate to lorate, 4.2–9.7 mm long, 1.2–2.1 mm wide, symmetrical, apically acute to rounded, prominently punctate, appearing prominently because of the prominently brown punctations, scattered lepidote outside at the base, the margins entire; corolla lobes basally connate, membranaceous, the tube 1.5–1.8 mm long, elliptic, the lobes 5.4–6.2 mm long, 2.2–2.4 mm wide at the middle, apically acute to acuminate, reflexed in anthesis, prominently pellucid punctate, the margins hyaline, entire, glabrous; stamens 4.8–5.1 mm long; filaments connate into a chartaceous elobate tube, the tube 0.4–0.5 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, lanceolate, 4.5–4.7 mm long, 1.2–1.5 mm wide at the base, sessile on the staminal tube, apically apiculate, basally cordate, longitudinally dehiscent by narrow, sublatrose slit, the connective conspicuously raised, pellucid punctate; pistil oblong 6.5–7.2 mm long; ovary 1.2–1.4 mm long, glabrous; style 5.3–5.8 mm long, erect, epunctate, glabrous; stigma punctiform; placenta ellipsoid, 0.6–0.8 mm in diam., apically apiculate; ovules 11–19, pluriseriate. Fruit ellipsoid, 6.2–7 mm long, 5.2–5.8 mm in diam., nearly epunctate, the style base persistent.

Distribution.—Jinotega, Chontales, Zelaya and Río San Juan, Nicaragua and Alajuela and Guanacaste, Costa Rica. It grows from (10–)450–1,100 m elevation.

Ecology and conservation status.—This species normally occurs in premontane wet forests, especially along ridgetops. The locations where the species has been found are actually premontane even though their absolute elevations are at times quite low. This phenomenon is due to the relative flatness of the Atlantic Slope in Nicaragua, where even elfin forest has been found under 1,000 m elevation. With increasing habitat destruction, and its consequent desertification, Hymenandra calycosa should be considered a threatened species.

Etymology.—The specific epithet refers to the calyx, which is always longer than the corolla and is accrescent in fruit.

Specimens examined. NICARAGUA. Chontales: Cerro Oluma, on ridgeline of Cordillera Americana, 750 m, 4 Jan 1984 (fr), A. Gentry et al. 43939 (DUKE, MO, NY); Cerro Oluma, ca 3 km SW de Ciudad Cuapa, 12° 18' N, 85° 20' W, 700–740 m, 3 Jan 1984 (fl), A. Grijalva et al. 3393 (M); Cerro El Portillo, ca. 3 km al NE de Ciudad Cuapa, 758 m, 1 Mar 1984 (fl, fr), A. Grijalva and D. Bradford 3652 (MO). Jinotega: Kilméb, Cerro San Pedro, 13° 36' N, 85° 39' W, ca. 600–800 m, 25 Mar 1981 (fl), P. Moreno 7532 (MO, NY); Las Brisas, Comarca Kilambe, 13° 35–36' N, 85° 39' O, 930 m, 13 Jul 1980 (fl), J. Sandino 159 (MO, NY). Río San Juan: Boca de Sábalos, trail to Buena Vista, 11° 03' N, 84° 27' W, ca. 70 m, 24 Mar 1985 (fl, fr), P. Moreno 25630 (MO); Sábalos, 1 km al N de Río San Juan, 11° 02' N, 84° 27' W, ca. 100 m, 9–10 Jul 1985 (fr), P. Moreno 26053 (MO); Bocas de Sábalos, 11° 03' N, 84° 27' W, 70–100 m, 14 Mar 1987 (stcr), P. Moreno 26753 (MO). Zelaya: Río Punta Gorda, Atlánta, desembocadura del Caño el Guineo, 11° 33' N, 84°
02° W, ca. 10 m, 11 Nov 1981 (fr), P. Moreno & J. Sandino 12853 (MO). COSTA RICA.

Alajuela: Ca. 3 km NNE of Bijagua along the new road to Upala, 10° 45' N, 85° 03' W, 450 m, 7–8 Nov 1975 (fr), W. Burger & R. Baker 9869 (F); E slopes of Volcán Miravilles, W of Bijagua, near the Río Zapote, 10° 44' N, 85° 05' W, ca. 600 m, 11–12 Feb 1982 (fl), W. Burger et al. 11687 (F, LL, NY); Cataratas (Los Angeles) de San Ramón, without elev., 17 Apr 1925 (fl), A. Brenes 21243 (NY); San Carlos Cantón, Betania de Curtis, 150 m, 26 Feb 1983 (fl), A. Carusuij U. 392 (DUKE, LL, NY); El Silencio de Tilarán, without elev., 31 May 1932 (fl, fr), A. Brenes 15653 (F, NY); Upala Cantón, P.N. Guanacaste, Cordillera de Guanacaste, Estación San Ramón, Dos Ríos, 10° 52' 50" N, 85° 24' 05" W, 550 m, 3 Apr 1995 (fl), M. Chinchilla 93 (MO), 100 (MO); Along road between Canas & Upala 4 km NNE of Bijagua on slopes leading into Río Zapote, ca. 400 m, 24 Jun 1976 (fl), T. Croat 36246 (LL, MO, NY); Upala Cantón, P.N. Guanacaste, Cordillera de Guanacaste, Estación San Ramón, presque en el sendero El Argentino, 10° 52' 40" N, 85° 24' 15" W, 550 m, 22 Mar 1994 (fl), D. Garcia 312 (MO); Santa María National Park, road down Caribbean slope 1 km E of summit of road, 4 km W of E side of park, 4 km E of colored house at junction of road to Hacienda Santa María, 10° 37' N, 85° 17' W, ca. 600 m, 7 Feb 1978 (fl), R. L.ieser 5066 (LL, MO, NY); 2 km N of Santa Rosa, 15 km N of Boca Arenal on Quesada-Muelle San Carlos-Lches road, 10° 38' N, 84° 31' W, ca. 100 m, 28 Apr 1983 (fl), R. L.ieser et al. 15041 (MO); Upala Cantón, P.N. Guanacaste, Cordillera de Guanacaste, Estación San Ramón, sendero El Argentino, camino al Volcán Cacao, 10° 53' 50" N, 85° 24' 29" W, 850 m, 27 Feb 1996 (fl), J. Morales 5305 (MO); Moravia de Curtis-San Carlos, without elev., without date (spec.), L. Poredat et al. 3681 (F); Cantón San Carlos, Cuenca de Pocosol, Escaleras, 20 km después de Pavón, Finca Elky María, 10° 52' 30" N, 84° 30' 25" W, 100 m, 16 Mar 1997 (fl), A. Rodríguez & N. Zamora 2067 (CR, F, INB, MO); Villa Quesada, 850 m, 21 Feb 1939 (fl), A. Smith 1630 (F, GH, MICH, NY), 1726 (F, MICH), 2609 (F, MO); On the slope of Volcán Rincón de la Vieja, along the road N from Liberia, ca. 5 km from the park, 400–700 m, 1 Mar 1985 (fl), C. Taylor 4551 (DUKE, LL-frag. of DUKE); 2 km N of Bijagua along roadside and on trail to San Miguel or 7 km N of Río Naranjo, 400–500 m, 8 Jul 1976 (fl), J. Utley & K. Utley 5318 (DUKE). Alajuela-Guanacaste Border: Border region on the slopes of Volcán Miravalles, along road N of Bagaces, from Guayabo to Aguas Claras, 400–600 m, 2 Mar 1985 (fl, fr), C. Taylor & C. Skotak 4630 (DUKE). Guanacaste: La Cruz Cantón, Parque Nacional Guanacaste, Cordillera de Guanacaste, Estación Pittilla, Sederó los Memos, 10° 59' 26" N, 85° 25' 40" W, 740 m, 15 Apr 1995 (fl, fr), E. Alfaro 169 (MO); Liberia Cantón, Parque Nacional Guanacaste, Cordillera de Guanacaste, Nueva Zelandia, Estación San Ramón, 10° 52' 50" N, 85° 24' 05" W, 550 m, 23 Mar 1994 (fl, fr), D. García 112 (MO); Tilarán, ridge above town ca. 2.5 mi, without elev., 6 Oct 1971 (fr), A. Gentry 2011 (LL, MO); Ridge to N of Rio Las Flores, ca. 1 km E of Río Tenorio, Hacienda Montezenia, 10° 40.5' N, 85° 04.5' W, 475–500 m, 24 Jan 1985 (fr), M. Grayum & G. Herrera 4852 (MO); Forest along Río San Juan, lower W Pacific slopes of Volcán Tenorio, Hacienda Montezenia, 10° 40.5' N, 85° 03' W, 600–700 m, 25 Jan 1985 (fl), M. Grayum et al. 4969 (LL, MO); El Dos de Tilarán, 4 km N, Cerro La Chirripa, Atlantic slope, 10° 25' N, 84° 50' W, 1,000 m, 12 Apr 1986 (fl, fr), W. Haber et al. 4430 (MO), 4432 (LL), 4447 (MO); La Chirripa ridge, 4 km NE El Dos de Tilarán, continental divide, 10° 25' N, 84° 53' W, 1,000 m, 8 May 1986 (fl), W. Haber et al. 4732 (MO), 4759 (MO), 4848 (MO); Tilarán, Río Chiquito de Quebrada Grande, Zona Monteverde, Finca López, Vertiente Atlántica, 10° 25' N, 84° 53' W, 700–900 m, 6 Jun 1987 (fl), W. Haber & E. Bello C. 7433 (MO); Parque Nacional Guanacaste, Estación Pittilla, camino al E de la Estación, 11° 02' N, 85° 25.3' W, 600 m, 24 May 1989 (fl, fr), B. Hummel et al. 17370 (BRIT, MO); Santa Cecilia, La Cruz, Estación pitilla, Faldas Cerro Oroasilbo, 10° 57' N, 83° 28' W, 700 m, 14 Jun
1989 (fl), Q. Jiménez et al. 709 (BRIT, MO); Santa Elena to Tilarán road, ca. 24 km from Santa Elena, ca. 1,000 m, 17 Feb 1984 (fl, fr) Khan et al. 1141 (BM 2-sheets); Liberia Cantón, Parque Nacional Guanacaste, Cordillera de Guanacaste, Estación Cacao, El Cañón, 10° 55' 43" N, 85° 28' 10" W, 1,100 m, 10 Feb 1995 (fr), Al. Lobo 47 (MO); Estación pitilla, La Cruz, Parque Nacional Guanacaste, 10° 59' 26" N, 85° 25' 40" W, 700–1,000 m, 7 Nov 1990 (fr), C. Moraga 214 (MO); Liberia Cantón, Parque Nacional Guanacaste, Cordillera de Guanacaste, Nueva Zelandia, Estación San Ramón, sendero al Volcán Cacao, 10° 53' 50" N, 85° 29' 29" W, 850–950 m, 23 Mar 1994 (fl), J. Morales et al. 2544 (MO); Forest at top of divide, 4 km NW of Tilarán, without elev., 27 Feb 1972 (fl), P. Opler 580 (F); Liberia Cantón, Parque Nacional Guanacaste, Cordillera de Guanacaste, Estación Cacao, Sendero Nayo, 10° 55' 43" N, 85° 28' 10" W, 1,000 m, 9 Feb 1995 (fl), A. Picado et al. 51 (MO); Hacienda Tenorio, without elev., 17 Feb 1956 (fl), B. Schubert 1079 (A, F); El Silencio, near Tilarán, ca. 450 m, 13 Jan 1926 (fl), P. Standley & J. Valerio 45539 (US), 45545 (US); La Tejona, N of Tilarán, 600–700 m, 25 Jan 1926 (fr), P. Standley & J. Valerio 45862 (US); Quebrada Serena, SE of Tilarán, ca. 700 m, 27 Jan 1926 (fl), P. Standley & J. Valerio 46181 (US), 46221 (US); El Silencio, 800 m, 15 Aug 1923 (fr), J. Valerio 147 (F); Liberia Cantón, Parque Nacional Guanacaste, Cordillera de Guanacaste, Estación Cacao, Cerro Cacao, 10° 55' 43" N, 85° 28' 10" W, 1,100 m, 8 Feb 1995 (fl, fr), R. Villalobos 37 (MO).

**Hymenandra calycosa** is closely related to *H. sternophylla*, but is very easily recognized by the calyx lobes entire, longer than the corolla and accrescent in fruit, larger corollas and crenate leaf margins.


Subshrubs 0.4–1 m tall. Vegetative shoots unknown; reproductive shoots terete, 4–7 mm in diam., densely appressed furfuraceous lepidote. Vegetative shoot leaves unknown; reproductive shoot leaf blades chartaceous, elliptic to oblanceolate, 16–29.5 cm long, 4.5–10.8 cm wide, apically acuminate, the acumen 0.5–1.8 cm long, basally attenuate, the midrib depressed above, prominently raised below, the secondary veins 35–70 pairs, slightly depressed or not visible above, prominently raised below, abaxially densely appressed furfuraceous lepidote along and near the midrib, adaxially glabrous, the margin entire, inrolled; petioles marginate, 0.5–2.1 cm long, glabrous above, densely appressed furfuraceous lepidote below. Inflorescence terminal, pinnately or bipinnately paniculate, 4.2–10.5 cm long, a columnar panicle of 7–14-flowered corymb, appearing racemose in fruit, secondary branches 0.5–2.3 cm long, the rachis densely appressed furfuraceous lepidote, glabrescent; inflorescence bracts early caducous, membranaceous, lanceolate, 1.4–2.8 cm long, 2.2–4.4 mm wide, sessile, midrib slightly raised above and below, secondary veins obscure to not visible above and below, scattered furfuraceous lepidote to mostly glabrous below, densely appressed furfuraceous lepidote below,
the margins entire, ciliolate; floral bracts 1.1–1.7 mm long, 0.3–0.5 mm wide, otherwise as in the inflorescence bracts; pedicels cylindrical, 5.5–8.7 mm long, scattered to densely appressed furfuraceous lepidote, glabrescent with age, persistent. Flowers pendent, 5-merous, reddish-violet; calyx lobes almost free, chartaceous, suborbicular, 1.9–2.2 mm long, the lobes 1.2–1.5 mm long, 1–1.2 mm wide, asymmetric, apically rounded, subapically notched, conspicuously black punctate medially, sparsely furfuraceous lepidote, glabrescent, the margin irregular, somewhat erose, hyaline, densely glandular-cilioate, glabrescent; corolla lobes connate basally, membranaceous, lanceolate, 3.2–3.7 mm long, the lobes 2.3–2.5 mm long, 1.2–1.5 mm wide near the base, apically acute, reflexed in anthesis, conspicuously, black punctate, the margin erose, hyaline, entire, glabrous; stamens 2.4–2.5 mm long; filaments connate into a chartaceous elongate tube, the tube 1.0–1.1 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, ovate, 1.4–1.7 mm long, 0.7–0.9 mm wide at base, sessile on the staminal tube, apically apiculate, basally cordate, longitudinally dehiscent by narrow, subulate rose slits, the connective conspicuously reddish punctate; pistil obturinate, 2.8–3.8 mm long; ovary 0.5–0.6 mm long, glabrous; style 2.3–3.2 mm long, erect, inconspicuously black punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.1–0.3 mm long, 0.1–0.15 mm in diam., apically apiculate; ovules 6–9, pluriserial. Fruit depressed-globose, 6–6.5 mm long, 6.5–7.5 mm in diam, inconspicuously black punctate, the style base persistent.

**Distribution.**—Alajuela and Guanacaste Provinces, Costa Rica, from 500–1,200 m elevation.

**Ecology and conservation status.**—_Hymanandra sordida_ is a ridgetop species, known only from primary and mildly disturbed cloud forests, and should thus be considered threatened.

**Etymology.**—The epithet comes from the Latin word 'sordidus', meaning dirty, soiled or ugly.

Specimens examined. **COSTA RICA.** Alajuela: Reserva Biológica Monteverde Río Peñas Blancas, Laguna Poco Sol, 10° 21' N, 84° 40' W, 500–800 m, 6 Aug 1989 (fl), E. Bello C. 1039 (MO); San Carlos, San Miguel de San Isidro, 600 m, 29 Jun 1985 (fl), W. Haber & E. Bello C. 1714 (MO); Peñas Blancas river valley NE of San Carlos, along road from Jabillos, 10° 22' N, 84° 38' W, 650 m, 29 Jun 1985 (fl), B. Hammel et al. 14078 (MO); Cantón de Upala, Bijagua, Finca Montezuma, Ladera Sur de Cerro Montezuma, 10° 41' 10" N, 85° 03' 40" W, 600 m, 18 Jul 1993 (fl), G. Herrera 6279 (F, K, MO); 15 km NW of Arenal by air, 2 km NW of Nuevo Arenal on road to Tilarán, then 3 km NE on road to San Rafael de Guatuso, then 2 km W on road to Finca Cote, then 2.5 km W on road to Finca Cote, then 2 km N of 34.5' N, 84° 54' W, 700 m, 30 Apr 1983 (fl), R. Lieuen et al. 15108 (MO); Near La Laguna, 6–8 km S of Villas Quesada, 1,200 m, 19 Feb 1966 (fr), A. Molina R. et al. 17525 (F). **Guanacaste:** Parque Nacional Guanacaste, La Cruz, 9 km al S de Santa Cecilia Estación Piríl, 10° 59' 26" N, 85° 25' 40" W, 700 m, 13 Sep 1990 (fl), C. Chávez 71 (MO); Parque Nacional Guanacaste, Estación Pitilla y Sendero
El Mismo, 10° 59' 26" N, 85° 25' 40" W, 700 m, 15 Jun 1991 (fr), R. Ríos 374 (INB, MO); Parque Nacional Guanacaste, Cordillera de Guanacaste, Estación Pitilla, Santa Cecilia, 9 km S, 10° 59' 00" N, 85° 25' 40" W, 700 m, 20 Aug 1993 (fr), V. Ramírez et al. 62 (BRIT, CR, INB, MO); N slopes of the Volcán Orosí along lower reaches of broad ridge running to the N, 650 m, 18 Jan 1968 (fr), R. Wilbur & D. Stone 9745 (LL).

_Hymenandra sordida_ appears to be most closely related to _H. squamata_ but may be immediately distinguished by the columnar shape of the panicle, and the larger sepals with merely erose (not erose-fimbriate) margins.


Subshrubs 0.2–1 m tall. Trunk and vegetative shoots terete, 3–5 mm in diam., densely appressed furfuraceous lepidote, glabrescent; reproductive shoots 1–2.5 mm diam., densely and minutely appressed furfuraceous lepidote, persistent. Vegetative shoot leaf blades membranaceous, elliptic, 7.4–22.4 cm long, (1.2–)3.5–6.9 cm wide, apically short to long-acuminate, the acumen 0.9–1.9 cm long, basally attenuate, midrib depressed above, prominently raised below, secondary veins 18–26 pairs, slightly depressed or not visible above, prominently raised below, densely appressed furfuraceous lepidote along and near the midrib below, appearing velutinous, glabrous above, the margin entire, inrolled; petioles marginate, 0.4–1.1 cm long, glabrous above, densely appressed furfuraceous lepidote below; reproductive shoot leaf blades similar to the vegetative ones but (3–)9.0–13.5 cm long, (0.9–)2.2–3.5 cm wide, the acumen 0.6–1.1 cm long, basally obtuse; petioles like those of the vegetative but 0.2–0.6 cm long. Inflorescence terminal, pinnately or bipinnately paniculate, 1.4–5.2 cm long, pyramidal, secondary branches 0.6–1.8 cm long, the rachis densely appressed furfuraceous lepidote, glabrescent, terminating in 5–14-flowered corymb; inflorescence bracts early caducous, membranaceous, lanceolate, 5.7–8.1 (–20.2) mm long, 2.4–3.9 mm wide, apically acute, sessile, midrib slightly raised above and below, secondary veins obscure to not visible above and below, scattered furfuraceous lepidote to mostly glabrous below, densely appressed furfuraceous lepidote below, the margins entire, ciliolate; floral bracts like the inflorescence ones but reduced in size, 0.9–2.4 mm long, 0.2–0.8 mm wide, apically subulate; pedicels cylindrical, 4.1–6.9 mm long, scattered, appressed furfuraceous lepidote, usually persistent with age, persistent. Flowers 5-merous, reddish-violet; calyx chartaceous, suborbicular, 2–2.2 mm long, the tube 1–1.1 mm long, the
Fig. 5. *Hyemenandra squamata* (Lundell) Pipoly & Ricketson. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Lepidote scale from above and from the side. D. Detail of inflorescence. E. Detail of flower. F. Detail of stamens, showing abaxial (left) and adaxial (right) surfaces. G. Ovules. H. Fruit. A–G drawn from MO isotype, W. Burger & R. Stolze 5853. H drawn from M. Grayum & G. Herrera 7857.
lobes almost free 1–1.2 mm long, 0.9–1.1 mm wide, asymmetric, apically rounded, subapically notched, prominently black punctate medially, sparsely furfuraceous lepidote, glabrescent, the margin irregular, minutely erose-fimbriate, hyaline, densely glandular-cilioate; corolla membranaceous, 4.2–4.4 mm long, the tube 1–1.2 mm long, the lobes connate basally, lanceolate 3–3.2 mm long, 1.2–1.3 mm wide near the base, apically acute, reflexed in anthesis, prominently black punctate, the margin erose, hyaline, glabrous; stamens 2.6–3 mm long; the filaments connate into a chartaceous elongate tube, the tube 1–1.2 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, ovate, 1.6–1.8 mm long, 0.8–0.9 mm wide at base, sessile on the staminal tube, apically apiculate, basally cordate, longitudinally dehiscent by narrow, subblatrorose slits, the connexive prominently reddish punctate; pistil obturinate, 2.1–3.4 mm long; ovary 0.5–0.7 mm long, glabrous; style (1.6–)2.5–2.7 mm long, erect, inconspicuously black punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.1–0.3 mm long, 0.1–0.15 mm in diam., apically apiculate; ovules 7–10, pluriseriate. Fruit depressed-globose, 4.5–6 mm long, 5.5–6.8 mm in diam, conspicuously black punctate, the style base persistent.

Distribution.—Provinces of Heredia, Limón and San José, Costa Rica, at 90–1,400 m elevation.

Ecology and conservation status.—Hymenandra squamata is known only from the swamp forests of the Atlantic drainage in Costa Rica. It occurs just above the high water level. Because these forests yield high volumes of timber, the species should be considered under threat.

Etymology.—The epithet comes from the Latin “squamatus” which means “provided with scales,” referring to the scales of the shoots and leaf blades.

Specimens examined. COSTA RICA. Heredia: Between Río Peje and Río Sardinalito, Atlantic slope of Volcán Barva, 10° 17' N, 84° 04.5' W, 800–1,000 m, 7 Apr 1986 (fr), M. Grayum & R. Chazdon 6853 (MO); Finca La Selva, the OTS Field Station on the Río Puerto Viejo just E of its junction with the Río Sarapiquí, along E River Road near Holdridge Trail, ca. 100 m, 15 May 1978 (fl), M. Grayum 1303 (DUKE); Finca la Selva, Puerto Viejo de Sarapiquí, along Quebrada El Taconazo, Between Quebrada El Sura and W boundary Trail, without elev., 15 Aug 1979 (fr), M. Grayum 2371 (DUKE); Parque Nacional Braulio Carrillo, 10° 15.5' N, 84° 05' W, 1,200–1,400 m, 13 Nov 1986 (fr), M. Grayum & G. Herrera 7857 (MO); Finca la Selva, Puerto Viejo de Sarapiquí along Quebrada El Santo, Hartshorn Trail, ca. 100 m, 17 May 1980 (fl), B. Hammel 8693 (DUKE), 22 May 1980 (fl), B. Hammel 8762 (DUKE); La Selva, on Río Puerto Viejo just E of its junction with Río Sarapiquí, Central Trail, 1,500 m S of edge of Trail, 100 m, 7 Jul 1981 (fr), B. Hammel 10962 (DUKE); La Selva, just E of junction of Río Puerto Viejo and Río Sarapiquí, ca. 100 m, 20 May 1982 (fl), B. Hammel 12372 (DUKE, LL), 7 Jun 1982 (fl), B. Hammel & J. Trainer 12757 (DUKE, LL); Finca La Selva, El Swampo, 600 m, 16 Jun 1984 (fl), B. Jacobs 2377 (DUKE); La Selva, Sendero El Peje, ca. 2,800 m line E-W, ca. 100 m, 18 May 1985 (fl), B. Jacobs 3113 (DUKE); 9 km SE of San Ramín, 10° 16' N, 84° 05' W, 1,000 m, Sep 1985 (fr), B. Loiselle 144 (MO); La Selva, near Puerto Viejo, along line B, 90 m, 29 May 1971
Hymenandra squamata is very closely related to *H. cordida*, but easily separated by it from the smaller, minutely erose-fimbriate calyx lobes, the pyramidal panicle and the dense furfuraceous lepidote tomentum, appearing velutinous.


*Auriculardisus sarapiiquiensis* Lundell, Phytologia 63:74. 1987. **Syn. nov.** *Ardisia sarapiiquiensis* (Lundell) Lundell, Phytologia 63:463. 1987. **Type.** COSTA RICA. **Heredia:** Finca La Selva, the OTS Field Station on the Río Puerto Viejo just E of its junction with the Río Sarapiquí, in forest on ridge at SW corner of new property, ca. 100 m, 20 Jul 1982 (fl), B. Hammel & J. Trainer 13262 (holotype: LL; isotype: DUKE).

Tree 1–7 m tall, trunk to 3 cm in diam. **Vegetative shoots** terete, 4–6 mm in diam., minutely scattered furfuraceous lepidote below, densely furfuraceous apically at least when young; **reproductive shoots** similar to vegetative ones but 1.5–3.5 mm in diam. **Vegetative shoot leaf blades** coriaceous, elliptic to oblong, 5.5–22.2 cm long, 1.3–7.8 cm wide, apically acuminate, the acumen 2–3 cm long, basally acute, midrib slightly raised above, prominently raised below, the secondary veins 11–19 pairs, slightly depressed or not visible above, prominently raised below, minutely scattered furfuraceous lepidote along the midrib below and on the blade below, glabrescent with age, the margin entire, flat; petioles marginate, 0.5–2.2 cm long, glabrous above, scattered and minutely furfuraceous lepidote below; **reproductive shoot leaf blades** as in the vegetative except 7.2–17.3 cm long, 2.1–4.7 cm wide, secondary veins 9–15 pairs; petioles as in vegetative ones but 0.3–1.3 cm long. **Inflorescence** terminal, pendent, pinnately or bipinnately paniculate, 7–16.5 cm long, pyramidal, secondary branches 4–6.5 cm long, the rachis
minutely scattered furfuraceous lepidote, glabrescent, terminating in 6–12-flowered corymbs; inflorescence and floral bracts unknown (presumably early caducous); pedicels cylindrical, 6.8–13.2 mm long, scattered furfuraceous lepidote, persistent. Flowers 5-merous, white; calyx lobes essentially free, chartaceous, suborbicular, 1.4–1.8 mm long, 1.6–2 mm wide, asymmetric, notched below the apex, apically obtuse, prominently black punctate medially, sparsely furfuraceous lepidote, the margin irregular, minutely erose, hyaline, densely glandular-cilicate; corolla lobes basally free, membranaceous, lanceolate, 5.5–6.5 mm long, 1.4–1.6 mm wide near the base, apically acute, reflexed in anthesis, prominently pellucid punctate without, sparsely so medially within, the margin erose, hyaline, glabrous; stamens 6–6.5 mm long; filaments connate into a chartaceous ebble tube, the tube 1.4–1.9 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, lanceolate, 5.5–5.8 mm long, 1.9–2.2 mm wide at base, sessile on the staminal tube, apically apiculate, basally corolate, longitudinally dehiscent by narrow, sublatrose slits, the connective conspicuously brown or pellucid punctate; pistil obturate, 5.7–6.5 mm long; ovary 1.5–1.8 mm long, glabrous; style 4.2–4.7 mm long, erect, inconspicuously pellucid punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.4–0.5 mm long, 0.2–0.3 mm in diam., apically apiculate; ovules 16–20, pluriseriate. Fruit subglobose, 7–8 mm long, 6–6.5 mm in diam., at times with noticeable longitudinal costae, densely and prominently punctate, the style base persistent.

Distribution.—Río San Juan, Nicaragua to Heredia and Limón, Costa Rica, from 0–700 m elevation.

Ecology and conservation status.—Hymenandra wilburiana is a ridgetop species in the lowland to premontane wet forest transition areas. It has a rather restricted distribution, but not enough is know of its population dynamics to determine its conservation status.

Etymology.—The species is named for Dr. Robert L. Wilbur, professor of botany at Duke University, expert in Mesoamerican Ericaceae and long-time student of the flora of the La Selva OTS station in Costa Rica.

Specimens examined. NICARAGUA: Río San Juan: Near Caño Chontaeño, 20 km NE of El Castillo, 200 m, 18–21 Apr 1978 (fr), D. Neill & P. Vinelli 3506 (MO, NY). COSTA RICA: Heredia: Sarapiquí Cantón, trail between Canta Rana Camp and Río Peje, Magsasay, 400 m, 14 Jan 1983 (fr), I. Chacón 80 (MO); Finca La Selva, on Río Puerto Viejo just E of its junction with Río Sarapiquí. Fila Río Peje, along the line at 3,600–2,200 m, 100 m, 21–22 Apr 1983 (fr), I Chacón 717 (DUKE); N of Puerto Viejo, 10 km down road, then 7–8 km W, without elev., 2 Feb 1983 (fr), N. Garrett et al. 936 (MO); Finca El Bejuco, S base of Cerros Sardinal, Chilamate de Sarapiquí, 10° 27′N, 84° 04′W, 70–100 m, 2 Jun 1985 (fr), H. Gray & B. Jacobs 5352 (BRIT, LL, MO); Sarapiquí Cantón, Parque Nacional Braulio Carrillo, Estación Magsasay, 10° 22′ 03″N, 84° 03′ 00″W, 200 m, B. Hummel et al. 17829 (BRIT, F, MO); Finca La Selva, Sendero El Peje, 3,200 m–1,600 m on line along
ridge, ca. 100 m, 28 May 1985 (fr), B. Jacobo 3189 (DUKE); Sarapiqui Cantón, Horquetas, Estación El Plástico, 15 km de Horquetas, Sendero el Tigre, 10° 17' 03" N, 84° 02' 47" W, 700 m, 11 Jan 1994 (fr), J. Sánchez et al. 308 (E, F); Sarapiquí Cantón, Zona Protectora La Selva, 6 km by road from Río Peje crossing, 5 km SSE of Magsasay, E from basecamp ridge above Río Peje, then S, 10° 21' N, 84° 03'-04' W, 300-500 m, 14 Jan 1983 (fr), G. Schatz & M. Grayum 599 (DUKE); 500 m, 19 Jan 1983 (fr), G. Schatz & M. Grayum 653 (DUKE, LL). Limón: SW-most ridge of Cerro Coronel, NW-facing slope, just S of the Río Colorado, 10° 40' N, 83° 39' 30" W, 10-80 m, 17–18 Sep 1986 (fl), G. Davide & G. Herrera 31739 (MO); Parque Nacional Tortuguero, Estación Agua Fría, ca. 7 km al SE Cerro Azules, 10° 27' N, 83° 34' W, 70 m, 21 Jan 1988 (fr), R. Robles 1571 (MO, US); Parque Nacional Tortuguero, Estación Agua Fría, ca. 12 km al NE, on other side of Río Pueblo Nuevo, over the Lomas de Sierpe, 10° 26' N, 83° 32' W, 80–100 m, 2 Mar 1988 (fr), R. Robles 1666 (MO); Cerro Coronel, E of Río Zapote, 10° 40' N, 83° 40' W, 10–100 m, 24 Jan 1986 (fr), W. Stevens 23977 (MO); Cerro Coronel, E of Laguna Danto, 10° 41' N, 83° 38' W, 20–170 m, 15–20 Sep 1986 (fl), W. Stevens & O. Montiel 24432 (MO); Cerro Coronel, along ridge from E of Laguna Danto SW toward hills E of Río Zapote, 10° 40–41' N, 83° 38–39' W, 30–170 m, 17 Mar 1987 (fr), W. Stevens et al. 24972 (MO).

_Hymenandra wilburiana_ is most closely related to _H. pitteri_ but may be distinguished by the much shorter perianth and androecial parts, smaller leaves and much thinner stems.

Populations corresponding to the type of _Auriculardisia sarapiquiensis_ are notable only for their slightly smaller inflorescence and slightly smaller leaves. The types of _Hymenandra wilburiana_ and _Auriculardisia sarapiquiensis_ were both collected at the Finca La Selva OTS Station.


Tree (0.9–2)–5–(8) m tall, 2–8 cm in diam. Vegetative shoots terete, 7–24 mm in diam., minutely scattered furfuraceous lepidote, glabrescent; reproductive shoots as in the vegetative but 2–9 mm in diam. Vegetative shoot leaf blades coriaceous, obovate to oblanceolate, 33.7–72.2 cm long, 5.3–16.5 cm wide, apically acute to rounded, gradually tapering to a cuneate base, decurrent to near the petiole base, midrib slightly raised above, prominently raised below, secondary veins 24–41 pairs, prominently raised above and
below, prominately punctate above and below, glabrous above, minutely scattered furfuraceous lepidote below, glabrescent, the margin regular, entire, flat; petioles marginate 1.8–4.7 cm long, glabrous above, minutely scattered furfuraceous-lepidote below; reproductive shoot leaf blades similar to the vegetative but 3.9–34.3 cm long, 1.2–11.8 cm wide, secondary veins 20–36 pairs, basally tapering to a rounded base appearing auriculate; petioles similar to the vegetative ones but 0.4–1.1 cm long. Inflorescence subterminal, pinately or bipinnately paniculate, (7–)12–30(–36) cm long, pyramidal, secondary branches 3.5–12.5 cm long, the rachis densely and minutely furfuraceous tomentose, terminating in 8–13-flowered corymb; inflorescence bracts early caducous, membranaceous, oblong, 7–13.5 mm long, 3.4–4.6 mm wide, apically acute to rounded, basally sessile, midrib slightly raised above and below, secondary veins not visible, prominently punctate, densely and minutely furfuraceous tomentose, the margin entire, flat; floral bracts 1.7–2.8 mm long, 1.1–2.1 mm wide, otherwise as in the inflorescences bracts; pedicels cylindrical, 7.5–14 mm long, densely and minutely furfuraceous tomentose. Flowers 5-merous, pink; calyx lobes almost free, chartaceous, suborbicular, 2.2–2.8 mm long, 2–2.4 mm wide, asymmetrical, subapically notched, apically obtuse to broadly rounded, prominently punctate, densely and minutely furfuraceous tomentose, the margin, irregular, minutely erose, hyaline, sparsely glandular-ciliolate; corolla lobes basally free, chartaceous, ovate to lanceolate, 9–10.5 mm long, 4–4.7 mm wide, apically acute, reflexed in anthesis, prominently pellucid punctate on both surfaces, the margin hyaline, entire, glabrous; stamens 8.7–9.5 mm long; filaments connate into a coriaceous eolobate tube, the tube 1.2–1.5 mm long, free from the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, lanceolate, 7.5–8 mm long, 1.4–1.7 mm wide at base, sessile on the staminal tube, apically acute, at times with a minute emarginate tip, basally cordate, longitudinally dehiscent by narrow, sublateral slits, the connective inconspicuously pellucid to black punctate; pistil 6.8–8.4 mm long; ovary 1.8–2.2 mm long, glabrous; style 5–6.2 mm long, erect, inconspicuously punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.9–1.1 mm long, 0.8–0.9 mm in diam., apically apiculate; ovules 14–16, pluriseriate. Fruit globose, 0.7–1.6 cm in diam., densely and prominently black punctate, the style base persistent, the exocarp thick, juicy, bright red.

Distribution.—Limón, Cartago, San José and Puntarenas, Costa Rica and Coclé, Colon and San Blas, Panama, from 50–1,300 m elevation.

Ecology and conservation status.—Hymenandra pittieri is an understory tree along ridgetops in lowland and premontane wet forest. Throughout its range, this species is locally common and is not threatened at this time.

Etymology.—This species is named for Dr. Henri Pittier, early explorer in
Central America but also known for his work in South America and particularly, for establishing the Herbario Nacional de Venezuela.

Specimens examined. COSTA RICA. Cartago: Along Camino Raúz de Hule, SE of Platanillo (Tsipiiri), 1,200–1,400 m, 1 Jul 1976 (fl), T. Croot 36705 (LL, MO); 24 km NE of Turrialba on hwy. to Limón, then E at Tres Equis on jeep road 1.5 km, 09° 58' N, 83° 34' W, 450–525 m, 10 May 1983 (fl), R. Liener et al. 15348 (MO); Pavones, Turrialba, 650 m, 18 May 1972 (fl), L. Póveda 106 (MO). Limón: Near the Río Catarata (Río Sand Box) in the hills between Bri on the Río Sisaloa and the Caribbean coastal plain, 09° 37' N, 82° 49' W, 50–100 m, 28–29 Nov 1975 (fr), R. Baker & W. Burger 126 (F). Puntarenas: Cantón de Osa, Refugio Nacional Golfo Dulce, Peninsula de Osa, Bahía Chal, entrance to Chocuaco, 08° 43' 00" N, 83° 34' 50" W, 200–350 m, 2 Nov 1994 (fr), R. Aguilar et al. 3663 (MO); Region between Río Esquinas & Palmar Sur de Osa, sea level, 30 Jan 1951 (fr), P. Allen 5828 (F), 75 m, 2 Feb 1951 (fr), P. Allen 5828A [sic] (F), 60 m, 18 Feb 1953 (fl), P. Allen 6726 (F); Cantón de Coto Brus, P1. La Amistad, Cordillera de Talamanca, Las Cruces, 08° 47' 20" N, 82° 58' 30" W, 1,200–1,300 m, 30 Jun 1995 (fr), L. Angulo 394 (MO); Forested slopes E of Las Cruces and 5–6 km S of San Vito on and around the property of Mr. Robert Wilson, 8° 47' N, 82° 58' W, 1,100–1,200 m, 15–16 Jan 1967 (fr), W. Burger & G. Matta U. 4406 (F); Original forest ca. 10 km SE of Palmar Norte along the Interamerican Hwy., to Panama, 08° 54' N, 83° 02' W, 20 m, 26 Jan 1967 (fl), W. Burger & G. Matta U. 4644 (F, G); Cantón de Osa, Rincon, Fila Casa Loma, 08° 43' N, 83° 32' W, 50–400 m, 22 Jul 1990 (fr), A. Chacón 934 (MO); Quebradas Pastora, Area y Pintadora, Fila Esquinas-Osa, without elev., Nov 1983 (fr), I. Chacón & G. Herrera 1758 (MO); Along Río Jaba S of San Vito de Coto Brus, 08° 47' N, 82° 58' W, 1,150 m, 1 Jul 1984 (fr), M. Grzymal et al. 3369 (MO); Refugio Nacional Golfito, both slopes of Fila Gamba and along crest of same, to ca. 0.7 km N of Golfito-Villa Briceño road, 08° 40.5' N, 83° 12' W, 160–260 m, 11 Dec 1988 (fr), M. Grzymal & G. Herrera 9200 (MO); Palmar Norte to Chacarita, along Interamerican Hwy., ca. 2 km N of Chacarita, 08° 48' N, 83° 18' W, 50 m, 25 May 1986 (fr), B. Humnel et al. 15186 (MO); Alto La Palmera, Carretera Panamericana, 950 m, 28 Feb 1966 (fr), A. Jiménez (DUKE, F); Cantón de Osa, Rancho Quemado, sector E, Sierpe, 08° 40' 20" N, 83° 35' 15" W, 500 m, 6 Nov 1991 (fr), J. Martín et al. 257 (MO); Finca las Cruces, along road to stream below OTS field station, without elev., 10 May 1973 (fl), B. McAlpine 2250 (DUKE); Cantón de Osa, Camino a la toma de agua, Rancho Quemado Rincón, 08° 42' N, 83° 34' W, 200 m, 9 Dec 1990 (fr), F. Quevedo 320 (MO); Wilson’s finca, 6 km S of San Vito de Java, 4,000 ft [1,219 m], 16 Aug 1967 (fr), P. Raven 21829 (F 2-sheets, MO); Golfito, Parque Nacional Esquinas, margins of Quebrada Gamba, 08° 40' 30" N, 83° 12' 20" W, 70 m, 29 Sep 1995 (fr), J. Sánchez 565 (CR, F); San José: Cantón de Pérez Zeledón, Tinamastre, Swiss farm, 09° 17' 40" N, 83° 46' 00" W, 1,000 m, 12 Jun 1997 (fr), D. Argüello M. et al. 11 (CR, F, MO, NY); Valley of the Río Hondura, below La Palma, NE of San Jerónimo, 10° 3' N, 83° 58' W, 1,000 m, 15 May 1968 (fl), W. Burger & R. Stude 3738 (F, MO); El General Valley, vicinity of San Isidro El General, Alto San Juan, road to Dominical, 900 m, 28 Feb 1966 (fl, fr), A. Molina R. et al. 18090 (F 2-sheets, NY, US); Z. P. La Cangreja, Santa Rosa de Puriscal, faldas de la Fila La Cangreja, 09° 42' 28" N, 84° 23' 38" W, 500 m, 8 Mar 1993 (fr), J. Morales & Y. Salazar 1195 (MO); Cantón de Acosta, Fila Bustamante, by Fila San Jerónimo, headwaters of Quebrada Colorado, 09° 43' 20" N, 84° 16' 45" W, 1,040 m, 29 May 1994 (fr), J. Morales & V. Ureña 2852 (INB-2 sheets, MO 2-sheets); Cantón de Amíridib, Fila Bustamante, Zoncuano, faldas Sur de Fila Zoncuano, ca. del Río Pariritilla, 09° 42' 02" N, 84° 13' 37" W, 700–900 m, 4 Jun 1995 (fr), J. Morales 4554 (MO); Zapatón de Puriscal, 400 m, 1 Aug 1986 (fr), N. Zamora & Q. Jiménez 1268 (MO). PANAMA. Cocele: Hills N of El Valle de Antón, 1,000 m, 23 Jun 1940 (fr), P.
Allen 2176 (F); Loma del Tigre, region N of El Valle de Antón, 1,000 m, 16 Nov 1946 (fl), P. Allen 3806 (G, MO, NY); 7 km from Llanada Grande on road to Cocolí near continental divide, 1,200 ft [366 m], Jul 1979 (fr), T. Antonio 1364 (MO); On the Atlantic side, ca. 5 hr. walk from sawmill at El Copé, along slopes above North Río Blanco near small village of Caño Sucio, 400–500 ft [122–152 m], 2 Feb 1980 (fr), T. Antonio 3627 (LL, MO), 3632 (MO); Area of El Valle, 2 km E of La Mesa, N slope of Cerro Gaítal, 88° 38' N, 80° 07' W, 800 m, 16 Nov 1983 (fr), H. Churchill 3867 (LL, MO, NY); 3876 (MO); Near continental divide along lumber road ca. 1.5 mi N of El Copé, ca. 900 m, 19 Jan 1978 (fr), T. Coot 44581 (BRIT, MO); Hills above El Valle de Antón, without elev., 13 Aug 1972 (fr), W. D'Arcy & J. D'Arcy 6749 (MO); Road from Penonomé to Cocolí, 9 km N of Llanada Grande, on tributary on Río Cascajía, without elev., 11 Oct 1978 (fr), W. D'Arcy & B. Hammel 12292 (LL, MO); Area between Caño Blanco del Norte, Caño Sucio and Chorro del Río Tíe, 08° 43'06" N, 80° 36' 30"–38" 00" W, 200–400 m, 3 Feb 1983 (fr), G. Davidge & C. Hamilton 23484 (MO); Hills N of El Valle de Antón, ca. 800 m, 17 Jan 1973 (fl, fr), R. Dressler 4254 (MO); Near Aserradero El Copé, N of El Copé, E of sawmill, 700–800 m, 2 Nov 1980 (fl, fr), R. Dressler 5962 (FLAS 2-sheets, MO); Slopes of Cerro Pílon near El Valle, 700–900 m, 10 Jun 1967 (fr), J. Duke 12197 (MO); Summit of Cerro Pílon, above El Valle de Antón, 2,700 ft [823 m], 28 Mar 1969 (fr), J. Dwyer et al. 4476 (LL, MO); Cerro Pílon, bottom of slope, ca. 2,500 ft [762 m], 19 Jan 1968 (fr), J. Dwyer 8351 (MO), 13 Jul 1968 (fr), J. Dwyer & B. Lallathin 8690 (F, MO), 14 Jul 1968 (ster.), 8690A (MO); Adjacent to chicken farm, La Mesa, above El Valle, without elev., 3 Jan 1974 (fr), J. Dwyer 118669 (MO); 7 km N of el Copá de Veraguas, near Rivera sawmill, Alto Calvario, 900–1,300 m, 11 Jan 1977 (fl), J. Folsom 1242 (BRIT, LL, MO); New Works at Rivera sawmill, Alto Calvario, 600–800 m, 12 May 1977 (fr), J. Folsom 3163 (MO); Area around Rivera sawmill, 7 km N of El Copé, Atlantic slope, N side of summit, Alto Calvario, 700–850 m, 3 Oct 1977 (fr), J. Folsom et al. 5741 (MO); Vicinity of La Mesa, N of El Valle, 1,000 m, 23 Dec 1972 (fr), A. Gentry 6854 (LL); Hills above El Valle, ca. 1,000 m, 24 Dec 1972 (fl), A. Gentry 6872 (LL, MO); Near continental divide along lumber road, 8.4 km above El Copé, 1 km beyond sawmill, 900 m, 19 Jan 1978 (fr), B. Hammel 958 (LL, MO); 7 km N of Llanada Grande on road to Cocolí, 1,700 ft [518 m], 8 Mar 1978 (fr), B. Hammel 1928 (MO); La Mesa region N of Cerro Gaítal vicinity of El Valle, 2,400 ft [732 m], 2 Jul 1978 (fr), B. Hammel 3898 (MO); Continental divide N of Penonomé on road to Cocolí, 1,600 ft [488 m], 25–26 Jul 1978 (fr), B. Hammel 4054 (MO); S of Cascajía along Continental Divide, 8° 45' N, 80° 25' W, 800–900 m, 7 Nov 1981 (fr), S. Knapp 1665 (MO); Cerro Pílon, 2,700 ft [823 m], Jul 1968 (fr), B. Lallathin 35A (MO); Along road ca. 8 mi N of El Valle de Antón, without elev., 3 Aug 1970 (fr), J. Leyten & H. Kennedy 1704 (DUKE, GH, LL, MO); Vicinity of la Mesa, beyond El Valle, N slopes of Cerro Gaítal, 8° 37' N, 80° 07' W, 850 m, 14 Jul 1987 (fr), G. McPherson 11270 (MO); Ca. 3 km NE of El Valle, along farmers road, without elev., 2 Nov 1974 (fl, fr), S. Mori & J. Kallunki 2978 (LL, MO); Continental Divide above El Copé, 8° 38' N, 80° 39' W, 650–750 m, 27 Nov 1985 (fl), G. de Nevers et al. 6398 (LL, MO); Foot of Cerro Pílon, above El Valle de Antón, 2,000 ft [610 m], 27 Mar 1969 (fr), D. Porter et al. 4422 (MO), 28 Mar 1969 (fr), D. Porter et al. 4597 (LL, MO); La Mesa, 2 km NW of Cerro Pílon, 800 m, 22 Jul 1976 (fr), G. Sullivan 553 (MO); Between Río Blanco and Caño Susio 1 hr. hike to the W, Río Blanco is ca. 5 hr. hike N down from Continental Divide above El Copé and El Petroso sawmill, 8° 38' N, 80° 36' W, 350–400 ft [107–122 m], 15 Dec 1980 (fr), K. Sijstma et al. 2453 (LL, MO); Ca. 1 km E of Quebrada Amarillo in La Mesa, 2.5 km N of El Valle, 8° 37' N, 80° 07' W, 2,600 ft [792 m], 14 Feb 1981 (fr), K. Sijstma & W. D'Arcy 3565 (LL, MO). Colón: Santa Rita lumber road, ca. 15 km E of Colón, without elev., 5 Oct 1969 (fl, fr), R. Dressler & W. Lewis 3725 (LL, MO); Santa Rita Ridge, logging area 19 km in from Transisthmian Hwy., with-
out elev., 28 Jan 1968 (fr), J. Dwyer 8551 (F, MO); Río Escandalo near the abandoned Manganese mine, 500 ft [152 m], 26 Apr 1978 (fr), B. Hammel 2662 (IL, MO); S approach to Cerro Bruja from Río Escandalo, ridge top, without elev., 20 May 1978 (fr), B. Hammel 3220 (MO); On Santa Rita Ridge Trail, beyond end of Santa Rita Ridge Road (Panamanian Hwy. R20D), 17–53 km from Boyd-Roosevelt Hwy, 400–800 m, 21 May 1975 (fr), S. Mori & M. Crosby 6313 (LL, MO); Santa Rita Ridge, km 13.8, 9° 20' N, 79° 45' W, 350 m, 24 Feb 1986 (fr), G. de Nevers 7203 (IL, MO). San Blas: Río Cangandi, pueblo Cangandi, camino de caballos al S del pueblo, 9° 27' N, 79° 07' O, 40 m, 17 May 1987 (fr), H. Herrera & P. Perez 98 (MO); campamento Nusagandi, en la Carretera El Llano-Cartí, a 19.1 km de la Carretera Panamericana, Cuadrante Nusagandi y Sendero Nusagandi, 9° 12' N, 78° 16' W, 350 m, 19 Mar 1993 (fr), R. Paredes 944 (BRIT, F, MO, PMA, STRI).

Hymenandra pittieri is most closely related to H. wilburiana, but is a much more robust plant, with larger sepals, stems and androecial parts.

Populations corresponding to the type of Ardisia cutleri are notable according to Standley for their large leaves and fruits. The subsessile leaf bases appearing auriculate have also been used to recognize it. However, we have now found that the subsessile leaves are restricted to the flowering shoots of Hymenandra pittieri, so the confusion is the result of an incomplete specimen rather than due to biological difference. Lundell (1971) stated that Ardisia coccensis may have affinity to A. pittieri, but he only knew it from the brief description by Standley (1938).


Tree to 7 m tall. Vegetative shoots terete, 7–10 mm in diam., densely and minutely furfuraceous lepidote; reproductive shoots unknown. Vegetative shoot leaf blades coriaceous, oblancoelate, (25–)31–45.5 cm long, (5–)7–12.2 cm wide, apically long-attenuate, the acumen 1.8–3.5 cm long, gradually tapering to a cuneate base, decurrent to petiole base, midrib slightly raised above, prominently depressed below, secondary veins 16–20 pairs, slightly depressed or not visible above, prominently raised below, glabrescent, the margin regular, entire, flat, petioles marginate (0.6–)1–1.2 cm long, glabrous above, densely and minutely furfuraceous lepidote below; reproductive shoot leaves unknown. Inflorescence subterminal, pinnately or bipinnately paniculate, (7.5–)12.5–24.5 cm long, pyramidal, secondary branches 3–12 cm long, the rachis minutely densely furfuraceous lepidote, glabrescent, terminating in 7–12-flowered corymbas; inflorescence bracts unknown (presumably early caducous); floral bracts early caducous, membranaceous, ovate to oblong, 2.3–2.5 mm long, 1.2–1.4 mm wide, apically acute to rounded, sessile bases, midrib slightly raised above and below, secondary veins not visible, prominently punctate, scattered and minutely furfuraceous lepidote, the margins erose,

hyaline, entire, flat; pedicels cylindrical, 0.7–1.8 cm long, densely furfuraceous lepidote, persistent. *Flowers* 5-merous, pink; calyx lobes almost free, chartaceous, ovate, 2–2.8 mm long, 1–1.3 mm wide, symmetrical, apically obtuse, prominently punctate medially, densely and minutely furfuraceous
lepidote, the margin irregular, erose, hyaline, sparsely glandular-ciliolate; corolla lobes basally connivent, coriaceous, ovate, 5.3–5.9 mm long, apically acute, highly reflexed in anthesis, medially thickened, prominently pellucid punctate without, somewhat so medially within, the margin hyaline, entire, glabrous; stamens 4.9–5.4 mm long; filaments connate into a coriaceous elobate tube 1.2–1.3 mm long, epunctate, glabrous; anthers free, lanceolate, 3.5–4.2 mm long, 1.3–1.6 mm wide, sessile on the staminal tube, apically attenuate, basally cordate, longitudinally dehiscent by narrow, sublatrose slits, the connective inconspicuously pellucid punctate; pistil ellipsoid; ovary 1.5–1.7 mm long, glabrous; style 3.8–4 mm long, erect, inconspicuously pellucid punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.8–1 mm long, 0.3–0.4 mm in diam., apically apiculate; ovules 12–15, pluriseriate. Fruit globose, 8–10 mm in diam., densely and prominently black punctate, the style base persistent.

**Distribution.**—Endemic to the Colombian Chocó Floristic Province, in the Municipio de Mutatá, Department of Antioquia, from 80–180 m elevation.

**Ecology and conservation status.**—This species is locally common on one farm, in lowland pluvial forest, but has not been found elsewhere. Therefore it should be considered threatened. The lowland pluvial forests of the Colombian Chocó are some of the wettest in the tropics, receiving annual precipitation well in excess of 8,000 mm per year.

**Etymology.**—The species was named in honor of Ricardo Callejas Posada, head of the graduate program in biology at the Universidad de Antioquia, Medellín, Colombia. Ricardo is the pre-eminent authority on the phylogeny and systematics of the Piperaceae on a worldwide basis.

Specimens examined. **COLOMBIA. Antioquia:** Corregimiento Longani, del Río Longani, 2 kms. N de Mutatá, 7º 20' N, 76º 30' O, 80–100 m, 19 Nov 1987 (fl), R. Callejas et al. 5683 (NY); Municipio Mutatá, margin of Río León (Bucabá), Villa Arteaga, Las Caucheras, hill above water tap, 100–180 m, 2 Oct 1961 (bud), J. Cuatrecasas 26136 (US); Hacienda El Darién, right bank of Río Chontadural, 20 Jun 1979 (fr), R. Fonseca et al. 1228 (COL, HUA, MO), (fl) 1249 (COL, HUA, MO), 13 Sep 1979 (fr), R. Fonseca et al. 1343 (COL, HUA, MO).

_Hymenandra callejasii_ is rather isolated within the genus; its inflorescence is rather unusual, as is the fact that no leaves have been seen on reproductive shoots. Further field study will be necessary to document the entire life history of _Hymenandra callejasii._


Tree 2–6 m tall. Vegetative shoots terete, 7.5–9.5 mm in diam., sparsely
and minutely furfuraceous lepidote, glabrescent; reproductive shoots as in the vegetative ones but 2.5–3.5 mm in diam. Vegetative shoot leaf blades coriaceous, ovate to lanceolate, 15.4–27.2 cm long, 9.3–10 cm wide, apically acute to long-attenuate, the acumen when present 0.5–1.5 cm long, basally acute to cuneate, midrib slightly depressed above, prominently raised below, secondary veins 18–36 pairs, slightly depressed or not visible above, raised below, glabrous throughout, the margin entire, flat; canaliculate, 2.1–2.3 cm long, minutely appressed furfuraceous lepidote, glabrescent; reproductive shoot leaf blades as in the vegetative ones except 15.5–17.8 cm long, 5.6–6.8 cm wide, the secondary veins 18–32; petioles as in the vegetative ones but 2.1–2.5 cm long. Inflorescence terminal, pinnately or bipinnately paniculate, 9–16.5 cm long, obpyramidal, secondary branches 5–5.5 cm long, rachis glabrous throughout, terminating in 6–12-flowered corymb; inflorescence and floral bracts unknown (presumably early caducous); pedicels cylindrical, 0.9–1 cm long, glabrous, persistent. Flowers 5-merous; calyx lobes almost free, chartaceous, oblate, 1–1.1 mm long, 1.4–1.6 mm wide, symmetrical, apically obtuse, prominently black punctate medially, glabrous, the margin irregular, erose-fimbriate along entire length, hyaline, sparsely glandular-ciliolate; corolla, stamens and pistil unknown. Fruit globose, 8–12 mm in diam., densely and prominently black punctate, the style base persistent.

**Distribution.**—From the central Chocó Floristic Province of Colombia, from 5–80 m elevation.

**Ecology and conservation status.**—This species occurs in coastal forests along rivers, an area frequently colonized by squatters. Therefore, the species should be considered threatened.

**Etymology.**—The epithet is the superlative form of the Latin word, "acutissimus," referring to the apically acute to long-attenuate leaf apices.

Specimens examined. **COLOMBIA.** Chocó: Río San Juan Basin, Río Bicordó, above Noanamá; river margin; 04° 42’ N, 76° 55’ W, without elev., 6 Apr 1979 (fr), E. Forero et al. 4713 (COL, MO).

_Hymenandra acutissima_ is most closely related to the vicariant _H. crosbyi_, but easily recognized because of its much longer sepals, terminal inflorescence and much larger fruit.

9. _Hymenandra crosbyi_ (Lundell) Pipoly & Ricketson, comb. nov. (Figs. 1E, 10). Ardisia crosbyi Lundell, Wrightia 6:73, 1979. *Iacoreoa crosbyi* (Lundell) Lundell, Phytologia 49:348. 1981. Type. PANAMA. COLÓN: On trail at end of Santa Rita Ridge Road, 18–30 km from Boyd–Roosevelt Highway, 600–800 m, 30 May 1975 (fr), S. Mori & Al. Crosby 6423 (HOLOTYPE: LL (F Neg. # 55657); ISOTYPE: MO (LL Neg. # 1979-11)).


Tree 1–3 m, 1–3 cm in diam. Vegetative shoots terete, 3–5 mm in diam., densely and minutely furfuraceous lepidote when young, glabrescent; reproductive shoots as in the vegetative ones but 1.5–3 mm in diam. Vegetative shoot leaf blades chartaceous, ovate or lanceolate to elliptic, 11.5–22 cm long, 3.2–7.6 cm wide, apically long-attenuate, the acumen 1.2–2.4 cm long, basally obtuse to rounded, only slightly decurrent, midrib slightly raised above, prominently raised below, secondary veins 12–30 pairs, slightly depressed above, or not visible above, prominently raised below, prominently pellucid to black punctate above and below, glabrous above, scattered and minutely furfuraceous lepidote below, the margin entire, flat; petioles marginate, 1.7–5.4 cm long, glabrous above, scattered and minutely furfuraceous lepidote below; reproductive shoot leaf blades as in the vegetative ones except 5.5–15.7 cm long, 1.7–5.2 cm wide, secondary veins 10–26 pairs; petioles like the vegetative ones except 1.6–3.9 cm long. Inflorescence subterminal, pinnately or bipinnately paniculate, 2.7–8.8 cm long, obpyramidal, secondary branches 1.3–3.5 cm long, rachis sparsely and minutely furfuraceous lepidote, early glabrescent, terminating in 4–6-flowered coryombs; inflorescence bracts membranaceous, lanceolate to elliptic, 1.4–2.4 mm long, 0.4–0.7 mm wide, apically acute, pellucid to black punctate medially, scattered and minutely furfuraceous lepidote below, the margin entire; floral bracts like the inflorescence bracts but 0.8–2.1 mm long, 0.4–0.8 mm wide; pedicels cylindrical, 0.8–12.2 cm long, scattered and minutely furfuraceous lepidote, glabrescent, persistent. Flowers 5(–6)-merous; calyx lobes (in fruit) almost free, chartaceous, ovate, 0.9–1.6 mm long, 0.9–1.2 mm wide, symmetrical, apically acute, conspicuously pellucid to black punctate, scattered and minutely furfuraceous lepidote, glabrescent, the margin irregular, erose, hyline, glandular-cilioate; corolla 3.5–3.7 mm long, membranaceous, lanceolate, the tube 0.3–0.5 mm long, the lobes (in young bud) basally connate, 3.1–3.3 mm long, 1.2–1.4 mm wide at base, apically acute, prominently pellucid punctate, somewhat so medially within, the margins erose, hyline, glabrous; stamens (in young bud) 2.6–2.7 mm long; filaments connate into a membranaceous obolate tube, the tube 0.3–0.5 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, lanceolate, 2.2–2.5 mm long, 0.4–0.6 mm wide at base, sessile on staminal tube, apically apiculate, basally cordate, longitudinally dehiscent by narrow, sublatrose slits, the connective prominently pellucid punctate; pistil 3–3.2 mm long; ovary 0.7–0.9 mm long, glabrous; style 2.1–2.5 mm long, erect, inconspicuously pellucid punctate, glabrous; stigma punctiform; ovules 22–24, pluriseriate. Fruit globose, 4.5–6.5 mm in diam., prominently raised pellucid to black punctate, glabrous, the style base persistent.

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Distribution.—Restricted to the Caribbean slope, in the provinces of Coclé, Colón and San Blas, Panama, from 100–850 m elevation.

Ecology and conservation status.—*Hymenandra crosbyi* occurs at the natural ecotone of premontane and cloud forest. Its conservation status cannot be determined owing to a lack of populational data.

Etymology.—The species is named for Dr. Marshall Crosby of the Missouri Botanical Garden, who collected the type specimen.

Specimens examined. PANAMA. Coclé: Coclecirro Road, elevational transection from 1 mile beyond the divide to the ridge top, 08° 42' N, 80° 28' W, 300–500 m, 12 Jan 1986 (fr), *G. de Nevers et al.* 6757 (LL, MO). Colón: Upper Río Piedras headwaters, along trail from end of Santa Rita Ridge Road, ca. 11 km SW of Cerro Braja, 09° 25' N, 79° 35' W, 600–700 m, 2 May 1981 (fr), *K. Sytsma et al.* 4220 (LL, MO); Ridge between Río Piedras and Río Garun waterbeds, along trail from end of Santa Rita Ridge road, ca. 5–8 km SW of Cerro Braja, 09° 27' N, 79° 36' W, 700–800 m, 2 May 1981 (fr), *K. Sytsma et al.* 4279 (LL, MO). San Blas: El Llano-Carti Road, 17.4 km from Interamerican Hwy., 09° 19' N, 78° 55' W, 350 m, 27 Sep 1984 (fr), *G. de Nevers et al.* 3941 (MO); Trail along Continental Divide, 5–10 km W of El Llano-Carti Road, 350 m, 10 Jan 1985 (fr), *G. de Nevers & H. Herrera* 4490 (MO); Río Nergala, 9° 22' N, 79° 07' W, 100–300 m, 12 Jan 1985 (frl), *G. de Nevers & H. Herrera* 4531 (MO).

*Hymenandra crosbyi* is most closely related to the vicariant *H. acutissima*, but may be recognized by the shorter and obtuse sepals, the subterminal inflorescence, shorter secondary branches, and smaller fruit.

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REFERENCES


LINDLEY, J. 1848. Illustrated dictionary of botanical terms. Excerpt from illustrated dictionary of botanical terms by John Lindley. (Reprint, With an Introduction by Alice Eastwood, Stanford University, School of Earth Sciences, 1941).


**NUMERICAL LIST OF HYMENANDRA TAXA**

1. *H. stenophylla* (Donn. Sm.) Pipoly & Ricketson
2. *H. calypoda* (Hems.) Pipoly & Ricketson
3. *H. soerida* (Lundell) Pipoly & Ricketson
4. *H. squamata* (Lundell) Pipoly & Ricketson
5. *H. wilburiana* (Lundell) Pipoly & Ricketson
6. *H. pittieri* (Mez) Pipoly & Ricketson
7. *H. callejasii* (Pipoly) Pipoly & Ricketson
8. *H. acutissima* (Cuatrec.) Pipoly & Ricketson
9. *H. crobyi* (Lundell) Pipoly & Ricketson

**LIST OF EXSICCATAE**

Figures in parentheses refer to the numbers from the numerical list of taxa. Collection numbers in boldface type indicate type specimens.

Aguilar, R., et al., 5663 (6); Alián, E., 169 (2); Allen, P., 2056 (6); 2176 (6); 3806 (6); 5828 (6); 5828A (6); 6726 (6); Angulo, L., 394 (6); Antonio, T., 1364 (6); 3627 (6); 3632 (6); Argüello M., D. et al., 11 (6).

Baker, R. & W. Burger, 126 (6); Bello C., E., 1059 (3); Brenes, A., 15655 (2); 21243 (2); Burger, W. & R. Baker, 9869 (2); Burger, W. & G. Marta U., 1106 (6); 1046 (6); Burger, W. & R. Stolze, 3738 (6); 5853 (4); Burger, W. et al., 11687 (2).

Callejas, R. et al., 5083 (7); Carvajal U., A., 392 (2); Chacón, A., 941 (6); Chacón, I., 80 (5); 717 (5); Chacón, I. & G. Herrera, 1758 (6); Chávez, C., 71 (3); Chinchilla, M., 93 (2); 100 (2); Churchill, H., 3867 (6); 3876 (6); Cooper, G., 12 (1); 370 (1); Croot, T., 36246 (2); 36703 (6); 41383 (3); 44581 (6); Cuatrecasas, J., 17219 (8); 26156 (7).
MYRSINE LUAE (MYRSINACEAE), A NEW SPECIES FROM BRAZIL

JON M. RICKETSON
Missouri Botanical Garden
P. O. Box 299, St. Louis MO 63166-0299, U.S.A.
jon.ricketson@mobot.org; jricketon@lehmann.mobot.org

JOHN J. PIPOLY III
Botanical Research Institute of Texas
509 Pecan Street, Fort Worth, TX 76102-4060, U.S.A.
jpipoly@brit.org; clusia@latinmail.com

ABSTRACT

A review of herbarium specimens of Myrsine for the Flora of the Venezuelan Guayana project revealed the presence of a distinctive new taxon from the Serra de Lua in the adjacent Territorio do Roraima, Brazil. Myrsine luae is described and illustrated, and its relationship to its nearest congener, Myrsine guianensis is discussed. An outline map showing the type locality is provided.

RESUMEN

Al estudiar pliegos del herbario pertenecientes al género Myrsine de la guayana venezolana, se encontró una especie nueva para la ciencia proveniente de la Serra de Lua, del Territorio do Roraima, Brazil; la zona brasileña adyacente a la guayana venezolana. Se describe, se ilustre y se discute el parentesco de la nueva especie, Myrsine luae. También incluye un mapa mostrando la localidad tipo.

INTRODUCTION

The genus Myrsine R. Br. contains ca. 300 species of which nearly 1/4 remain undescribed. C. Chen and Pipoly (1996), Pipoly (1991, 1992a, 1992b, 1996), Pipoly and C. Chen (1995), and Ricketson and Pipoly (1997) have provided summaries of evidence for broader circumscription of the genus, especially to include Rapanea Aubl. Myrsine is pantropically distributed, occurring in diverse vegetation types, from mangroves to subalpine scrub, but always in moist, wet or pluvial habitats. The genus is defined by lateral (axillary), fasciculate or umbellate inflorescences, sessile or on short, perennating peduncles girdled by persistent floral bracts, thus forming “short shoots.” In preparation for our treatment of the genus Myrsine for Flora of the Venezuelan Guyana, a new species from just out side the region in the state of Roraima in Brazil was discovered and is described herewith.

Myrsine luae Ricketson & Pipoly, sp. nov. (Fig. 1). Type. BRAZIL. RORAIMA: Summit of Serra da Lua, 02° 25′−29′ N, 60° 11′−14′ W, 1,400 m, 24 Jan 1969 (fr), G. Prance, J. Steward, J. Ramos & L. Farias 9416 (holotype: NY; isotypes: BRIT, INPA n.v.).

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Fig. 1. Distribution of *Myrsine lae* Ricketson & Pipoly.

Quoad ramulos glabros, lamina coriacea nitidaque, petiolos marginatos, inflorescentiam 5–8-floribus, *M. guianensis* valde arcte affinis sed ab ea ramulis angulatis (non teretibus), necnon pedicelis angulatis (nec teretibus), periantis coriaceis (non chartaceis), stigmatibus sinuato-capitatus (non conicis), denique fructibus ellipsoides vel obovoides (non globosis), praeclare distat.

*Tree* 4 m tall, 10 cm DBH. *Branchlets* ridged, 0.5 cm in diameter, glabrous apically. *Leaves* alternate; blades coriaceous, elliptic to oblanceolate, 4–9.5 cm long, 1.6–3.5 cm wide, apically acute, basally acute, decurrent on petiole, smooth, shiny and nited above, dull and inconspicuously black punctate below, the midrib slightly impressed above, prominently elevated below, the secondary nerves not prominent, 13–15 pairs, the margins entire, flat to subrevolute, opaque, minutely glandular-ciliolate in bud, glabrous at maturity; petioles marginate, 0.5–1 cm long, glabrous. *Staminate inflorescence* unknown. *Pistillate inflorescence* a subsessile, 5–8-flowered umbel; peduncle obsolete to 3 mm long; floral bracts, deltate, 1–1.2 mm long, 1–1.2 mm wide, apically acute, early caducous, glabrous, the margins ciliolate; pedicels angulate, 2–3 mm long, glabrous. *Staminate flowers* 5-merous; calyx coriaceous, cotyliform, 1–1.5 mm long, the tube 0.3–0.5 mm long, the lobes ovate, 1–1.2 mm long, 0.8–1 mm wide, apically acute, conspicuously punctate and punctate-lineate, glabrous, the margins entire, glandular-ciliolate; corolla chartaceous, subrotate, 1.8–2.1 mm long, the tube 0.5–0.6 mm long, the lobes lanceolate, 1.3–1.5 mm long, 0.7–0.9 mm wide, apically acute, densely and prominently punctate and punctate-lineate, glabrous, the margins
Fig. 2. *Myrsine linae* Ricketson & Pipoly. A. Branchlet. B. Infructescence, showing obovoid fruit shape. C. Pistillate corolla, showing hastate antherode and marginal glandular granules. A-C, drawn from holotype.
entire, minutely glandular-ciliolate; staminodes inserted at junction of corolla tube and lobe, the sterile anthers subsessile, oblong, 0.9–1 mm long, 0.1–0.2 mm wide at apex, 0.4–0.5 mm wide at base, apically apiculate, the apiculum proximally curved, basally deeply cordate, the connective epunctate; pistil 1–1.9 mm long, the ovary globose, 1–1.2 mm long, 0.7–0.9 mm in diameter, prominently pellucid punctate and punctate-lineate, the stigma sessile, sinuate-capitate, prominently vertically lobed, 0.5–0.7 mm long, 0.5–0.8 mm wide, persistent in fruit, placenta globose, 2-ovulate. Fruit green, cylindrical to obovate, 3.5–4 mm long, 2.4–3 mm in diameter at the apex, 1.2–1.7 mm in diameter at the base, prominently pellucid punctate and punctate-lineate, glabrous.

**Distribution.**—Known only from the type on the summit of Serra da Lua, Roraima, Brazil (Fig. 2), growing at 1,400 m elevation.

**Ecology and conservation status.**—*Myrsine luæ* inhabits cloud forests in Serra da Lua, a somewhat isolated range of mountains. No ecological notes are on the type collection, but it is from an area known for granitic mountains inhabited by vine forests, with cloud forests above.

**Etymology.**—Names for the location of the type locality, Serra da Lua, Territorio do Roraima, Brazil.

*Myrsine luæ* is most closely related to *M. guianensis*, but is easily recognized by its angulate branchlets and pedicels, coriaceous calyx sessile, sinuate-capitate stigma and ellipsoid or obovoid fruit.

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**REFERENCES**


BOTANICAL RESULTS FROM THE 1995 BISMARCK-RAMU EXPEDITION IN PAPUA NEW GUINEA

W. TAKEUCHI
Botanical Research Institute of Texas
c/o Papua New Guinea Forest Research Institute
and Lae National Herbarium
P.O. Box 314, Lae, PAPUA NEW GUINEA

ABSTRACT
Botanical results are presented from the 1995 biological survey of the Bismarck-Ramu tract, an area identified by multiagency assessment as a prime site for possible conservation action. The findings provide confirmation of the area’s presumed biodiversity value. Over 610 distinct morphospecies and up to 15 confirmed or suspected plant novelties were documented by an intensive 24-day expedition. Three of the new species are formally described. General descriptions of the vegetation are also provided for the major floristic environments explored by the survey team. Adoption of special management and conservation measures is recommended for the subject territory.

INTRODUCTION
Papua New Guinea (PNG) is a well known center for biological endemism and diversification. It ranks among the world’s most botanically diverse countries, with a species-level floristic content variously estimated as high as 15,000–20,000 (Johns 1993), 20,000+ (Womersley 1978), and to ca. 25,000 (Mathew 1995). As one of its principal missions, the Department of Environment and Conservation (DEC) is responsible for identifying specific areas of conservation value within PNG. Based on several DEC internal evaluations and the Conservation Needs Assessment Report (Beehler 1993), a 168,000 hectare tract between Mt. Wilhelm and the Ramu River was recently selected for potential designation as a conservation unit (Figs. 1–2). This poorly-known area of interest (AOI) was suspected of sequester-
Fig. 1. Top. Papua New Guinea in aspect, showing the general location of the survey tract. Fig, 2. Bottom. Exploded view of the area of interest (AOI). Figures from Hedemark et al. (1997).
ing high biodiversity, and a survey was deemed necessary to secure more information on its suitability for further development as a protected zone.

During October 2–26, 1995, a biological survey was thus conducted from 4 base camps established between 600–2400 meters elevation inside the AOI (Fig. 3). Ten scientific participants from Papua New Guinea evaluated the botany, entomology, and vertebrate zoology of the area. Survey protocols were consistent with the ICAD (Integrated Conservation and Development) model. Although a comprehensive account of the expedition was published by Hedemark et al. (1997), only a cursory description of the vegetation was included since the botanical specimens had not been examined. Recently completed determinations, an amended site by site overview of the vegetation, synopsis of notable collections, and an improved species list (Appendix 1) can now be provided. A wide range of organizational, socio-cultural, and physical site information is presented in Hedemark et al. (ibid, to which the reader is referred), and will not be repeated here.

**METHODS**

The botanical component of the survey consisted entirely of opportunistic general collecting, employing the 'Kostermans method' of field-packing duplicates in 70\% surgical spirit for deferred processing. A complete set of the Bismarck-Ramu plant collections has been deposited at Lae National Herbarium (LAE). Principal recipients of duplicate sets are A, BRIT, K, and L; residual sheets are dispersed in no particular sequence and are likely to be at the institutions of family specialists.

In genera for which revisions are available, vouchers were keyed to species and the result confirmed against annotated sheets at LAE. For unrevised groups, exsiccatae were matched against authentically identified material and/or original descriptions. A number of specialists were also consulted; their identifications are provided with attribution on the attached species list (Appendix 1).

In the following account, taxa are referenced by the collection number on which the claim is based. The text has been expanded from Hedemark et al. (1997: 41–44) by addition of taxonomic detail resulting from the new determinations.

**VEGETATION SUMMARIES**

**Camp 1**

*Location:* Mt. Oipu, GPS 05°35.5' × 144°47.3', elevation 2360 m

*Life zone:* montane

*Forest type:* elfin or low stature mossy cloud forest

*Collections sequence:* 10381–10625
Figure 3. Trip route of the expedition. Reproduced from Hedemark et al. (1997).
At 2360 m, the expedition’s highest camp was established in mossy ridgeline forest exposed to severe wind shear and constant misting. The vegetation at this site was generally stunted, taxonomically depauperate, and structurally unstratified. Stocking densities tended to be comparatively high due to the small size of most trees, with boles and crowns exhibiting the scraggly form and poor development typical of cloud stands. Due to steep slopes and everwet conditions, plant communities reflected the influence of frequent landslips and exposure of new earth. Successional montane taxa were prominent components of the vegetation on unstable terrain. A Saurania complex with S. cf. capitulata (10596), S. ilicifolia (10424), S. cf. naumannii (10539), and a possible Saurania sp. nov. (10447, 10570), was characteristic of colonizing communities. Trimenia papuana (10393, 10402) and the family Theaceae; including Eurya cf. leptantha (10394), E. tigang (10421, 10571), and Ternstroemia britteniana (10532, 10624), were also common in secondary growth. The regenerating facies was particularly striking and distinctive due to the towering inflorescences of Harmisiopanax ingens ssp. ingens (10514).

On the summit ridge beginning at ca. 2400 m, arborescent growth consisted of a stunted monolayer less than 4 m in height. The principal woody taxa were Olearia rufa (10598), Prumus pullei (10608), Helicia microphylla (10609), and Ascarina philippinensis (10613). Acsrithia reticulata (10603) was common in sheltered ravines off the crest.

On buttress ridges below the summit, the canopy layer was similarly reduced to dwarfed scrub. Phanerophytes typically included Dillenia cf. schlechteri/ quercifolia (10495), Elaeocarpus tariensis (10422, 10591), Garcinia archboldiana (10494), Planchonella monticola (10589), Podocarpus sp. (10585, sterile), Schuurmannia benningii (represented by two distinct architectural morphs: 10515 robust arborescent, and 10409 dwarfed form), Weinmannia sp. (all sightings sterile), and Xanthomyrt/is montivaga (10602). Two Pandanus species; one monocaulous and planted, the other branched and naturally regenerating (§ Intraobtutus, 10623), were conspicuous emergents on summits and steep slopes, the latter species being otherwise scarce on level ground. The understorey was occupied by various infraspecific forms of the highly variable Symplocos cochinobinis (e.g., 10415, 10566, 10614). Schefflera shrubs from the 'S. schumaniana group' were also common, with representatives including S. schumaniana s. str. (10643, 10744), and allied forms such as S. aff. sparsidentata (10427, 10471). Lianas were relatively rare and inconspicuous.

Canopy statures increased progressively on the path descending towards Bubkile and lower slopes. However by elevation 2075 m, forest was replaced by grassland composed of weed and waif species characteristic of anthropogenic disturbance. Eurya tigang (10571), Parasponia rigida (10567), Polyscias
heleensis (10580), and Rhodomyrtus noroguineensis (10568), formed a seral border between forest and grassland.

From the standpoint of floristic richness, herbaceous plants collectively represented the most important elements in the summit forest. Orchids and ferns were undoubtedly the most speciose groups. The genus Cyrtandra had more morphospecies than any other dicot understory constituent. Urticaceae was especially varied; Elatostema blechnoides (10450, 10478), E. mongense (10535), E. norobense (10433), and E. trident (10475) being particularly common. Debregaoria was also frequent, but the genus is unrevised and there are no available binomials for the Papuan species.

Two new taxa were discovered on Mt. Oipu, including a Pilea sp. nov. (10481; also 10559, 10740 from Camp 2), and Prunus sp. nov. (10588).

While the community composition was unarguably that of a well-preserved native forest, several cosmopolitan weeds have encroached along established trails on ridgelines and buttress crests. Although adventive species are often ignored in biological estimates of site value, such plants are convenient indicators of the proximity and intensity of human activity. At elevations above 2200 m, alien species were limited to Bidens pilosa var. minus (10458), Ageratum conyzoides (10429), and an unidentified subshrub (10425, 10431) cultivated as a village ornamental. The introduced elements are benign herbs and not community-invasive taxa like Piper aduncum of disturbed lowland environments. A planted Pandanus (aff. zieulianettii) was seen only as scattered individuals along footpaths, but is otherwise naturally-occurring in the Highlands region.

On Hammermaster and Saunders's (1995) system of vegetation classification, the Mt. Oipu communities are assigned to structural code 'L,' applied to lower montane forests (above 1000 m) having dense, small-crowned canopies. Such forests change progressively in composition and stature according to elevation, eventually grading into the high montane formations (loc. cit.: 14). The expedition’s ground survey indicates that the Mt. Oipu summit is structurally and taxonomically very close to subtype code ‘Ls,’ referring to very small-crowned forest where emergents (except Pandanus) are generally absent.

The Mt. Oipu vegetation would also be regarded as a ‘lower montane rain forest’ on the system of Grubb and Stevens (1985). However the apparent equivalence hides significant distinctions in the way the term is applied by the different authors. The Hammermaster and Saunders classification is derived primarily from stand-level characters determined from aerial survey, with the objective of identifying merchantable forest. Grubb and Stevens employ higher-resolution criteria applicable only by ground inspection (e.g., incidence of buttresses, woody climbers, cauliflory, drip tips, etc.) and is purely phytoecological in orientation. Irrespective of the distinctions, Mt.
Oipu is clearly a lower montane rain forest sensu Grubb and Stevens, and of the ‘mixed forest’ type with no single dominant component.

Camp 2

*Location:* Mt. Gulno, GPS 05° 32.71' × 144° 47.8', elevation 2045 m  
*Life zone:* montane
  
*Forest type:* medium stature mossy cloud forest
  
*Collections sequence:* 10647–10768; 10626–10646 from transit between camps 1 to 2

On Mt. Gulno, the canopy was similar to that from the first site. Many taxa were present at both camps, though apparently differing in their frequencies. Because of logistical concerns, collections were generally not repeated between camps for plants thought to be conspecific.

*Kania engenoides* (10648) was a dominant tree species around Camp 2. Other common trees included *Actinodaphne monticola* (10752), *Ascarina subessilis* (10760), *Caldclavia rufa* (10673), *Cryptocarya mothofagorum* (10652, 10680, 10728), and *Shorea brebystyla* (10747). The most frequent shrubs were *Acronychia ledermannii* (10717, 10750), *Diosxylum enantiophyllum* (10751), *Fittingia* sp. (10661, 10745), *Myrsine leucantha* (10573, 10671), *Pittosporum sinnata* var. *tennivalve* (10655, 10689), *Stegautera* cf. *insculpta* (10672), and *S. ilicifolia* (10749). Woody genera previously dominant on Mt. Oipu (*Weinmannia*, *Dillenia*, *Garcinia*, etc.), became less common at the second site. In general, phanerophyte taxa seemed more similarly abundant, though this was difficult to assess properly due to difficulties in making collections. Expedition climbers were rendered ineffective by rain, heavy misting, and thick bryophyte growth on tree trunks. Since the camp site was less exposed to wind, canopies generally exceeded 10 m, also making vouchers comparatively more difficult to secure.

As for camp 1, understory and epiphytic plants were very diverse, with ferns and herbs accounting for the majority of collections. Ericaceae was well-represented by *Diphycia norobensis* (10658), *Rhododendron anagalliflorum* s. str. (10686), *R. beyeriickianum* (10685), and *R. wrightianum* var. *insulare* (10656). The most notable find was a new species of *Bulbophyllum* (10724; det. N.H.S. Howcroft).

During the hike between camps 1 and 2, tall stature forest was encountered along the descent to the Kanel River and on the corresponding climb up opposing slopes to Mt. Gulno. A sharp structural break was evident at elevation 5700 feet aneroid (1740 m), with marked changes in epiphyte abundance, forest stature, and tree architectural form. This elevational level probably marks the lower limit of the cloud zone. The abruptness of physiognomic transition suggests that the cloud line is spatially fixed, at least locally.
The Mt. Gulno vegetation is assignable to the same forest classification units as discussed for Mt. Oipu.

Camp 3

*Location:* Wara Kanel (Kanel River), GPS 05° 31.8' × 144° 49.1', elevation 1545 m

*Life zone:* premontane

*Forest type:* tall stature ecotone forest with intermixed lowland and montane taxa

*Collections sequence:* 10769–10964

Camp 3 was sited in secondary vegetation extending along the Kanel riverbed and over adjacent slopes. *Saurania* and *Cyathea* were the most conspicuous members of this riverine formation. In the former genus, the major species included *Saurania aff. conferta* (10815), *S. congestiflora* (10826), *S. cf. nanmannii* (10904), *S. schumanniana* (10940), and an unusual subglabrous species (10829, not *S. pluribulcularis*). *Cyathea angiensis* (10848) and *C. werneri* (10794) were common tree ferns in heliophytic situations, while *C. bornei* (10846) was frequent in advanced regrowth. *Gastonia spectabilis* (10956) was a massive emergent. Other plants indicative of disturbance were repeatedly encountered throughout the area, their dominance the result of subsistence agriculture by Gulno villagers. Euphorbiaceae and Piperaceae were prominent in the successional vegetation, being represented by *Euphorbia plumerioides var. acuminata* (10792), *Homalanthus novo-guinensis* (10957), *Mallotus papuanus* (10947), *Piper lessertiannum* (10874B, 10927), *P. radatzii* (10773), and *P. subbullatum* (10822). In mid-seral phases, *Alpinia excelsa* sensu Schirarend (no coll.), *Melicope* spp. (10823, 10892), *Gensia pentandra* (10821), and *Trena cannabina* (10918) became frequent, often forming dense stands. This regrowth association is found throughout northeastern PNG whenever human or natural agencies permit establishment of seral taxa. Phytogeographically, the weedy plants often range over the whole of Papuasia and also into the larger Malesian region. Several alien species were noted, mainly ephemerals such as *Crascocephalum crepidioides* (10799) and *Erectites valerianifolia* (10797).

Away from the river, the primary forest canopy was diverse and more difficult to characterize. *Podocarpus* (10952, sterile) and *Calophyllum* (populations sterile) were common trees in a premontane assemblage also composed of *Cunoniaceae, Elaeocarpaceae, Ericaceae, Lauraceae, Myrsinaceae,* and *Winteraceae.* Intermixing with montane taxa were lowland representatives from *Moraceae* (principally *Ficus*) and *Meliaeae* (*Aglaia*). *Urticaceae, Zingiberaceae,* and various small ferns dominated the understory layer. Among the more abundant gingers were *Alpinia werneri* (10869), *Alpinia* sp. § *Dieramalpinia* (10964), *Etingera* sp. (10878), *Plurantibodum* sp. § *Psychanthus*
(10849, 10959), and *Tapeinochilus* (populations sterile). Common urticating species included *Elatostema beccarii* (10894), *E. aff. belense* (10891), *E. novo-guineense* (10885, 10896), *Poikilospermum inaequale* (10858), and *Procris frutescens* (10901). In general, however, the forest floor community was sparse and taxonomically depauperate. The most notable collections were possible new species in *Dendrobium § Grastidium* (10856; det. N.H.S. Howcroft) and *Myrsine aff. acrostica* (10958; det. J. Pipoly).

Unlike the montane camps, epiphytic loads were minimal and tree boles typically lacked mossy growth. Canopy species tended to be represented by trees with massive stems branching high above the ground (>20 m). There appeared to be sizable populations of merchantable *Elaeocarpus* and *Syzygium*, but this could not be confirmed by fertile gatherings. In contrast to the situation at the montane sites, virtually all the arborescent taxa in the mature growth forest were seen only in sterile condition. The few fertile individuals were often too high in the overstory for collection, the only exceptions being *Ceratopteris succirubrum* (10853), *Flindersia pimenteliana* (10944), and *Lithocarpus cf. celebicus* (10785). According to local respondents, the forest trees begin flowering in November or December after the start of the rainy season, a claim consistent with climatic data reviewed in Hedemark et al. (1997).

The Kanal River forest is regarded as lower montane by Hammermaster and Saunders (1995), but differs from the previous sites in the appearance of lowland elements. Genera recorded from camp 3 which are characteristic of the lowland zone include *Caryota* (sightings), *Aceratium* (10806), *Leea* (10825), *Pometia* (sightings), and *Poikilospermum* (10858). Lowland rain forest can ascend to 1500 m (van Royen 1964), and the floristic composition of the Kanal locality is transitional to such forests. Unlike high elevation formations, the lowland-montane ecotone exemplified by the Kanal site has not received critical attention in Papuasia (Grubb & Stevens 1985). Future surveys in the Bismarck-Ramu tract could profitably focus on the transition, especially as unpublished findings from recent RAP (Rapid Assessment Protocol) surveys suggest that floristic richness in Papuasia peaks at or near this elevational level (e.g., Beehler 1997; Kulang et al. 1997).

**Camp 4**

*Location:* Wara Ikil (Ikil River), GPS 05° 30.8' × 144° 50.6', elevation 600 m

*Life zone:* lowland

*Forest type:* tall stature alluvial and foothill forest

*Collections sequence:* 10969–11110; 10965–10968 from transit between camps 3 to 4
Flanked by steeply ascending ridges, camp 4 was the most isolated expedition site and the least affected by disturbance. However on riverine flats, the vegetation was still subject to natural upsets and marked by the development of *Pometia* dominant canopy. Such communities are very typical of lowland environments throughout northern PNG. In addition to *Pometia pinnata*, the woody taxa on alluvial ground usually included *Bridelia penangiana var. penangiana* (11020), *Callicarpa longifolia* (10973), *Chisocheton lasiocarpus* (11000), *Dolichobotrys oxylobum* (11042), *Endospermum labius* (11048), *Leucozyke capitellata* (11044), *Massaenda scratchleyi* (11097), *Pipturus argentus* (10990), *Prunus dolichobotrys* (11037), *Sauroria aff. conferta* (11036), and *Anacardiaceae*. The latter was represented primarily by sterile *Buchanania*, *Campnosperma brevipetiolata*, and *Semecarpus*. Subarborescent *Ficus* was represented by large populations of *F. arbuscula* (11038) and *F. comitis* (11100). The most common herbaceous plants were *Derris cuveifolia* (11031), *Desmodium sequax* (11023), *Pueraria pulcherrima* (11029), and *Stachytarpheta cayennensis* (11028). *Urticaceae* was also common, with many sightings of *Boehmeria platypylla* (11016), *Cypholophus nummularis* (11018), *Elatostema novo-guineense* (11022), *E. weinlandii* (11096), *Laportea decumana* (10974), and *Poikilogyne macrophylla* (11095).

The slopes and ridges above Wara Ikil have taxa less common than those along the river and represent a more diverse forest. Proper botanical assessment of such communities requires considerably more time and effort than is possible with brief surveys such as ours. From general impression, the stands near Camp 4 could be the richest plant community encountered by the expedition. Both the Kanal and Ikil foothills would no doubt repay further efforts at exploration.

Notable collections were *Antidesma katikii* (11054, 11079), formerly known only from a type collected in the Ramu area, *Garcinia* sp. nov. (11098, det. P.F. Stevens), *Psychotria* sp. nov. (11090), and *Syzygium* sp. nov. (11068).

The Kanal River vegetation is assigned to type code ‘Hm’ on Hammermaster and Saunders (1995), a category consisting of medium crowned forests on uplands below 1000 m. The camp 4 area has the most merchantable timber seen during the survey and represents the forest type of greatest interest to commercial operators.

**NEW SPECIES, DISTRIBUTIONAL RECORDS, OR OTHER NOTEWORTHY COLLECTIONS**

**PTERIDOPHYTES**

**DENNSTAEDTIACEAE**

*Hypolepis scabristipes* Brownsey; coll. 10778. Apparently a rare fern, represented by few collections in the Malesian region (Brownsey 1987).

*Hypolepis scabristipes* is a distinctive species, with yellowish-brown stripes marked by darker excrescences from the dilated hair bases (loc. cit.).
THELYPTERIDACEAE
Sphaerostephanos sp. ?nov.; colls. 10707 and 10733. The genus is one of the most speciose in Malesia (Holttum 1981) and includes numerous localized endemics. Our expedition numbers are sessile-glandular on both lamina surfaces, lack indusia, and have laxly setose sporangia. Sori are multiserial and sometimes confluent. The collections are closest to S. adenostegius and S. warburgii.

MONOCOTS

ORCHIDACEAE
Bulbophyllum sp. nov.; coll. 10724
Dendrobium sp., § Grastidium; possible sp. nov.; coll. 10856. About 45 orchid species were collected during the survey, from which orchidologist N.H.S. Howcroft has determined two numbers as representing new species.

ZINGIBERACEAE
Alpinia sp. aff. odontonema, § Pycnanthus; coll. 10595. This differs from A. odontonema s. str. in its sessile leaves with raised nervation on upper surfaces. The expedition’s collection conforms to material cited by R.M. Smith (1978) as an undescribed species.

DICOTS

ARALIACEAE
Polyscias belensis Philipson; coll. 10580. An uncommon montane tree, previously known from Bele River in West Iryan and from Morobe Province (Philipson 1979). Lae Herbarium has only one sheet of this taxon. Apparently a first record for the Highlands Provinces.

Resembles a Gastrodia but the pedicels are distally articulate. The voucher agrees in detail with the single sheet annotated by Philipson at LAE.

Schefflera aff. sparsidentata Frodin; colls. 10427, 10471. A possible novelty in the S. ‘schumanniana-sbraderiana complex’ from which a number of new species have been described by Frodin (1982).

Closest to Schefflera sparsidentata but differing in the more robust inflorescence with extended rachis, glabresent axes, and much longer pedunculate umbellules. The flowers are distinctly pedicellate rather than sessile. The conspicuous peduncular and floral bracts are densely clothed with setiform innovations on margins and/or surfaces.

CLUSIACEAE/GUTTIFERAE
Garcinia sp. nov.; coll. 11098. A Garcinia with cordate-based leaves has been preliminarily determined by P.F. Stevens as a novelty (pers. comm.).

The new species was seen as a single 10 m tree growing on the ridgeline above camp 4. Its leaves are sessile, decussate, firm-coriaceous, and abaxially
glabrous, unisexual, and sparingly obtuse and hispidulous. It is vegetatively distinguishable from other species by the subovate blade, typically 11.5 × 7 cm, with reflexed margins and amplexicaululous cordate base. The flowers are deployed in numerous axillary or infrastem fascicles, seemingly bisexual but probably functionally unisexual and with the plants dioecious.

ERICACEAE
Rhododendron anagalliflorum Sleumer; colls. 10389, 10686. As delimited by Craven (1980), R. anagalliflorum is an uncommon species confined to the Carstenz Mts. and the Bismarck-Wahgi-Jimi Divide. It has the reduced leaves characteristic of Series Linnaceae.

The expedition vouchers were procumbent or decumbent epiphytes. Corollas were campanulate, chartaceous, white or pink, with erect lobes and outer surfaces exclusively lepidote. The ovary is densely clothed with patent hairs but also provided with a lesser indumentum of coarsely tubercululate scales. Styles did not exceed the ovary and were mostly glabrous.

EUPHORBIACEAE
Glochidion sp. nov.; coll. 11543. The collection was from a subarborescent species seen in cloudy montane forest. It does not key out on Airy Shaw (1980). In appearance most like Glochidion frondinii and G. inaequale, but separable on the following combination of characters:

Vegetative parts hispidulous. Inflorescence axillary or internodal; pistillate flowers often solitary. Capsules globose, 1.5 cm diameter, subsessile, glabrous, exocarp somewhat verrucose.

The capsules are eaten raw by Bubkile villagers, a practice not usually encountered for Papuan Glochidion. The fruit is crunchy in consistency and has a rather pleasant aftertaste. Unfortunately, this resulted in the village laborers consuming all the gatherings as they were made, leaving only a unicate for the press.

Macaranga reiteriana Pax & Hoffman; colls. 10496, 10508. Macaranga reiteriana was formerly known only from Morobe Province, Gulf Province, and the Idenburg River (Whitmore 1980). Lae Herbarium has material from each of the areas cited in Whitmore (ibid) but no new occurrences have been added to the national collection since then.

The species is distinguished by the single elongate stipule, narrow leaves, and solitary fruits on bare peduncles. It is frequent in regrowth communities on Mt. Oipu. Recent work at Crater Mt. in Simbu (Chimbu) Province has also documented the presence of the species from that area (e.g., Takeuchi 12262, 12274). Although the expedition vouchers represent a distributional record for the Highlands region, the plant is almost certainly more common and widespread than herbarium specimens would indicate.

Mallotus papuanus (J.J. Sm.) Pax & Hoffman, or aff.; coll. 10947. The
species has paired leaves; each leaf pair consisting of a highly reduced, stipuliform lamina opposed to an unreduced caudate blade. An indumentum of fulvous hairs covers the apical parts and underleaves.

*Malotus papuanus* was previously regarded as endemic to West Iryan (Airy Shaw 1980). The expedition collection is apparently a first record for Papua New Guinea. Although annotated specimens of *M. papuanus* have not been seen, the species' characteristics are sufficiently distinctive for a description-based identification.

**EUPHORBIACEAE/STILAGINACEAE**

*Antidesma* aff. *chalaranthum* Airy Shaw; coll. 10716 (fr). *Antidesma chalaranthum* is known with certainty only from the staminate type collection, obtained from Goroka subdistrict in the Eastern Highlands (Airy Shaw 1979). A second specimen (*Straimann & Kairo NGF 27636*), was referred to this species as an example of the female plant, though the assignment was explicitly provisional (loc. cit.). The expedition voucher is similar to NGF 27636; both numbers being subappressedly puberulent on twigs, inflorescence axes, and abaxial midveins. Fruits are also identically glabrous, 5 mm in diameter, and with lateral styles. However, our Bismarck collection has drupes distinctly oblique, compressed, and lacking a thin-crustaceous pericarp; characters unlike the number cited by Airy Shaw. There are possibly two taxa hidden in the *chalaranthum* facies.

*Antidesma katikii* Airy Shaw; colls. 11054, 11079. Supposedly a rare endemic, previously known only from the type specimen (*Coode & Katik NGF 32762*) originating near the Ramu River at 90 m elevation. The large linear-lanceolate leaves with pubescent midrib readily identify the species (Airy Shaw 1973, 1980). Unlike the type, the expedition collections include flowering material, from which the following accessory description is provided:

Inflorescence from leaf-bearing or defoliate nodes, axillary, racemose, 2–6 cm long, rachis patently pubescent; bracts ovate, 0.5 mm long; pedicels to 1 mm, provided with indumentum like the rachis; perigone cotyliform, typically 1 mm × 0.5 mm, glabrescent or puberulous, margins minutely toothed, otherwise truncate; disc tomentulose; ovary asymmetric, 0.8 mm × 0.6 mm, pilosulous; styles excentric, 2–4, divergent or reflexed, 2-fid.

*Antidesma katikii* is locally common and a characteristic taxon in the Kanal drainage. The label on the type indicates that the species was very abundant in disturbed forest at the original collection site. It is likely that the plant is not as rare as the scarcity of specimens would suggest, but is simply undercollected and of limited range.

**LAMIACEAE/LABIATAE**

*Basilicum* sp.; coll. 10626. The collection is not *B. polystachyon*, the only *Basilicum* species recorded for Papuasia (cf. Keng, 1978). It may represent a
new species or a distributional record. The plant’s major characteristics are:

Suffrutescent and terrestrial. Leaves opposite, herbaceous, sub-bullate, adaxial surface dark green, abaxially purple. Inflorescence terminal only, racemiform, axes puberulent; verticillasters about 1.5 cm apart, short and sparingly branched; pedicels long. Calyx bilabiate, manifestly venose (also with intercostals), hairs subulate and septate; lower lip with 3 segments, midlobe furcate and biapiculate, lateral lobes much reduced, rounded or obtuse; upper lip wider, entire, shorter than the lower labium. Corolla blue to violet, bilabiate, tube contorted, shorter than the calyx; upper lip shallowly 4-fid; lower lip induplicate, entire, enlarged, enfolding the stamens; stamens didynamous, scarcely exserted, connate at the base, filaments glabrous but with some sort of median callosity, anthers discoid and centrifixed; stigma 2-fid.

MELASTOMATACEAE
Astronidium novoguineense Merrill & Perry; coll. 10762. The species was formerly reported only from West Iryan and is now newly recorded for Papua New Guinea.

Collection 10762 keys out to couplets 71–72 in Maxwell & Veldkamp (1990) and best matches A. novoguineense. However the shape of the calyx tube also suggests A. fragilissimum. If the specimen is actually the latter species, it would represent a first record for Mamose (i.e., northern PNG) region, since A. fragilissimum is currently known only from Central Province (loc. cit.).

Medinilla sp. nov.; coll. 10408. Keys to species 49–52 in Mansfeld (1925) but does not match the binomials there. The collection is somewhat like Merrill and Perry’s ‘mansfeldiana-markgrafii’ group except for the cernuous cauline inflorescence. Other salient characteristics are the following:

Epiphytic, erect, monocaulous or not. Stems and innovations setose. Leaves opposite, acroscopically directed, elliptic, to ca. 20 cm × 7.5 cm, glabrous except near the base of abaxial costae, 5–7 pinerved. Petioles proximally provided with large auriculiform alae, the auricles foliaceous, paired, purple, rounded but with margins erose. Inflorescence racemiform or sparingly ramifying, conspicuously and persistently bracteate.

MONIMIACEAE
Steganthera insculpta Perkins; colls. 10513, 10672. Steganthera insculpta is the only species in Philipson’s (1986) conspectus with sub sessile female inflorescences. It was previously known from two collections in the Sepik region (ibid).

MYRSINACEAE
Myrsine aff. acrostica (Mez) Pipoly; coll. 10958. Myrsine is currently be-
ing reviewed by J. Pipoly, and Maleayan taxa formerly included in Rapanea are being transferred to Myrsine.

Collection 10958 is either a new species or a very aberrant Myrsine acrostica (Pipoly, pers. comm.).

MYRTACEAE

Syzygium sp., aff. megistophyllum Merrill & Perry; coll. 11068. The collection keys out to S. megistophyllum in Hartley and Perry (1973). It differs from that species in the linear-elliptic leaves, to 36 cm × 8.5 cm in size, with base subsessile-emarginate but not deeply cordate. The lateral veins are in 25–30 pairs, generally straight, and obliquely diverging to a commissural nerve 2 mm from the leaf margin.

Syzygium megistophyllum is apparently known only from a fruiting specimen obtained in West Iryan (loc. cit.). The inflorescence on 11068 was cauline, developing as abbreviate cymes ≤ 4 cm length at the base of a short stem. This is not too different from the description for S. megistophyllum, though the foliar characters are otherwise distinct. The expedition voucher probably represents a new species.

PIPERACEAE

Piper lessertianum (Miq.) C. DC.; colls. 10874B and 10927. The species is a laxly pubescent climber with auriculate leaves. It is infrequently collected and apparently uncommon; Lae Herbarium has only two sheets of this taxon.

ROSACEAE

Prunus gideonii Takeuchi, sp. nov. (Fig. 4). Type: PAPUA NEW GUINEA.

Western Highlands Province: Bismarck Range, Mt. Oipu, ridge between 'Camp 1' and Bubkile, GPS lat. 05°35.513'S, x long. 144°57.252'E, elevation 2357 m, 07 Oct 1995 (fr), W. Takeuchi 10588 (Holotype: LAE; Isotype: L).

A P. palles laminis lanceolatis (non ellipticis vel oblongis) 15 cm longioribus (ne minoribus), atque glandularibus basalaribus obsoletis (non praeditis), denique habitro monoaxiali (non polyaxiali) facile dignoscenda.

Understory shrub, monocaulous or hardly branched at the top; provided with fulvous to orange-brown indumentum on all vegetative parts. Stem ascending, weak, virgate, 2–3 m long, woody throughout. Branchlets few or none, if present short and obliquely ascending, tomentose. Stipules conspicuous, paired at the petiole base, free, lanate, persisting, acuminate, 12–20 mm × 5–10 mm. Leaves spirally arranged, firm, manifestly bullate; mature blades lanceolate to oblong-lanceolate, 18–27 cm × 9–11 cm, apex acute, margin reflexed, base obtuse or subequally notched, often induplicated; adaxial surfaces dark green, initially pilose on veins, later glabrescent, abaxially orange-brown and lanate, opaquely punctulate; lateral veins 6–9 pairs, obliquely diverging, supramedially looping and usually closing at 2–4 mm from the
Fig. 4. Prunus rideonii Takeuchi, sp. nov. A: habit, mature leaves. B: shoot with stipules and immature leaves. C: infructescence.
Prunus gideonii is known only from the type locality, in stunted montane forest within the cloud zone.

_Etymology._—The new species is named for Dr. Osia Gideon, a specialist in Papuasian Rubiaceae and Costaceae, and currently the deputy director of the PNG Forest Research Institute.

*Prunus gideonii* has a distinctive aspect, with fulvous-lanate hairs on nearly all parts and large bullate leaves to 25 cm × 11 cm. Other diagnostic features are the sub-monocaulous habit and the conspicuous, persisting stipules.

The plant’s sectional affinity is unclear because the type is apparently aglandular and lacks flowers. On the basis of phytogeography, *P. gideonii* probably belongs to subgenus *Laurocerasus* section *Mesopygeum* (cf. Kalkman 1965). The type keys out to *Prunus pullei* in Kalkman (1993) but is obviously not that species.

On Kalkman’s (ibid: 322–26) key to fruiting specimens, the simplest way of accommodating the new binomial is by deleting *P. pullei* from fork 46 but retaining line 46b as the lead to the following couplet:

Ramiform trees or shrubs; leaves elliptic to oblong, 2–12 cm length, basal glands present .................................................. *Prunus pullei*

Monocaulous or sparingly branched shrubs; leaves lanceolate, >15 cm length, basal glands absent .................................................. *Prunus gideonii*

**Rubiaceae**

_Psychotria howcroftii Takeuchi, sp. nov._ (Fig. 5). _Typus_: PAPUA NEW GUINEA. _Madang Province_: Bismarck Range, ridge above ‘Camp 4,’ GPS lat. 05° 30.771'S, × long. 144° 50.646'E, elevation 900 m. 23 Oct 1995 (fl, fr), W. Takeuchi 11090 (holotype: LAE; isotypes: A, BISH, BRIT).

Propert inflorescentiam trichotomam, stipulas valvatas, tubum corollinum 2 mm longiorum, denique fructum magnum, _P. solomonensi* valde arce affinis, sed ab ea laminis 22–30 (non 17–20) cm longis, nervis secundaris 15 minoribus (non majoribus), denique floribus pedicellatis (non sessilibus) statim distinguitur.

Fruticoso or subarboreoscent to 4 m height, vegetative parts entirely glabrous. _Stem_ erect and laxly branching, basal swell absent. _Branchlets_ terete, 4–7 mm diam., pithy, fleshy, moderately robust, collapsing when dry, surfaces smooth and nitid. _Stipules_ valvate, basally connate, ±fugacious, at first
Fig. 5. *Psychotria howcroftii* Takeuchi, sp. nov. A: habit; mature leaves and young inflorescence. B: architectural form (ternate) of the infructescence. C: drupe in longisection. D and E: drupe in cross-section. Endosperm ruminations not shown.

acuminate and conduplicate, expanding and ovate when fully developed, 7–9 mm × 6 mm, undulate, margins entire. Leaves opposite, coriaceous, spreading, domatia lacking; mature lamina ob lanceolate-oblong, 22–30 cm × 8–13 cm, apex abruptly acuminate, base cuneate; adaxial surfaces dark
green, abaxially very pale green, in sicco bifacially fuscous; lateral veins in 16–19 pairs, equispaced, evenly arcuate, closing only rarely by marginal loops, major veins embossed on upper side, prominent beneath; reticulum feeble, the crossing nerves subscalariform, otherwise with plexus irregular; petioles 4–6 cm. Inflorescence terminal, to 5 cm length, umbelliform, 3 rachises connivent and approximately 'trichotomous', primary branches ternate-verticillate, ultimately cymose, all axial surfaces light green and glabrous; bracts caducous, deltoid, minute, reflexed, adaxially pilosulous. Flowers sessile and externally glabrous; calyx cupular-turbinate, 5–6 mm × 4–6 mm, margins strictly truncate; corolla 4-merous, valvate, white, the bud acute, 9 mm × 2.5 mm prior to anthesis, lobes oblong, divided to 3 mm from the base (rehydrated bud 12.5 mm × 4.5 mm with segments 7.5 mm × 3 mm and divided to 5 mm from the base); throat pilose, hairs sepalate-moniliform; stamens 4, alternipetalous, adnate near the sinuses; anthers dorsifixed, oblong; style exceeding the anthers, glabrous, ?heterostyloous; stigma 2-fid and fimbriate; disc annulate, glabrous, marked by a central excavation after stylar abscission; open flowers not seen. Infructescence diffusely paniculiform-umbelliform, flaccid, to 10 cm length, articulated at the ramifications; peduncle 2 cm. Drupes subglobose-ellipsoid, 19–22 mm (excluding calyx) × 15–17 mm, pericarp orange-red, convex, contracting and conspicuously angulate after drying; calyx tube persisting at the summit, vasiform to cylindric, 3–4 mm × 4–6 mm. Pyrenes 2, equal, plane on the commissural face, dorsally crested; endosperm ruminate.

Distribution and ecology.—Known only from the type locality, there occurring as scattered individuals in the understory of mature growth forest or in stands with advanced regrowth.

Etymology.—The new species is named for N.H.S. Howcroft; an orchidologist, silviculturist, and botanical illustrator, currently serving as the managing consultant of a balsa project in New Britain.

Psychotria howcroftii is immediately distinguished by the exceptionally large fruits borne on a diffuse, articulated infructescence. The oversized drupes are made even more conspicuous by persistence of the 4 mm long calycine tube. Among Papuasian Psychotria only P. monopedicellata has fruits as large but that species has calyptrate stipules and monoaxial inflorescences (Sohmer 1988).

The immature inflorescence on P. howcroftii appears trichotomous (sensu Sohmer), but since the mature infructescence is pedunculate, the initial trichotomous structure is merely due to delayed prolongation of the peduncle. Another developmental peculiarity is that stipular form becomes manifest only at the subapical node, the stipules being otherwise severely enfolded at the apex.
The new species will key to fork 36 on Sohmer (1988: 15). It can then be assimilated to the existing decision train by deleting lead 36b for *P. solomonensis* and adding the following:

36b. Corolla tube at least 2 mm long
   Mature blades >20 cm long; lateral veins >15 pairs; fruits >15 mm long ....... *P. howcroftii*
   Mature blades <20 cm long; lateral veins <15 pairs; fruits smaller ....... *P. solomonensis*

**URTICACEAE**

**Pilea hedemarkii** Takeuchi, sp. nov. Type: PAPUA NEW GUINEA. Border of Western Highlands Province and Madang Province: Bismarck Range, near 'Camp 2' on Mt. Gulno, GPS lat. 05° 32.7' S, \( \times \) long. 144° 47.8' E, elevation 2040 m, 12 Oct 1995 (fl, fr), W. Takeuchi 10740 (Holotype: LAE; Isotypes: K, L).

Species haec inter se allis species generibus, laminis linearibusque uninervis atque squamibus aurantiaco-lepidotibus ineditis praecellente distat.

Weakly ascending monocaules or ramiform chamaephytes, <0.5 m height, terrestrial, monocious. *Stems* slender, terete, glabrate, orange-brown, marked by parallel cystoliths or not. *Stipules* axillary, connate, caducous, obscure, 0.2–0.3 mm long, entire. *Leaves* paired, isomorhous but generally unequal, divergent, glabrous, chartaceous, bifacially squamulose; scales diffuse, peltately based, orange-hyaline with darkened centers; lamina linear, major blades usually 17–34 mm × 2–3 mm, apex acute, margins distally and distantly serrate, proximally entire, base obtuse; adaxial surfaces dark green, provided with linear cystoliths, these mostly transversal, less often randomly directed, on leaf margins abruptly longitudinal and congested; abaxial surfaces pale green to glaucous, collaterally glandular-lineate along the midrib; venation unicostate, other nervation invisible; petiole 1–3 mm long. *Inflorescence* axillary and solitary; cymes glomerulate, several together, occasionally simple; peduncle obsolete or to 9 mm long and filiform. *Male flowers* (rehydrated measurements) sessile or less commonly pedicellate, bracteolate, glabrous, entirely white; perigone 4-fid, typically 3 mm long, 1.5 mm wide at the base, ovoid in bud, segments lanceolate-ovate, each about 1.8 mm × 1.2 mm, costate, the rib excurrenty corniculate or mucronulate; stamens 4, oppositi-tepalous, adnate to the tube, filaments inflexed; pistilode reduced to a minute flap. *Female flowers* glabrous, pedicelled or appearing sessile when immature; perigone 3-partite, fleshy, lateral segments vestigial, median segment enlarged and accrescent, acroscoptic; staminodes 3, globular, oppositi-tepalous; ovary ellipsoid to cylindriform at first, later oblique and compressed; stigma penicillate, semi-persisting, directed at the major tepal. *Inflorescence* entirely light green. *Fruits* basiscopic on a retrorsely turned stalk, asymmetrically ovoid, 1.2–1.0 mm × 1.0 mm, compressed, marginate; pericarp thin and smooth. *Seed* flattened, rostrate.

*Distribution and ecology.* — *Pilea hedemarkii* is known from montane forest...
in the Western Highlands, Madang, and West Sepik Provinces. During the expedition it was often seen along footpaths and forest margins. Another collection which is referable to this species (NGF 41691), has a label describing its habitat as 'broken forest,' further showing that the plant is found in successional situations.

Etymology.—The new species is named for Michael Hedemark, the expedition leader and a former conservation biologist with the United Nations Development Program. He is currently with the Wildlife Conservation Society in Laos.

Other Specimens Examined: PAPUA NEW GUINEA. West Sepik Province: Bli Mt. south of Oksapmin, broken forest on hillside, lat. 05° 20' S × 142° 15' E, elevation 7200' (2195 m), 22 Oct 1968 (fl), E. Henty, R. Igar, & M. Galore. NGF 41691 (A, BRI, CANB, K, L, LAE). Western Highlands Province: Bismarck Range, Mt. Oipu, subcrest slopes of main ridge in vicinity of 'Camp 1,' low stature montane forest in cloud zone, GPS lat. 05° 35.5' S, × long. 144° 47.3' E, elevation 2560 m, 05 Oct 1995 (fl), W. Takeuchi 10481 (A, BISH, BRIT, CANB, L, LAE); Bismarck Range, Mt. Oipu, ridge community between 'Camp 1' and Bubkile, low stature montane forest in cloud zone, GPS lat. 05° 35.5' S, × long. 144° 47.3' E, elevation 2400 m, 07 Oct 1995 (fl), W. Takeuchi 10559 (K, LAE).

Papuasian *Pilea* have been treated in Winkler (1922) and van Royen (1982). Although both authors provide keys to species the coverage of either account is incomplete. The genus still awaits a synthetical revision.

*Pilea hedemarkii* is distinguished from all other Papuasian congeners by the linear and uninnervial leaves. The minute, orange-brown, and peltate scales are also distinctive, though not unique.

**Discussion**

The expedition discovered about 15 confirmed or suspected new species, in addition to other noteworthy gatherings summarized in the preceding section. At least 613 distinct morphospecies were represented in the 730 collections made by the survey. It is instructive to compare the number of novelties reported here with two of the largest surveys recently concluded from other parts of Papuasia, both of which were also of approximately one month duration. The 1994 New Ireland survey produced only two new taxa (Takeuchi & Pipoly 1998), and a total of 8 novelties is suspected from the 1997 Lakekamu survey (Takeuchi & Kulang 1998). Results from the present expedition support previous estimates of high biodiversity in the Bismarck-Ramu tract, and justify enactment of conservation measures for the area. Due to inclement weather and the overall scarcity of fertile sightings, the collections coverage was far from comprehensive. There is clearly considerable scope for further discovery.
APPENDIX I

Expedition Plant List From Bismarck-Ramu. Numbers refer to exsiccatea vouchers. SR = sight record without exsiccatea; (m) = male plant; (f) = female plant. Determinations by the author unless otherwise indicated. Asterisk (*) preceding binomial indicates presence of discussion in text.

AVASCULAR PLANTS

BRYIDAE
genre inder., 10675, 11003

FERNS AND FERN ALLIES

ADIANTAECES
Syngnoma quinata (Hook.) Carruth., 11062
Tarenna biceleoides (Willd.) Swartz., 10937

ASPLENIAEAE
Asplenium acrobyrum Christ., 10537, 10970, 11055
Asplenium affine Swartz., 10526
Asplenium bipinnatifidum Baker, SR from Camp 3
Asplenium candidum Forst. f., 10777, 10910
Asplenium connatum Swartz., 11051
Asplenium decorum Kunze, 10837
Asplenium morumense Copel., 10643B
Asplenium nudum L., SR from Camp 3
Asplenium phyllitis D.Don subsp. maleatum
Holttum, 10895-A, 11050
Asplenium stewart Harrington, 10445, 10456
Asplenium cf. stewart Harrington, 10479
Asplenium submargiratum Rosend., 10996
Asplenium tenerum Forst. f., SR from Camp 3
Asplenium unilaterale Lam., 11002
Didymochlaena transatlantica (Swartz) J. Smith., 10924

ATHYRIEAE
Didiplazium hantzschii Blume, 11064
Didiplazium cordifolium Blume, 10761, 11056
Didiplazium confertum (Retz.) Swartz, 10781
Didiplazium sp., 10779

BLECHNACEAE
Blechnum australioides (v.A.v.R.) C. Chr., 10435
Blechnum cf. archboldii C. Chr., 10604
Blechnum dentatum (Kuhn) Diels, 10828, 11074
Blechnum doorei-lohianum Brause, 10423
Blechnum fraseri (A. Cunn.) Luerssen, 10576
Blechnum orientale L., SR from Camps 1 & 3
Stenochlaena arendarsis (Harr.) Copel., 10772

CHEIROLEUPIRACEAE
Cheirolepis bicuspis (Bl.) Presl., 10942

CYATHEACEAE
Cytisena angustis (Gepp) Domin, 10848
Cytisena cf. cincinnati Brause, 10763
Cytisena selvamensis Rosend., 10551, 10561, 10706
Cytisena bornii (Baker) Copel., 10846

DAVALLIAEAE
Davallia divaricata Blume, 10776
Humata sp., ‘alpha-neogineensis group’, 10572
Humata sp., 11066
Lewesia pallida (Mett.) Copel., 10804, 10820

DENNSTAEDTIACEAE
Denststaeada glabrata (Cesati) C. Chr., 10688, 11087
Denststaeada sp., ‘novogineensis group’, 10533
Histiopteris cestipulata v.A.v.R., 10698
Histiopteris integripilta Copel., 10889
Histiopteris squamulata Holttum, 10483
Hypolepis bullomiaria Rosend., 10491
Hypolepis stahristpax Brownsey, 10778
Microlepta sp., 10646
Paelea radula (Baker) C. Chr., 10574

DIPTERIDACEAE
Dipertis congynata Reiw., 10617, 10803

GIECHENIACEAE
Dixwiaopsis linearis (Burm.) Underw., SR from Camp 1
Gleichenia brassi C. Chr., 10611
Gleichenia dicarpa R. Br., 10616

GRAMMITIDACEAE
Calypnophora chalcif (Hook.) Copel., 10557
Ctenopteris sp., ‘cornitia-cenoides group’, 10575
Ctenopteris flagelliforme Brause, 10548
Ctenopteris cf. langset (Rosenst.) Copel., 10594B,
10496
Ctenopteris millefolia (Blume) Copel., 10578
Ctenopteris repandula Kunze, 11053
Ctenopteris stellatoidea Copel., 10668
Ctenopteris (close to) stellatoidea Copel., 11070
Ctenopteris subauzorndiisata (Zoll.) Copel., 10549,
10699
Grammitis dolichospora (Copel.) Copel., 10594A,
10664
Grammitis cf. dolichospora (Copel.) Copel., 10915
Grammitis interrupta (Baker) Copel., 10607
Grammitis stahristpax (Baker) Copel., 10594D
Grammitis sumatrana (Baker) Copel., 10546,
10594C
Takeuchi, Bismarck-Ramu expedition in Papua New Guinea

HYMENOPHYLLACEAE

Hymenophyllum sensu lato:
Meadium sp., 'badium-baditamiun group', 10679

Lygodium aff. productum (Kunze) Copel., 10839
Meringium cf. gorgoneum (Copel.) Copel., 10621
cf. Meringimum sp., 10550; sterile collection
Trichomanes sensu lato:
Cephalomanes oblongifolium Presl, 10916

Lindsaea

Macroglena meffilia Copel., 10739
Macroglena schlecterii (Brause) Copel., 10651
cf. Macroglena sp., 10721
Neopteris cf. intermedia (v.d.B.) Copel., 10969, 11004
Pleurozium palidum (Blume) Presl, 10628

Lindsaea group

Lindsaea obtusa J. Smith, 10691, 10844
Lindsaea obtusa J. Smith, 10705; pinnate form
Lindsaea pulpella (J. Smith) Mett. ex Kuhn, 10838, 10932
Lindsaea pulpella (J. Smith) Mett. ex Kuhn var. blanda (Mett. ex Kuhn) Kramet, 10525
Lindsaea rigida J. Smith, 10966
Sphenomeris chimonis (L.) Maxon, SR from Camps 3 & 4
Sphenomeris retusa (Cav.) Maxon, SR from Camps 1, 3, & 4
Tapeinidiun sp., 10565

LOMARIOPSIDACEAE

Bolbitis heteroclita (Presl) Ching, 11021
Bolbitis viridaris (Brackenridge) Ching, 10995, 11007
Bolbitis viridaris (Brackenridge) Ching, 11011; large form
Elaphoglossum novoguineense Rosenst., 10590
Lomatiaegna ruina (C. Chr.), 10998

LYCOPODIACEAE

Huperzia nummularifolia (Blume) Jermy, 10771
Huperzia phlegmaria (L.) Rothm., 10509
Huperzia aff. tpinifolia Trevisan, 10877
Huperzia squarrosa (Forst. f.) Trevisan, 10935
Lygodium vulubile Forst. f., 10397
Pallhiniaea cernua (L.) Vasc. & Franco, SR from Camps 1 & 3

MARATTIACEAE

Angiopteris evaeta (Forst.) Hoffman, 10816
Marattia cf. tafaenus C. Chr., 10499, 10501

OLEANDRACEAE

Nephelepis lasiura (Swartz) Schott, 10786
Nephelepis bisusuta (Forst. f.) Presl, 11030
Nephelepis lasiura (Swartz) Christ, 10605
Nephelepis roseochna (Brause), 10812
Nephelepis schlechteri Brause, 10670, 10769
Oleandra cuspidata Baker, 10634, 10758, 10775
Oleandra sibbaldii Grev., 10703
Oleandra werneri Rosenst., 10814

OPHIOGLOSSACEAE

Ophioglossum pendulum L., 10534

POLYPODIACEAE

Aglaotheca drynarioidea (Hook.) Roos, SR from Camp 3
Aglaotheca heraclea (Kunze) Copel., SR from Camp 3
Belvisia mucronata (Vée) Copel. var. mucronata, 11017
Belvisia novoguineensis (Rosenst.) Copel., 10412, 10467, 10694
Belvisia validicostata (Kunze) Copel. var. longissima (Holttum) Hovenkamp & Franken, 10509
Colysis polysora (Brause) Copel., 10893
Drynaria rigidula (Swartz) Bechd., SR from Camps 2 & 3
Goniophlebium demerum (Brause) Rödl-Linder, 10503
Goniophlebium pseudonauticum (Copel.) Copel., 10817
Goniophlebium serratifolium Brackenridge, 10432, 10484, 10489
Lecanopteris deparioides (Cesati) Baker, 10802, distr. as L. curtissii Baker
Lemmaphyllum accedens (Blume) Donk, 10783, 10925, 11008, 11010
Losogomme pattoniioides Presl, 10487
Microsorum papaum (Baker) Parris, 10477, = Phymatosorus sp.
Microsorum sp., 10987, 11012
Phymatosorum communis (Blume) Pichi Sermolli, 10801
Selliguea albidognamata (Blume) Parris, 10505, 10782, 10871, sn, distr. as Cryptisus spp
Selliguea cervisia (Cav.) Ching, 10528, 10759, 'subgimrneus, distr. as Cryptisus inbedusia anus
Selliguea bellwighi (Diel) Hovenkamp, 10449, 10538, 10931, distr. as Cryptisus senexsens
Selliguea lauterbachii (Brause) Hovenkamp, 10439, distr. as S. cf. gibitae
Selliguea Plantaginana Brackenridge, 10492; distr. as Selliguea sp.

PTERIDACEAE

Pteris blumeana Agardh, 10764
Pteris wallichiana Agardh, 10493
Pteris warburgii Christ, 10988
SCHIZAEACEAE
Schizaea dichotoma (L.) J. Smith, 11057
Schizaea fistulosa Labill., 10970

SELAGINELLACEAE
Selaginella spp., angustifolius-bicornian group, 10547, 10930

Tectaria group
Pteridium cf. microcarpum (Fée) C. Chr. & Ching, 10960
Tectaria cf. christanae (C. Chr.) Alston, 11014
Tectaria decurrens (Presl) Copel., 10997

THLYPTERIDACEAE
Cyrtomium falcifolium (Fourn.) Holttum, 10620
Platycerium marattioides (Alston) Holttum, 10547
Pnemaphyton sgerrens (Gepp) Holttum, 10810
Pnemaphyton sp., ‘superb-sulaphytondata group’, 10549, 10543
Promerium hecarranianum (Cesati) Holttum, 10645B
Promerium pentaphyllum (Rosenst.) Holttum, 10736
Promerium br. scoparium Holttum, or aff., 10645A, 10786, 10880
Pseudophytophyton aurita (Hook.) Ching, 10485
Sphaerotheca arborialis (C. Chr.) Holttum, 10416
Sphaerotheca cf. arfakiana (Baker) Holttum, 10993
Sphaerotheca densiflora (Brause) Holttum, 10788
Sphaerotheca micranthema (Brause) Holttum, 10989
Sphaerotheca unitas (L.) Holttum var. papillosea
Holttum, 10784
Sphaerotheca sp. exseta Holttum, 10808, 10911
*Sphaerothecas sp. nov., 10707, 10733

VITTARIACEAE
Autophyllum planatinum (Cav.) Kaulfuss, 10542
Autophyllum reticulatum (Forst.) Kaulfuss, s.l., 10989
Vittaria elongata Swartz var. angustifolia Holttum, 10953

GYMNOSPERMS

GNETACEAE
Gnetum gnemon L., 10805

MONOCOTS

AGAVACEAE
Cordyline terminalis Kunth, SR from Camp 3

ARACEAE
Alcaica acutipila N. E. Br., 11001
Alcaica nakajimensis A. Hay, 10947
Amygdrium zippelii (Schott) Niolsen, SR from Camp 4
Colocasia esculenta (L.) Schott, 10807
Cyrtosperma macrorhizum Becc. ex Engl., 11075
Epipremnum angulatum (Schott) Engl., SR from Camp 4
Epipremnum pinnatum (L.) Engl., SR
Hololepia tessellata Engl., 10999
Hormidium sp. A, 10642, short-stem herb
Hormidium sp. B, 11110, robust cordate-leaf herb
Pathus sp., § Pathus, 11063, sterile collection
Rhipidophylla sp., 10863, Stone’s architecture

ARECACEAE
Calamus cf. reticulatus Becc., 10569
Caryota rumphiana Blume, SR from Camp 3
Heterospatha sp. A, 10766
Heterospatha sp. B, 10676, 10954
Hydnarsete sp., 11077
Korthalsia cf. zippelii Blume, 11064
Lanospilax sp., 10712; not L. albertriana
Oenocarpus cf. oerophila Essig, 10875

COMMELINACEAE
Commelina diffusa Burr. f., 10789
Filosca scramoides Lour., 10873
Frostia multissima (Blume) Kds., 10989; as
Amicabilis spp. marginata (Blume) Backer
Pallida thyrsiflora (Blume) Steud., 11076

COSTACEAE
Tropaenobis bollumaeii K. Schum., 10985; det. O. Gideon

CYPERACEAE
Carex alopocaroides D. Don var. chlorostachys (D. Don) Clarke, 10455
Carex graefeiica Boeck., 10714
Carex lamprechtiana S.T. Blake, 10564
Cyperus cyperinus (Retz.) Valck. Sur., 11086
Cyperus distans L., 10795
Cyperus kylidioegi Endl., 11070, 10774
Eleocharis attenuata (Franch. & Sav.) Palla, 10629
Eryngium dysosoma (L.) Vahl, 10835
Hyptidium compactum Nees & Mey., 10933
Hygrophorus noronhae (Vahl) Sprone., 10900, 10912
Paracnempsa parviflora (Clarke) Ullrich, 10928
Scleria isochracea Nees & Mey., 10842

DIOSCOREACEAE
Dioscorea bulbifera L., 10133
FLAGELLARIACEAE
Flagellaria indica L., SR from Camp 3

HELICONIACEAE
Heliconia papuanu W.J. Kress, 11045

JUNCACEAE
Juncus prismatocarpus R. Br. var. indicus, 10403

LILIACEAE
Dianella ensifolia L., 10419

MARANTACEAE
Phrynium cf. macrocephalum K. Schum., 11047 Phrynium sp., 10882

MUSACEAE
Musas sp., 11046


PANDANACEAE
Freyerina sp. 110725 Freycinetia sp. A, 10881 Freycinetia sp. B, s.n., Oct. 23, 1095 Pandanus sp., "adunobryoid-setisulystylos group", 10767 Pandanus sp., § Intrafrombius, 10623 Pandanus sp., 11071

PHRIESIACEAE
Getsemnelium cymosum A. Cunn., 10592B

POACEAE/GRAMININAE
Bambusa cf. forbesii (Ridley) Holtsum, 10962 Ischne albens Trin., 10476 Ischne albo-marginata Jansen, 10448 Ischne myositis Nees, 10684 Ischne paniculata Hack., 10938 Lophatherum gracile Brongn., 10847 Penisetum macrorachyham (Brongn.) Trin., 10798 Saccharum officinarum L., 10800 Setaria palmifolia (Koenig) Stapf, 10465

SMILACACEAE
Smilax cf. zeylanica L., 11034

ZINGIBERACEAE
Alpinia odontonema K. Schum., 10683 Alpinia werneri Valeton, 10869 Alpinia sp., § Dissomia pfaffii, 10964 *Alpinia sp., aff. odontonema, § Psychotria, 10595 Elingera angustifolia (Valeton) R.M. Smith, 10538 Elingera sp., 10878; Grammostylis (Psychotria) Pleurotonduum sp., § Psychotria, 10849, 10959 Redelia gelonioides (Laut.) Valeton, 10397 Redelia monticola Valeton, 10619, 10727 Redelia rosea van Rooyen, or aff. monticola, 10780, 10757 Redelia subacaulys Valeton, 10723

DICOTS

ACANTHACEAE
Hemigraphis aff. primuliflora (Nees) E. Vill., 11015 Leptosiphon sp., 10870 Ptyxis apiculata sp., 11006 Rhusia lillwi S. Moore, 10524

ACTINIDIACEAE
Saurania cf. capitata A.C. Smith, or aff., 10596 Saurania aff. conferta Warburg, 10815, 11036 Saurania congestiflora A.C. Smith, 10826 Saurania ilicifolia van Rooyen, 10424 Saurania sp. van Rooyen, or aff., 10539, 10904, 11043 Saurania schumanniana Diels, 10940
AMARANTHACEAE
Iresine herbiflora Hook. f., 10796

ANACARDIACEAE
Campnosperma brevipetiolata Volk, SR from Camp i

ANNONACEAE
Haplopterygium longirostris (Schlter) van Heusden, 11048

APIACEAE

APHRODITEIACEAE
Hydrocotyle erioptima Lamk, 10473, 10520

APOCYNACEAE
Alyxia markgrafii Tsang, 11109
Parsonia cl. sangaima (Wernham) Markgr., 11093
Parsonia sangaima (Wernham) Markgr. var. brasii (Markgr.) D.J. Middleton, 10733
Parsonia warneri Kanehira & Matsumura, 10906
Parsonia sp., 10860
Tabernaemontana pandanifolia Lam., 10967

AQUIFOLIACEAE
Hex samarindula Merrill & Perry, 10841
Hex samicata Blume, 10583

ARALIACEAE
Gastonia specabilis (Harms) Philipson, 10956
Harmosiphax ingen Philipson sp. ingen, 10514
Mackinlaya celebana (Harms) Philipson, 10674
Mackinlaya schlechteri (Harms) Philipson, 10710
Osmoxylon novoguineense (Schel.) Becc., 10968
*Polystachys bidentata* (Honda) Philipson, 10580
Schiffnera ubamanniana Harms sp. ubamanniana, 10643, 10744
*S. specabilis* sp. nov., aff. sparsidentata Frodin, 10427, 10471
Schiffnera cl. sambucus Frodin, 10498
Schiffnera cl. vestigie Harms, 11109; also possibly *S. forbesii*

ARISTOLOCHIACEAE

ASCLEPIADACEAE
Hoya sp., 10922
Tylophora cirrhoides Blume, 11025

ASTERACEAE/COMPOSITAE
Adenostemma atavaa (L.) O. Keitz., 10404, 10480
Agaratum conyzoides L., 10429
Arrhenatherum novegineense (S. Moore) Mattf., 104826 sp. novoguineensis
Bridin piliola L. var. minor (Blume) Sherff, 10458
Blumea arbricata Martelli, 10884
Blumea arnoldiflora Mattf., 10536
Blumea sylvatica (Blume) DC., 10562
Blumea sylvatica (Blume) DC. var. macrophylla (Blume) Randieria, 10434, 10531
Blumea sylvatica (Blume) DC. var. sylvatica, 10454
Craspedia cephalophorus (Benth.) S. Moore, 10799
Erechtites vulgaris (Walt.) DC., 10797
Mikania cordata (Lam.) R. Rob., 10879
Olearia platypylla Mattf. var. exmurea (Mattf.) Koster, 10413
Olearia sylva Koster, 10598
Vernonia cuneata Less., 10831

BALSAMINACEAE
Impatiens banksii Bull, 10381, 10428, 10872

BEGONIACEAE
Begonia cf. augusta (L.) Irmscher, 10992
Begonia sp., *kauaiensis group*, 10441; climber, det. O. Gicle
Begonia envanana Merrill & Perry, or aff., 10502, 10889

BIGNONIACEAE
Toxanthus denophila (Blume) K. Schum. & Laut., 10704

BORAGINACEAE
Teinostemma serotinae Lamk, SR from Camp i

BURSERACEAE
Haplocladium cf. floribundus (K. Schum.) H.J. Lam., 11093; *floribundus-vestigie*

CAMPANULACEAE
Peracarpa canna (Wallach) Hooker & Thompson, 10544

CARYOPHYLLACEAE
Caryocarya cubensis Blume, 10793

CARICOPHYLACEAE
Drymaria cordata (L.) Willd. ex Roem. & Schult., SR from Camp i

CASUARINACEAE
Gymnostoma pumilum (S. Moore) L. Johnson, 10655

CELASTRACEAE
Celastrus monoperaeoides Loes., 10851

CEPHALOTAXACEAE

CHORANTHACEAE
Ascarina phillipinensis C.B. Rob., 10613
Ascarina suboosulifolia Verdc., 10760

CLUSIACEAE/GUTTIFERAE
Garcinia arbicifolia A.C. Smith, 10494
*Garcinia sp nov., 10108; det. P.E. Stevens
Garcinia sp., 10591

CRYPTERONIACEAE
Cryptothrasiinaea (Planch.) Planch. ex Endl., 11104
CUCURBITACEAE
Trichosanthes sp., 10927A; sctete collection
Zebneria cissymium (Jacobs) Jeffrey, 10737
Zebneria cf. cissymium (Jacobs) Jeffrey, 10518

CUNONIACEAE
Asmitaphila rutlandata (Schltr.) Hoogland, 10603
Caldenia naja (Schltr.) Hoogland, 10673
Ceratopteris succirubrum C.T. White, 10853

DAPHNIPHYLLACEAE
Daphniphyllum gracile Gage var. gracile, 10584

DILLENIACEAE
Dillenata cf. schlechteri Diels or cf. quenifolia White & Francis, 10495

ELAEOCARPACEAE
Aceratrum peregrinum Schltr., 10806
Elaeocarpus tariens Weibel, 10422, 10591
Shorea brachystyla (Schltr.) A.C. Smith, 10747
Shorea velutina (Schltr.) A.C. Smith, 10553

ELEGNAEACEAE
Eleagnus trifolia Roxb. cf. var. breviloba T. Hart, 10811, 10874

ERICACEAE
Dinophoranthera cornuta J. J. Sm. var. tenuiflora
Sleumer, 10395
Dinophoranthera aff. cornuta J. J. Sm., 10743; det. P.F. Stevens
Dinophoranthera elegansissima K. Schum. var. splendens (Sleumer) P.F. Stevens, 10632 (fl); det. P.F. Stevens
Dinophoranthera elegansissima K. Schum. var. splendens (Sleumer) P.F. Stevens, 11108 (fr)
Diphylia acidula Schltr., 10908
Diphylia morrisii Sleumer, 10658
*Rhododendron anagalliflorum Sleumer, 10389, 10686
Rhododendron bayerinckianum Koord., 10683
Rhododendron aff. bayerinckianum Koord., 10396; not the species
Rhododendron englerianum Sleumer, or aff., 10863
Rhododendron cf. mangrogaef F.v.M. var. glebifilum (J.J. Sm.) Sleumer, 11073
Rhododendron superbum Sleumer, 10859
Rhododendron wrightianum Koord. var. stanislare Sleumer, 10656
Vaciniun reticulatum-vosigni Sleumer, 10887
Vaciniun sp., § Ovaranth; aff. vossiiforum J.J. Sm., 10907

EUPHORBIACEAE
*Antidesma aff. chelavarianum Airy Shaw, 10716
*Antidesma katikiri Airy Shaw, 11054, 11079
Apopsis sp., 'breviceps-squarrosa group', 10701 (l), 10722 (m)
Aposeris laxiflora Pax & Hoffman, 10582
Breynea cernea (Poir.) Muell. Arg., 10529
Bridelia pentangiana Hook. f. cf. var. pentangiana, 11020
Clausena ostiaco-lantanum Airy Shaw, 10519
Endoperoxum labios Schodde, 11048
Euphorbia plumerioides Tejsm. ex Hassk. var. acuminata J.J. Sm., 10792
*Glochidion sp. nov., 10543
Macaranga akosoridas F. Muell., SR from Camp 4
Macaranga bireita J. J. Sm., 10792
Macaranga candata Pax & Hoffman, 10414, 10470
*Macaranga reiteriana Pax & Hoffman, 10496, 10508
*Mallophor pusasanz (J.J. Sm.) Pax & Hoffman, or aff., 10947
Omalanthus nov-guineensis (Warburg) K. Schum., 10407, 10957

FAGACEAE
Castanopsis acuminatissima (Blume) A. DC., 11082
Lithocarpus cf. celebicus (Miq.) Rehd., 10785

FLACOURTIACEAE
Flacourtia ziziphiis Slooten, 11039
Pongium edule Reinh, SR from Camp 4

GESNERICACEAE
Aeschynanthus sp. A, 10442
Aeschynanthus sp. B, 10630
Aeschynanthus sp. C, 10678
Cytandra fuscosella K. Schum., 11009
Cytandra aff. pawowskyi Schltr., 10897, 11078
Cytandra sp., subgenus Cytandra, 10443, 10741
Cytandra sp., subgenus Cytandra, 10510
Cytandra sp., § Diplochiton, 10469, 10715
Cytandra sp., cf. § Diplochiton, 10506, 10599
Cytandra sp., cf. § Diplochiton or § Luxoxobas, 10440
Cytandra sp., § Geodesma, 10383, 10452, 10681
Cytandra sp., § Luxophyllium/Phacotrichium, 10577, 10637, 10840
Cytandra sp., cf. § Luxophyllium/Phacotrichium, 10734
Cytandra sp., § Macrocytandra, 10631
Cytandra sp., 10709; possibly = sp. 10443
Dicksonia sp., 10883
Rhynchobosia obliqua Blume, 10986

GOODENIACEAE
Scevola oppositifolia R. Br., 10832

GROSSULARIACEAE
Polyrampa aff. subelpina Schultz-Menz., 10555, 10677

HALORAGACEAE
Gomarcarpus bagonensis (Merrill) Orchard, 10600
Gunnera macrophylla Blume, 10420

HYDRANGEACEAE
Debora floribunda Lour., 10426; 'sylvestris complex'

LAMIACEAE/LABIATAE
*Basilicum sp., 10626, 10972
Orchisphora aristata (Blume) Miq., 10966
Platcrtamus parviflorus Willd., 10581

LAURACEAE
Actinodaphne nitida Teschner, 11105
Actinodaphne tomentosa Teschner, 10752
Cinnamomum laniariai Allen, 10649
Cinnamomum cf. pedigracum Kostermans, 10845
Cryptomyrtus aff. roscofiforme Teschner, 10516
Cryptomyrtus notobiligeratum Kostermans, 10652, 10680, 10728
Litsa curtii Kostermans, 10444

LEACEAE
Lea indica (Burm. f.) Merrill, 10825, 11040

LEGUMINOSAE/FOBACEAE
Derris camellifolia sensu Verdec., 11031
Desmodium repandum (Vahl) DC., 10457
Desmodium squarrosum Wall., 10895, 11023
Isocarpos 'rubidus' morphtype, papuanns group, 11083; sensu Verdecourt
Macaranga nov-guineensis Schell., SR from Camp 4
Paezara pubescentia (Koord.) Koord.-Schumacher, 11029

LOGANIACEAE
Fagara cf. ceylanica Thunb., 10729
Fagara elliptica Roxb., 11106
Geniostoma aff. 'regeste complex', 10644

LORANTHACEAE
Amyema squarrosum (Krause) Danser ssp. squarrosum, 10606
Macrourous ochinomelas (Lour.) Tiegh. var. ochinonemas, 10854

MAGNOLIACEAE
Elmerrillia tsiamaca (L.) Dandy ssp. tsiamaca, 10738

MELASTOMATACEAE
Astroma arm-viridis Mansfeld, 10437, 10612
*Astrondium cf. mariguamense Merrill & Perry, 10762
Astrondium indet., 10533; probably Astrondium sp. Beccarianthus sp., 10902
Cecrionia mariguamense (Baker f.) Veldkamp & Nayar, 11094
Dischacheta angiovois Olivi, 10790
Medinilla albida Merrill & Perry, 10654
Medinilla aff. albida Merrill & Perry, 10556; but leaves sessile
Medinilla dentata Veldkamp, 10666
Medinilla bollingiana Mansfeld, 10852
Medinilla aff. 'amplissima-teymannii group', 10862; closer to lorentiziana
Medinilla soerensii Baker f., or aff., 10406
Medinilla teigmanni Miq., 10977
*Medinilla sp. nov., 10448
Melastoma malabathricum L., 10398
Otanthera adressa Mansfeld, 10888
Poleiogene infurcata Markgr., 10400
Poleiogene macrophylla (Cogn.) Mansfeld, 11095

MELIACEAE
Aglaia cl. silvestris (M. Roemer) Merrill, 10665; but leaflets symmetric
Aglaia aff. 'tomentosa group', 10813; but inflo. pendant, new
Chisocheton lasiocarpus (Miq.) Valeton, 11000;
formosa-cum-pachyrhachis
Diosyxiium eucantiophyllum Harms, 10438, 10751

MONIMIACEAE
Kihara karengana Philipson, 10554
Leviera montana Becc., 11049
Palmera arakiana Becc., 10401
Palmera gracilis Perkins, 10876
Stegantbera hypnota (Becc.) Kanchira & Hatusima, 11041
Stegantbera idyllosa A.C. Smith, 10593, 10749
*Stegantbera insculpta Perkins, 10513, 10672

MORACEAE
Ficus adolphia Laut. & K. Schum., 10903
Ficus arborea Laut. & K. Schum., 11038
Ficus comita King, 11100
Ficus opposita Miq., 10726, 10730
Ficus pungea Reiw. ex Blume, SR from Camps 3 and 4
Strychnos trophylla Diels, 10601

MYRISTICACEAE
Alcyristia pachypilla A.C. Smith, 10660
Alcyristia suahelata Miq., 10787, 10929
Alcyristia velutina Markgr., 10711

MYRSINACEAE (detd. by J. Pipoly)
Ardisia forskhi S. Moore, or aff., 11060
Ardisia sp., 10718
Conodendrum polyanthemum (Laut. & K. Schum.) Mez, 10824
Fittingia sp., 10661, 10745
Musa papuana Warburg, 10960; det. WT
Myristica acrostica (Mez) Pipoly, 10857
*Myrista aff. acrostica (Mez) Pipoly, 10958; possible sp. nov.
Myrista laxanthera (K. Schum.) Pipoly, 10573, 10671
MYRTACEAE
Kania englerioides Schltr., 10540, 10648
Metrosideros ramiflora Laut. var. humilis (Diels) Dawson, 10474
Rhabomyrtus novoguineensis Diels, 10568
Syzygium cf. longipes Merrill & Perry, 10914
Syzygium malaccense (L.) Merrill & Perry, s. lat., 10719
*Syzygium aff. megistophyllum Merrill & Perry, 11068
Xanthoxylon montivaga A.J. Scott, 10602

NEPENTHACEAE
Nepenthes maxima Nees, 10592, 10713

OCHNACEAE
Schauernia benningii K. Schum., 10515; characteristic robust form
Schauernia benningii K. Schum., 10409; diminutive form

PIPERACEAE
Peperomia cf. gurukorana Dull, 11067
Peperomia pellucida (L.) Kunth, 10695
Piper balanicum Chew, 10411
Piper canarium Blume, 11072
*Piper lesoriannum (Miq.) C. DC., 10874B, 10927
Piper cf. pseudouboimense C. DC., or aff., 10975
Piper rawaii K. Schum. & Laut., 10541, 10702, 10773, 11032
Piper rubellatum K. Schum. & Laut., 10822
Piper subcanariense C. DC., 10486
Piper triangulare Chew, 10552

PITTSOSPORACEAE
Pittosporum pulchrum Burk. ssp. ledermannii (Pritzel) Schoode var. ledermannii, 10618
Pittosporum sinuatum Blume var. sinuatum, 11058
Pittosporum sinuatum Blume var. djuniandra Steen., 10405, 10655, 10689

POLYGALACEAE
Polygala paniculata L., 10834

POLYGONACEAE
Muilenbeckia platyclada (F. Muell.) Meissn., 10934
Polygonum chinense L., 10466

PROTEACEAE
Helicia cf. farbiana F.M. Schuit., 11103
Helicia microphylla Diels, 10609
Helicia obtusa Sleumer, 10638
Helicia ovata Diels, or aff., 10917

RHAMNACEAE
Alphitonia excelsa (Fenzl) Reiss. ex Endl., SR from Camp 3
Ziziphus papuana Laut., or Z. djemennsis Laut., SR from Camp 4

ROSACEAE
Prunus dichotoma (K. Schum. & Laut.) Kalkman, 11037
Prunus pullii Koehne Kalkman, 10608
Prunus schlerophylla Kalkman, 10742
*Prunus sp. nov., 10588
Rubus archibaldianus Merrill & Perry, 10451, 10563
Rubus ledermannii L. var. ledermannii, 11013
Rubus ledermannii L. var. obtusangulatus Miq., 10453
Rubus trigonus Kalkman, 10463

RUBIACEAE
Aristolochia ramunculoides Laut. & K. Schum., 10905
Argostemma sp., 10385; not A. bryophillum
Dolicholobium oxylaburnum K. Schum., 11042
Gardenia pullii Merrill & Perry, 10625
Hedyotis congera R. Br., 10965
Hedyotis proscens Valeton, 11080
Hydropityum radians Becc., 10943
Hydropityum virgatum Valeton, 11069
Ixora dolichobryoides Brem., 10943
Morinda umbellata L. var. papuana Valeton, 10886
Musaceae veedidae Wernham, 10867; det. O. Gideon
Musaceae scrobukleyi Wernham, 11097; conf. O. Gideon
Myrcia fenestra (Blume) Reinw. ex Korth., 10978
Myrmecodia melanacantha Hussey & Jebb, 10720
Myrmecodia schlechteri Valeton, 10720B
Nertera guerardiana (Mutis ex L. f.) Druce, 10504
Ophiitrichia aff. ramoidea Valeton, 10991, 11019
Ophiitrichia dobyrynae Valeton, 10382
Ophiitrichia tenelliflora Valeton, 10926
Pavetta platyclada K. Schum., 10983
Psychotria ampliflora Valeton, 10791
Psychotria multicosata Valeton, 11065
Psychotria aff. *nemfrex group", 10662
Psychotria ochnacea Valeton, 11102
Psychotria phaeochlamys (Laut. & K. Schum.) Valeton, 10982
Psychotria ramadembeens Sohmer, 10768
Psychotria vechianiana Sohmer, 10399, 10941
*Psychotria sp. nov., 11090
Terenne barbella Valeton, or aff., 10830
Timonius belense Merrill & Perry, 10587
Timonius aff. xantobarcarpus Merrill & Perry, 10418
Uncaria bernaysii F.M. Schuit., 10827
Urophyllum britannicum Wernham, or aff., 10756

RUTACEAE
Aroniophyllum ledermannii Laut., 10717, 10750
Flindersia pinellataea F.M. Schuit., 10944
Melicope sp. A, 10606; small trifoliolate leaves, congested inflorescence
Melicope sp. B, 10615; subcruate petiolar leaflets
Melicope sp. C, 10823; gestalt like Melicope
macronata, leaflets villous, sessile, to 3.5 cm × 20 mm
Melicope sp. D, 10892; glabrous ovate leaves

SABIACEAE
Sabia paniculata Blume, 11026
Meliosma propinqua (Roxb.) Maxim. ssp. humilis (Merrill & Perry) Beus., 10488
Meliosma propinqua (Roxb.) Maxim. ssp. macrophylla (Merrill) Beus., 11107

SANTALACEAE
Cladomyza canecata Danser, 10436

SAPINDACEAE
Arjuna aff. montana or macrophylla, 10976
Capuniopsis macrocarpa Radlk., 11089
Gusia convergens Radlk., 11094A
Pomelia propinqua Forst. & Forst. f., SR from Camps 3 and 4
Saropteryx crispata Weizman, 11101

SAPOTACEAE
Platanus monticola (Krause) H.J. Lam, 10589;
presumably better as Sideroxylon monticola Krause

SOLANACEAE
Solanum australeum Symon, 10530; det. Symon
Solanum rostellatum Merrill & Perry, 10663; det.
Symon

SPHENOSTEMONACEAE
Sphenostemon papuanus (Laut.) Seeen. & Erdtman, 10731

STERculiACEAE
Sterculia amara Baker f., 10963
Sterculia schumanniana (Laut.) Miklbr., 11085
Sterculia cf. schumanniana (Laut.) Miklbr., 11084

SYMPLOCACEAE
Symphosus cochinchinensis (Lour.) S. Moore, 10566
Symphosus cf. cochinchinensis (Lour.) S. Moore, 10415
Symphosus cochinchinensis (Lour.) S. Moore ssp. leptophylla (Brand) Nooteb., 10614, 10746
Symphosus cochinchinensis (Lour.) S. Moore var. schumanniana (Brand) Nooteb., 10748, 10843, 10961
Symphosus sp., small leaves, ±infiorous, 10507

THEACEAE
Eurya cf. leptantha Diels, 10394
Eurya sp. 'leptantha-merrilliana group', 10657
Eurya tang K. Schum. & Laut., 10421, 10571
Terostroma britannicum f.M., 10532, 10624
Terostroma cherryi (EM. Ball) Merrill, SR between
Camps 3 and 4

THYMELAEACEAE
Phaleria macrocarpa (Scheff.) Boerl., 10430

TRIENIACEAE
Trimenia papuanus Ridley, 10393, 10402

ULMACEAE
Pararhippia rigida Merrill & Perry, 10567
Trema cannabina Lour., 10918

URTICACEAE
Boehmeria platyphylla D. Don, s. l., 10116
Boehmeria sp., 10522 (m); Cypholophus
Cypholophus mammulatus H. Winkler, 10118
Debressia sp., 10464
Elatostema baccari Schroeter, 10894
Elatostema aff. helensae Perry, 10891, 10994
Elatostema blechnoides Ridley, 10450, 10478
Elatostema macrophyllum Brongn., 10979
Elatostema mongense Lour., 10535
Elatostema modestum Perry, 10433
Elatostema noto-guineense Warburg, 10885, 10896,
10922
Elatostema truncatis Perry, 10475
Elatostema univalvulans K. Schum., 11096 (f)
Laphora decussata (Roxb.) Weddl., 10974
Lyciocarya capitellata (Poir.) Weddl., 11044
Pila sp., H. Winkler, 10512
Pila ledebourii H. Winkler, 10687
Pila tonomata H. Winkler, 10521, 10410
*Pila sp. nov., 10481, 10539, 10740
Pepturus argentus (Forst. f.) Weddl., 10444 (m),
10500 (f), 10990 (f)
Pepturus fulci H. Winkler, or aff., 10511
Potokspermum macrolepis Chew, 10858 (f), 10984
(m)
Proris frutescens Blume, 10901
Proris sp., 10981

VERBENACEAE
Callicarpa longifolia H.J. Lam, 10973
Gentiana pentaandra (Roxb.) Merrill, 10821
Stachycthera ceylonensis (Rich.) Vahl, 11028

VITACEAE
Cayratia geniculata Blume, or aff., 11027
Cayratia japonica (Thunb.) Gagn., SR from Camp
4
Cissa aristata Blume, 10948
Cissa dichotoma Blume, SR from Camp 3
Tetraspis laterebaccianum Gilg., 11033

WINTERACEAE
Zygogynum alpinum (Schlr.) Vink, 10184
Zygogynum c. sylvestre (A.C. Smith) Vink, 10850

FAMILY INDET., 10425, 10431
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STUDIES IN NEW WORLD AMARANTHUS
(AMARANTHACEAE)

JAMES HENRICKSON
Department of Biology
California State University
Los Angeles, CA 90032, U.S.A.

ABSTRACT

Amaranthus crassipes is recognized as consisting of two varieties: var. crassipes from the
West Indies, coastal Mexico-Texas-Louisiana, and northern South America, and var. warnickii
of the Chihuahuan Desert region of Texas and Mexico. Amaranthus scleropoides contains two
morphs that are not taxonomically recognized. Amaranthus x texensis, considered of hybrid
origin between A. crassipes and A. scleropoides, is described as new. Amaranthus berlandieri
is not considered as distinct from the more wide ranging A. polygonoides. A new species, Amaranthus
tamaulipensis, is described from southmost Texas and eastern Mexico. It is related to A.
dubius and the poorly known A. brandegei of Sinaloa. An enigmatic Amaranthus x tucsonensis
is described from the Tucson Mountains of southern Arizona, with related populations occurring
in Sonora, Mexico.

RESUMEN

Se reconoce a Amaranthus crassipes como constituida por dos variedades: la var. crassipes,
con distribución desde la costa de México, Texas y Louisiana, a través del Caribe hasta el
norte de Sudamérica; y la var. warnickii, de la región del Desierto Chihuahuense. Amaranthus
scleropoides consiste de dos fases morfológicas sin designación de rango taxonómico formal.
La notoespecie nueva Amaranthus x texensis probablemente se originó de la hibridación en-
tre A. crassipes y A. scleropoides. No se considera a A. berlandieri como diferente de A. polygonoides,
especie de más amplia distribución. Se describe Amaranthus tamaulipensis, especie nueva
del este de México y la parte más meridional de Texas. Esta especie está relacionada con A.
dubius y con A. brandegei, taxón sinaloense pobremente conocido. Se describe la enigmática
Amaranthus x tucsonensis como notoespecie nueva de la Sierra de Tucson, del sur de Arizona.

KEY WORDS: Amaranthus, Amaranthaceae, plant taxonomy, plant systematics, hybridization.

Studies in the Amaranthaceae in connection with the Chihuahuan Desert
Flora have resulted in this paper on the systematics of the Amaranthus crassipes-
A. scleropoides and A. polygonoides groups. Two additional taxa are described
as new.

The Amaranthus crassipes-A. scleropoides group has dichasial clusters of flowers
borne at all nodes from the base of the plant to the tip. The inflorescences
are modified compound dichasia in which the terminal flowers are overtopped
by opposite, sinuous peduncles that bear one to a few pairs of persistent
bracts with mostly male flowers and terminate in pistillate flowers that are
again overtopped by similar paired, sinuous peduncles. As the peduncles

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mature they become greatly thickened and indurated in some species and trap the fruit between the expanded peduncles (Fig. 3A, D). Gray (1862) considered thickened peduncles to be an abnormal character in *A. crassipes*, but Holzinger (1892) showed they were consistently produced in that species, caused by a proliferation of expanded parenchyma cells that develop thickened walls. At maturity, the entire inflorescence falls from the plant and serves as a dispersal unit capable of flotation.

**VARIATION WITHIN AMARANTHUS CRASSIPES**

*Amaranthus crassipes* Schltdl. is a widespread New World species occurring from the West Indies, Bahamas, Florida Keys, Arizona, Texas, Mexico, Colombia, and Venezuela (Fig. 1)—its type locality is on St. Thomas in the Virgin Islands. The species consists of decumbent-procumbent, glabrous, monoecious annuals with ovate-obovate to lanceolate, long-petiolate leaves. The flowers are produced at each node usually from the base of the plant upwards in short dichasias 5–10 mm long (Fig. 2C, E). The dichasia develop the aforementioned greatly thickened, indurate, strongly sinuous lateral axes (Fig. 3A). The female flowers have 5 erect to spreading, narrowly spatulate sepals that are thickened and joined at the base (Fig. 3B). They are usually shorter than the fruit. The fruit wall is closely adherent to the seed and indehiscent, although it may develop a colored encircling line below the middle. It is usually smooth below and somewhat tuberculate above and along the margins. The 2–3 styles are joined together into a distinctive lyrate-shaped neck before they taper and diverge as slender tips (Fig. 2A–C). The male flowers are produced on the sides of the developing inflorescence axes. They mature and fall away before the inflorescence axes thicken and they have 5 membranous sepals and three anthers.

Throughout the Caribbean region the plants are initially erect but usually become procumbent weeds in disturbed places. They usually have ovate, broadly ovate to obovate leaves that may either be uniformly small or, in fast growing plants, large in size. (Fig 2C). Similar ovate-leaved plants also occur in northern South America, the Yucatan Peninsula, northeast Mexico, coastal Texas, Louisiana, Key West (Florida) as well as Sonora and Arizona. In contrast, plants in inland Texas and in the Chihuahuan Desert region, develop narrower, more oblanceolate, grayish leaves (Fig. 2E). They also tend to be more erect or decumbent in growth habit, features that are shared with the related *A. scleropoides*. The grayish color of the leaves also make the reticulate pattern of the Kranz structure less conspicuous. In 1944 I.M. Johnston described these inland plants as *Amaranthus warnockii*, distinguishing the species by its elongate, somewhat thinner oblanceolate leaves, its less elongate, more slender stems, and smaller more compact cymes conspicuously crowded at the stem bases. Except for the narrower, more oblanceolate-
ceolate leaves, all the other features noted by Johnston also occur in occasional plants of *A. crassipes* throughout its range. In all technical characters of flowers, fruit and inflorescence, *A. warnockii* and *A. crassipes* are identical.

Recognition of these two taxa at the species level is considered unjustified as the distinguishing features are minor and to some extent inconsistent and recognition would create poorly differentiated microspecies within this highly variable genus. But overall the group of specimens referable to *A. warnockii* can be recognized solely on the basis of the narrower, more oblanceolate, grayish leaves. Because of this *A. warnockii* is here retained at the varietal level as it represents a geographically based subunit of the species (Fig. 1). Correll and Johnston (1970), in contrast, considered *A. warnockii* synonymous with *A. crassipes*. The collections from southern Arizona and adjacent Sonora, however, have distinctly ovate leaves and fall within var. *crassipes*. A formal description of *A. crassipes* follows.

**AMARANTHUS CRASSIPES**

Low spreading, taprooted, procumbent to decumbent, basally branched, monoecious annuals, sometimes with the central stems erect-ascending; stems glabrous, striate, stramineous, moderately branched, 1–4(–9) dm long; internodes 1.5–4 cm long below, reduced to 5–15 mm long distally. Leaves alternate, ascending, (12–)30–55(–78) mm long, the petioles slender, (5–)10–25(–47) mm long; leaf blades broadly to narrowly obovate to ovate, to
oblanceolate or elliptical, (7–)20–30(–50) mm long, (5–)10–20(–28) mm wide, obtuse to rounded, usually retuse with the midvein short-excurrent at the tip, narrowly acuminate-cuneate at the base, the margins entire to erose-crisped, whitish, the veins curved towards the tip, but not extending to the margins, distinctly whitened beneath, the lamina glabrous, with distinct Kranz internal anatomy. Flowers borne in axillary, congested, tan or rarely dark brown, glomerate dichasia 5–9 mm long usually borne at all nodes from the base of the plant upwards, the dichasia decussately branching below each pistillate flower, the branches strongly sinuate-curved, becoming thickened and indurated, 0.9–1.2(–1.6) mm thick and crowding-enclosing the developing fruit; bracts and bracteoles broadly delate, 0.5–0.9 mm long, green along the midrib, the margins scarious, broadly attached at the base, persisting on the sides of the thickened dichasia. Staminate flowers produced on the sides of the developing dichasia, with 5, subequal, lanceolate sepals 1.2–1.6 mm long, these membranous except where green along the midrib, acute; stamens 3; anthers 0.7–0.9 mm long; filaments 1.5–2 mm long. Pistillate flowers born at each branch of the dichasium; fruiting sepals 5, with 2 at each margin of the fruit and with a smaller sepal on one face, 2 on the other face, the sepals distinctly clawed or merely spatulate, 1.4–2.3 mm long, the claws narrowly linear, 0.1–0.2 mm wide, keeled, expanding to ovate, acute, slightly keeled, conduplicate, sometimes slightly reflexed tips 0.5–1 mm long and nearly as wide, the tips each with a green in a trullate patch medially and with membranous margins, the sepals expanding to become spongy-indurate, tan, united and truncated around the fruit base. Fruiting ovary compressed orbicular-ovobovate, 1.3–1.5 mm wide and long (excluding the style), the fruit wall somewhat thickened, closely surrounding the seed, indehiscent or in some plants with a darkened line in the lower half, usually but not consistently smooth below, distinctly tuberculate above and along the margins, topped with the persistent style; the styles 2(–3), about 1.5 mm long, connate and erect for 0.2–0.5 mm below, the yellowish lobes erect or usually lyrate, curving outward, then inward as they taper, terminating as slender outwardly curved appendages, the papillate-stigmas extending all along the inner surface of the styles onto the terminal slender portions. Seeds compressed-obovoid, 1.1–1.3 mm long, 0.9–1.1 mm wide, 0.6–0.7 mm thick, shiny, dark brown-black, the margin obtuse to somewhat rounded, the surface shiny, with a visible cellular surface pattern. With two varieties:

Ehrenberg s.n. (holotype: HAL). Dr. U. Braun has sent a xerox copy of the holotype from HAL, deposited TEX.

Scleropus amarantoides Schrad., Index sem. Hort. gott. 1835; (reprinted in: Linnaea 11: Litt.-ber. 89. 1837). Type: unknown.

Plants typically erect when young but becoming procumbent, occasionally decumbent, leaf blades ovate to broadly ovate, sometimes nearly orbicular or obovate, (7–)15–30(–50) mm long, (5–)10–15(–28) mm wide, the lower surface green to yellow-green, distinctly marked by the whitish, arcuate veins.

Weed in roadsides, waste grounds, fields, pastures, in clay, silty, sometimes sandy flats, beaches, and rocky slopes in shaded or open habitats, widespread in the Caribbean region, south Florida, coastal Louisiana, Alabama (adventive), Texas, northeastern Mexico south to northern South America (Columbia, Peru), from sea level to 250(–1250) m (Fig. 1). It also occurs in Arizona, Sonora, Chihuahua at higher elevations. Collected throughout the year but
expected to be vegetatively active during hot months due to C4 photosynthetic pathway.

*Amaranthus crassipes* Schltldl. var. warnockii (I.M. Johnston) Henrickson, comb. nov. (Fig. 2D-E). Basionym: *Amaranthus warnockii* I.M. Johnston, J. Arnold Arbor. 25:153. 1944. TYPE: MEXICO. COAHUILA: a mi SE of Ocampo, low place near mogote on plain, 8 Sep 1941, I.M. Johnston 8886 (holotype: GH!).

Plants initially erect when young, the lateral branches becoming decumbent, ascending terminally; leaf blades oblanceolate to narrowly oblanceolate, (12—)16—33(-44) mm long, (4—)6—10(-16) mm wide, the surfaces more glaucescent-green, the veins of the lower surface slender, not conspicuous.

Open silty flats, mesquite thickets, muddy areas to 1300 m elevation, in south-west Texas and in the Chihuahuan Desert in Coahuila and eastern Chihuahua (Fig. 1).

**AMARANTHUS SCLEROPOIDES**

In 1895 Uline and Bray described a second species related to *A. crassipes* differing in its circumscissile, smooth utricle and 3 style branches. Uline and Bray considered *Amaranthus scleropoides* intermediate between *A. crassipes* and *A. gracizans* auth. non L. (now *A. albus* L.), the latter also having 3 styles and circumscissile utricles. Vegetatively and in inflorescence structure, *A. scleropoides* is very similar to *A. crassipes*, but *A. scleropoides* is a taller, bushier plant. While its mature utricles are uniformly circumscissile, the pistillate flowers are somewhat variable in sepal structure, style number and other features. Mature sepals vary from 1.2—2.5 mm in total length. As in *A. crassipes*, two sepals are usually distributed at each edge of the mature fruit, with a two on one face and a one smaller sepal on the other face. The sepals are clawed and vary greatly in development. In some specimens the blade portion is erect, green, rounded, apiculate and rather flattened, however, in others, including the type collection, the tips are distinctly thickened, keeled, conuplicate, recurved, and sharp pointed, with a central green rhomboid patch (Fig. 4C). Styles vary from two to three (Fig. 4A—B), or rarely five (1-flower on *Cory 2933 GH*), with some plants being consistently two styled and others with varying numbers. In flowers with two styles, the styles are located directly over the margins of the compressed ovary and as the fruit mature the styles develop distinct decurrent ridges that extend down the fruit margins. When styles are three, the third, often reduced style, develops on one of the faces, again with a distinct decurrent base. The surfaces of the utricle may be smooth or tightly tuberculed.

Among collections observed, two distinct forms are recognizable based on differences in the development of the styles and upper ovary wall. The most common form has distinctly spongy-thickened style bases and the upper
The utricle is indurated and stramineous in color (Fig. 4A–B). The styles are papillate (stigmatic) along their inner margins and the papillae continue onto the slender terminal lobes. A second form does not develop expanded, indurated thickenings on the style bases and upper fruit and the two or three styles are thus clustered at the top of the fruit (Fig. 4C). The two forms both occur throughout the range of the species—they do not sort out geographically (Fig. 5). Because of this, and because this variation does not correlate with any other morphological or ecological variation, they are here recognized as unnamed forms. A description of the species follows.

**Amaranthus scleropoides** Uline & Bray, Bot. Gaz 19:316. 1894. (Figs. 3C–E, 4A–C, 5). Type: U.S.A. TEXAS: “Texas, Western Texas to El Paso,” Wright 582; (LECTOTYPE: GH; ISLECTOTYPE GH). Notation on lectotype by L.M. Johnston: “Texas: Val Verde County, Wright field number 798, Amaranth, Devil’s River, summit of hills, 2 Aug 1849.” The type has sepals with conduplicate, sharply divergent tips; the style base is not inflated as in some collections.

Very similar to *Amaranthus crassipes* vegetatively and in inflorescence and flower organization, but typically more erect, bushy, 2–5 dm tall and often as wide, with the lower stems ascending or decumbent and ascending to erect distally. Leaves with slender petioles (4–)10–25(–47) mm long; leaf blades lanceolate, oblanceolate to narrowly trullate, (5–)15–25(–42) mm long, (2) 5–10(–12) mm wide, glabrous, somewhat glaucous. Flowers borne in thickened, sinuate dichasia produced from the base to the top of the plant; staminate flowers with 5 sepals, 3 stamens. Pistillate fruiting sepals 5, with 2 at each margin of the fruit, two sepals on the one face, with one smallest sepal on the other face, the sepals moderately clawed to narrowly spatulate, in fruit (1.2–)1.5–2.2(–2.5) mm long, the claws 0.2–0.7 mm wide, the distal sepal blade typically broader, erect or variously reflexed, ± keeled and conduplicate, ± ovate-lanceolate, acute, with a small or large, central, green narrow to trullate green patch to 0.5–1 mm long, the margins membranous, the sepals expanding and becoming spongy-indurate, tan, and united around the fruit base. Fruiting ovary compressed orbicular-ovovate, 1.1–1.3 mm wide and long (excluding the styles), the wall circumsissily dehiscent, with a distinct brownish medial line, the body smooth or becoming closely tuberculate above and less strongly tuberculate below the line of dehiscence, the styles 2–3(–5) [the third (fifth) one(s) smaller when present], arching outward from the upper margins of the fruit wall, the style bases continuing as decurrent ridges down the fruit wall, the lower portion of the styles and adjacent distal fruit wall (but not extending down to the line of dehiscence) often spongy-thickened, inflated, or the distal fruit wall and adjacent style bases only slightly inflated and ascending; the stigmas papillate, extending along the inner margin of the style lobes and continuing as slender tips for 0.4–0.5 mm. Seeds compressed obovoid, 1.0–1.1 mm long, 0.85–0.96 mm wide, 0.6–0.7 mm thick, dark
brown–black, the margin obtuse to somewhat rounded, the surface shiny, with a slightly visible cellular surface pattern.

A NEW TAXON FROM SOUTHERN TEXAS

Within the complex of *A. crassipes* and *A. scleropoides*, a series of specimens from southern Texas are characterized by an erect-ascending growth habit and what appear to be circumsessile utricles as in *A. scleropoides*. However, the utricles are thick walled, weakly and closely tuberculate and are actually indehiscent as in *A. crassipes* although a distinct medial line is present. As in *A. crassipes*, the styles are united at the base into a distinct neck before they separate, but the 2–3 styles have distinct decurrent ridges that extend down the utricle wall as in *A. scleropoides* (Fig. 4E). These specimens also have rather narrowly lanceolate to linear-lanceolate, long petioled leaves, and they tend to have longer, more strongly reflexed pistillate sepals of a type sometimes found in *A. scleropoides*. The specimens, some of which are sterile and produce no mature seed, appear to represent hybrids or derivatives of hybridization, perhaps between *A. crassipes* and *A. scleropoides*. These collections are all from loose red sands to sandy loams in southern Texas in Duval, Webb, Hidalgo, and Atascosa counties of southern Texas, with one collection from adjacent Tamaulipas. They are of sufficient distinction to be recognized as a separate nothospecies.

*Amaranthus × texensis* Henrickson, nothosp. nov. (Figs. 4D, 5). **Type:** U.S.A. TEXAS. WEBB Co.: in red sand at roadside on Hwy. 83, 13 mi NW of Webb, 16 Jul 1957, D.S. Correll & L.M. Johnston 18101 (holotype: LL; isotype: GHI).

A *Amaranthus scleropoides* caulibus erecto-ascendentibus stylis (2–)3 et fructibus dehiscentibus seminis sed differt basibus styliaribus collum distinctum 0.2–0.4 mm longum formantibus (ut *A. crassipe*) et sepalis florum pistillatiorum valde reflexis ad apices.

Annual herbs 10–35 cm tall; stems erect-ascending to decumbent, with scattered obscurely gland-tipped hairs to 0.3 mm long, glabrate. Leaf blades linear-ob lanceolate, (5–)13–25(–40) mm long, 2–6(–8) mm wide, obtuse-emarginate with the midvein excurrent at the tip, narrowly cuneate, the margins extending well down the (3–)5–15(–20) mm long petiole, the margins whitish, crisped, the blades green to gray-green with the veins impressed above, stramineous and raised beneath. Flowers borne in short, thickened, axillary dichasial cymes produced at each node of the plant from base to tip, the cymes 3.5–6 mm long, the cyme axes sinuate, stramineous, spongy-thickened, indurate, 0.5–1 mm thick, bracteate, the bracts 1–1.5 mm long, green medi ally in a diamond pattern with broad clasp ing scarios bases, the staminate flowers early deciduous, the dichasial cymes bifurcating at the bases of each pistillate flower and terminating in pistillate flowers; staminate flowers: sepals 5, narrowly ovate, 1.5–1.8 mm long, membranous except along the excurrent midvein; stamens 3; mature pistillate flowers: sepals 5,
clawed, 1.5–2.1 mm long, to 0.3–0.6 mm wide below the acute tips, spongy, thickened and all conjoined at the base, the distal portion expanded, strongly spreading, becoming nearly horizontal below the spinose tip, the base and claws stramineous, sometimes ciliate with slender gland-tipped hairs, the expanded tips with an elongate green patch 0.9–1.3 mm long, with narrow scarious margins. Fruiting ovary vertical, the wall initially smooth and with a medial encircling line, but in age becoming thickened, bullate-tuberculate in the upper half, remaining smooth below but indehiscent, the
styles 3(−2), joined into a vertical neck for 0.2–0.5 mm before the tapered styles gradually arch outward, when styles 3, with two styles larger than the third, the styles papillate along their the inner surfaces.

The new nothospecies occurs with *A. crassipes* in Webb Co., Texas and some collections (i.e., McCart et al. 8559) are mixed with that species. *Amaranthus × texensis* is similar to *A. scleropoides* in most features, but stands apart in the distinctive narrow neck produced by the combined style bases (Fig. 4D) and by the thickened utricle wall—in these characteristics it relates to *A. crassipes*. The strongly reflexed sepals, are overall of similar structure to those found in some specimens of *A. scleropoides*, but are much thicker, as in *A. crassipes*. The pistillate sepals of *A. crassipes* are erect and may or may not be reflected at the tip.


**AMARANTHUS POLYGONOIDES VS. AMARANTHUS BERLANDIERI**

*Amaranthus polygonoides* L. and *A. berlandieri* (Moq.) Uline & Bray are similar species readily distinguished from other *Amaranthus* by a number of features (Fig. 6). In both the flowers are borne in tight axillary dichasial clusters at each node that become distinctly crowded at the uppermost nodes. The peduncles are not thickened at maturity. The pistillate sepals are thin and distinctly three veined in the claw area, with the central vein extending into the expanded, obtuse-acute, spreading blade area. The sepals are united at the base and this basal area expands via cell enlargement to form a spongy, somewhat indurated floration device. The fruit wall is thin, cylindrical, inflated, dehiscent or not, and is topped by three expanded style bases that are exserted above the spreading sepals.

Uline and Bray (1895), Standley (1917), Correll and Johnston (1970) and others have recognized both *A. polygonoides* and *A. berlandieri* as distinct species, basically repeating the characteristics given Uline and Bray (1895) and modified by Standley (1917) in his key as noted below:

Utricle circumscissile; leaf blades suborbicular to ovate or oval, the leaves not crowded; West Indies, Florida, Texas, Mexico, northern South America. .......................................................... *A. polygonoides*

Utricle indehiscent; leaf blades oblong-lanceolate, the leaves crowded at the ends of the branches; central-west Texas. .......................................................... *A. berlandieri*

Moquin-Tandon (1849), in his treatise of the “Amaranthaceae” (sic) in DeCandolle’s *Prodromus*, recognized the above two species in distinct gen-
era in separate subtribes of his tribe Achyrantea. He recognized taxon *polygonoides* in subtribe Aerveae, (with indehiscent utricles) as *Amblogyna polygonoides* Raf. (monoecious, staminate flowers with 3 sepals, 3 stamens, the pistillate calyx being subglobose-funnel-form, 5-parted, and the inflorescence axis not becoming thickened as in *A. crassipes*). Moquin-Tandon’s newly described taxon *berlandieri* was placed in subtribe Amaranteae (with utricles circum-scissile) as a new genus *Sarratia* next to *Amaranthus* (sic), differing in having staminate flowers with 5 sepals and pistillate calyces funnel-form-urceolate. In his description he noted *Sarratia berlandieri* had 5 anthers per male flower and circumscissile utricles.
Moquin-Tandon made several errors in characterizing these taxa. In both taxa, staminate flowers have 5 (rarely 4) sepals and both taxa have only 2 anthers per staminate flower. My observations showed that, contrary to his data, the fruit of specimens referable to *A. berlandieri* are indehiscent (not dehiscent as he stated) while those of taxon *polygonoides* are usually, but not consistently dehiscent (not indehiscent as noted by Moquin-Tandon). These errors were caught by Gray (1861, p. 168) who, in expanding the genus *Amblygynae* to include two species previously placed in *Sarratia*, included taxon *berlandieri* within his *Amblygynae polygonoides* noting that the specimens upon which taxon *berlandieri* was founded were very poor. In contrast, both Uline and Bray (1895) and Standley (1917) recognized both taxa within the genus *Amaranthus*. Thellung (1914), in contrast, treated *berlandieri* as a subspecies of *A. polygonoides*.

During an initial study of these taxa it was noted that the characters in Standley’s 1917 key did not work consistently and several specimens showed characteristics of both taxa. Regarding fruit dehiscence, an analysis of 118 collections from F, GH, NY, TEX-LL, and US revealed the following. Specimens attributable to *Amaranthus berlandieri* are mostly indehiscent (Fig. 6F), but occasional specimens (2 of the 42 collections examined) did show a distinct encircling line below the rugate cap of the utricle. In the 76 collections of *A. polygonoides* with mature fruit examined, 36 were noted to be actually circumscissile (Fig. 6D) or at least had developed a colored line encircling the fruit wall below the tuberculate cap (however, the fruits may or may not dehisce along this line) and 35 (49 percent) were clearly indehiscent. Indehiscent utricles occur in collections from coastal Texas, Cuba, and throughout the Caribbean region, often in localities where other collections clearly have circumscissile fruits. In all instances care was taken to insure that the fruit walls were mature when the dehiscence character was scored.

As noted in Standley’s key, there are some recognizable differences in leaf shape. Most specimens from the Caribbean region to coastal Texas have ovate to broadly ovate, rarely obovate (Fig. 6A), slightly more greenish leaf blades and many specimens from interior Texas and Mexico have more narrowly trullate or trullate-lanceolate (Fig. 6D), somewhat bluish-gray leaf blades. To illustrate this a series of leaf-blade length-width ratios were taken. The ratios of specimens from the Caribbean and coastal Texas attributable to *A. polygonoides* range from 1.3 to 2.6 times longer than wide. Those of inland areas attributable to *A. berlandieri* have leaf-blade length-width ratios ranging from 2.1 to 4.2 times longer than wide. The problem is that when plants are mapped out based on these leaf characteristics we find several collections from Sutton, Edwards, Tom Greene, Terrell, Presidio and Pecos counties in Texas, as well as collections from Coahuila, that clearly have broad leaves
as in taxon polygonoides. In many cases nearby specimens have narrow leaves as in taxon berlandieri. Recognition of two taxa on the basis of this characteristic would be quite arbitrary. Likewise leaves and inflorescences are crowded at the distal stems in both taxa and the taxa could not be separated on the basis of this characteristic. In fast growing stems, the leaves in both taxa are well separated by long internodes.

As the distinguishing characteristics of these taxa are very weak and variable, the two taxa are combined into a single variable species with recognition that there are some trends present, but they are insufficient for nomenclatural recognition. Thus only one species is recognized from this complex as follows.

**Amaranthus polygonoides L.** (Figs. 4E, 6, 7), Pl. jamiac. pug. 2:27. 1759. *Roumeria polygonoides* (L.) Moench. Merh. 3:14. 1794; *Amblygyna polygonoides* (L.) Ralf., Fl. Tell. 3:42. 1837; *Albersia polygonoides* (L.) Kunth, Fl. Berol. ed. 2, 2:144. 1838. *Sarratia polygonoides* Moq. in DC., Prod. 13(2):270. 1849, as synonym. **Type:** JAMIIACA: Linnaeus' 1759 protologue referenced "Sloan. jam. 1. t. 92. f2." (H. Sloane's Voy. Madera Jamaica 1:144 tab. 92, fig. 2. 1707) where the taxon was designated by a polynomial "Blitum polygonoides viride, seu ex veridi & albo variegatum, polygonus". Linnaeus only saw Sloane's figure and not the specimen from which it was drawn, hence the specimen (Herb. Sloane 2:116, BM), can not be designated as lectotype. I herein designate the illustration in Voy. Madera Jamaica t. 92, fig. 2, as lectotype. The original Sloane plate 92, and the Sloane specimen, from which it was drawn, are at BM (C. Jarvis, pers. comm.). Sloane's (i.c.) notes: "It grows in hard Clayy grounds, and amongst Rubbish, every where about the Town of St. Fago de la Vega." St. Fago de la Vega is now known as Spanish Town. Elizabeth A. Kellogg, *Fl. Lesser Ant. 4:160*. 1988, treated the Sloane specimen as "Type," however, for reasons noted above, it may not serve as lectotype.


Low spreading to erect-ascending, monoecious annuals 2–4 dm tall; stems branched below, the lateral (or all) branches decumbent, sometimes ascending, 1–4 dm long; internodes 2–5 cm long below, reduced to 2–5 mm long distally, stramineous, striate, puberulent-villous with tipped moniliform hairs 0.2–0.5 mm long, the lower stems glabrate. Leaves alternate, ascending, often crowded, larger in the upper half of the plant; petioles (2)–5–20(–40) mm long; leaf blades ovate to trullate-lanceolate, sometimes obovate or lanceolate, (4)–8–25(–42) mm long, (2.4)–5–15(–23) mm wide, rounded, obtuse or emarginate with the midvein excurrent at the tips, narrowly to broadly cuneate at the base, glabrous, the margins entire to erose, the veins and margins whitish beneath, the lamina with distinct Kranz internal anatomy, green
to grayish in color. Flowers borne in axillary congested globose dichasia 3–8 mm in diameter, these remote on the lower branches but becoming aggregated as the internodes shorten above, the inflorescence axes thin, to 2 mm long; bracts and paired bracteoles lanceolate, 1–1.5 mm long, membranous, curved and cupped below, attenuate often with a long excurrent midvein at the tip; staminate flowers: sepals (4–)5, ± unequal, 0.7–1.3 mm long, membranous except for the midvein; stamens 2, anthers 0.4–0.6 mm long, filaments moderately thickened, to 1 mm long; pistillate flowers: mature calyx (1.6–)2.3–3.0 mm long, the sepals united and becoming spongy-thickened in the lower third forming an expanded float 0.9–1.2 mm long and wide that slightly extends over the subtending broad-tipped pedicel, the separate lobes clawed, spathulate, the claws 0.3–0.4 mm wide, notably 3-nerved, with scattered slender gland-tipped hairs, the lobes to 0.6–1.2 mm wide, erect to recurved-spreading, rounded to acute at the tips with the midvein sometimes excurrent, membranous except for the 3 veins, the lateral veins straight, slightly spreading outward, diminishing below the margin, the midvein strongest, unbranched, when young overlain with a narrowly oblanceolate central green patch. Mature ovary wall (the utricle) inflated, adnate to the spongy calyx in the lower third, the mid portion smooth, compressed, 0.7–0.9 mm long and wide, sometimes developing a darker encircling line just below the expanded tip (where dehiscence may occur), the distal tip.
portion variously roughened, sometimes distinctly expanded at the base, capped with the narrower, fused, obconate, expanded style bases 0.4–0.6 mm long and wide, the styles 3(–2), the papillate slender terminal portions 0.5 mm long. Seed vertical, lenticular, 0.8–0.9 mm long, ± 0.7 mm wide, 0.35–0.5 mm thick, reddish-brown, smooth, shiny, the margins thin.

The species ranges throughout the Caribbean region to coastal Central America, Key West Florida to central and western Texas and adjacent Mexico (Fig. 7) occurring mostly in disturbed habitats. Also cultivated in Germany, Italy and Egypt (Thellung 1914). Collections from Sonora and Sinaloa with more erect, slender habits and similar staminate and pistillate flowers but with the central vein of the pistillate sepals conspicuously branching are referable to *Amaranthus venulosus* S. Wats.

**A NEW AMARANTHUS FROM EASTERN MEXICO AND SOUTHMOST TEXAS**

During initial observations of Mexican *Amaranthus*, a series of collections distinguished by inflated turret-like style bases and short, slender, basally connate, erect, well-separated, spatulate sepals, and bracts much shorter than the sepals were marked as possibly new. In Standley (1917), the taxon keyed closest to *A. brandegei* Standl., a species known only from a few collections in eastern Mexico (the type collection is from Sinaloa, México), with which it shared the characters of 3 stamens per male flower and short pistillate floral bracts. A loan of the type collection of *A. brandegei* from UC confirmed that our material is indeed is similar to *A. brandegei*, but *A. brandegei* actually has 5(–4) stamens per male flower, as previously noted by Sauer (1950), not 2–3 as stated by Standley (1917). In its small perianth and short bracts the new species also showed similarities with *A. dubius* Mart. ex Thell., which also has 5 stamens per staminate flower.

*Amaranthus dubius* is a tropical, sometimes temperate, New World weedy species common from the Caribbean region, southern Mexico to Panama and northern South America. It is adventive in Africa and tropical Asia and cultivated in Europe (Aellen 1959), Jamaica (Correll and Correll 1982), and elsewhere. It has been reported as one of the very few polyploid (2n=64) species in the genus (Grant 1959). Floral differences between *A. brandegei* and *A. dubius* are illustrated in Sauer (1950); pistillate flowers of *A. dubius* are illustrated in Aellen (1959), and both taxa are described in Standley (1917). In the material seen, both *A. brandegei* and *A. dubius* are more robust plants with larger, leaves to 12 cm long and 8 cm wide with distinct terminal inflorescences. I have seen additional material of *A. brandegei* from Tom Van Devender’s recent collections from Sonora and Sinaloa, México, which have larger leaves than the type.

In *A. brandegei* the larger pistillate sepals are reflexed, thickened at the
base at maturity and the midveins often branch distally, the fruit wall is smooth below the line of dehiscence but roughened above the line (Fig. 4F). In contrast in *A. dubius*, all pistillate sepals are erect, they do not thicken at the base at maturity and have distinct single green midveins bordered with thin membranous margins and the fruit walls are typically elliptical and often smooth throughout. In the new taxon (Figs. 4G, 8) the sepals are much thicker, the margins are often not membranous medially, the sepals are distinctly thickened and join together at the base of the developing fruit and are typically shorter than the developing fruit. They are somewhat contracted in the lower half and slightly broader below the acute to obtuse-rounded tips. The sepals are often green along the distal mid vein and in the larger, marginal sepals, the midveins are branched distally. The fruit wall is irregularly rugose throughout and has a distinct smooth tower. Furthermore the plants are much more slender, with small leaves that continue, though diminished in size, well into the inflorescences—they do not develop distinct leafless terminal inflorescences as in the other two species. Also the new taxon has only three stamens per male flower not 4–5 as in the other species.

**Amaranthus tamaulipensis** Henrickson, sp. nov. (Figs. 4G, 5, 8). Type:

*A Amarantho brandegei-dubius* differt calyce pistillato sepalis binis ad margines ovarii quam tribus alterae majoribus (vs. sepala abaxiali maxima), sepalis erectis (non distaliter reflexis ad maturitatem), et pericarpio maturo omnino inflati-tuberculato (vs. distaliter inflati-tuberculato).

Erect to ascending, sometimes decumbent monoecious annuals 1.5–3(–6) dm tall; stems branched at base, sparsely branched above or unbranched, striate, glabrous, slender, tan-stramineous or suffused with betalin red, 1–3.2 mm thick at base. Leaves largest near the base, reduced above, the petals 3–15(–21) mm long, one-half (when small) to as long as the leaf-blades; leaf blades ovate, rhombic-ovate, (5–)10–27 mm long, (2–)5–11(–18) mm wide, tapering to an obtuse-rounded, typically emarginate tip topped with the excurrent midvein, the base cuneate, decurrent along the petiole, the margins rather crisped, white, the blades green above, gray-green with 3–4 arcuate white, raised veins beneath. Flowers in glomerate axillary dichasia from base of plant to the tip, either interrupted at the nodes, or crowded or interrupted in terminal leafy spike-like inflorescences, the 2 lateral branches of the dichasium unbranched, zig-zagged, to 4 mm long; bracts lance-ovate, acute, conduplicate-cupped, green along mid vein, otherwise scarious-membranous, 0.9–1.2(–1.4) mm long, shorter than the sepals, persisting on inflorescence axis where 0.4–0.8 mm apart; bracteoles 2, similar to the bracts but 0.3–0.8 mm long, often membranous throughout, persistent or not;
staminate flowers: basal and scattered on the lateral dichasia shoots, sepals 4–5, oblong-ovate, acute-acuminate, 1.2–1.6 mm long, green along the excurrent midvein, otherwise scarios; stamens 3(–4); pistillate flowers: sepals 5, separate and not overlapping except where expanded and joined at the base, oblong-spatulate, subequal with the two marginal sepals usually larger (broader) than the other three, 1.1–1.6(–2.1) mm long, narrowed to 0.2–0.3(–4) mm wide in mid portion, expanded, obtuse-rounded, to 0.25–0.6 mm wide near the tip, rather scarios except along midvein, becoming gibbously thickened, spongy and joined around ovary at base, the smaller 3 sepals 1-veined and green along the vein above, the largest 2 sepals with the midvein green and weakly branching distally (in some specimens the veins in all sepals branching distally and the tips rounded to acute), the calyx shorter than the mature fruit, the sepal margins typically sparsely glandular-puberulent. Mature utricle obpyramidal, slightly biconvex, 1.5–1.7 mm long, to 1.1 mm wide, with age becoming brownish, rugose tuberculate throughout the
body with ridge-like branched folds, medially circumscissile but no specific line of dehiscence evident, the utricle tipped by a distinct, lighter tan, smooth, rather inflated, dome-like style base 0.3–0.5 mm long, 0.5–0.6 mm wide, with 3 broadly conic lobes at tip each bearing a papillate stigmatic line along the inner margin that extends onto a slender 0.2–0.3 mm long tip. Seeds black to reddish-brown, smooth, shiny, lenticular, orbicular, 1.0–1.2 mm wide, 0.6 mm thick, margins edged, slightly notched at base.


As noted above, the species structurally is similar to A. brandegei and A. dubius but is immediately distinguished from A. brandegei by its erect, not reflexed calyx and from A. dubius by: 1) the narrow subequal, well-separated, firm (not membranous margined) spatulate, acute to round-tipped pistillate sepals that are shorter than the fruit and are expanded and united at the base; 2) the distinctive roughened (not smooth) utricle wall with its smooth, inflated, turban-like style bases; and 3) the 3 stamens. The sepals along the edges of the compressed fruit are usually largest and typically have veins branched below the tip. In A. dubius the bracts and pistillate sepals are larger, more elliptical, more membranous, stamens number 5–4 in male flowers and the utricle wall more gradually expanded above. Amaranthus dubius, however, exhibits variability in bract length, sepal size, mature pericarp configuration and may be confused with unarmed individuals of A. spinosus L. with which it hybridizes (Grant 1959). Three varieties were described by Moquin-Tandon (1848) under A. tristis L. and transferred to A. dubius by Thellung (1914) (see Thellung 1914; Aellen 1959), but these are seldom accepted. They involve differences in inflorescence development, color and thickness.

A NEW TAXON FROM ARIZONA

Dr. Tom Van Devender requested identification of a series of Amaranthus collections from the Tucson Mountains and Organ Pipe National Monument west of Tucson, Arizona. The collections show a number of characteristics unlike any other southwestern Amaranthus. In Standley's (1917) key, the material, which has non-spatulate pistillate sepals, dehiscent utricles, a terminal inflorescence, no spines, bracts shorter or equal to the pistillate sepals, and the fruit shorter than the sepals, keys to the aforementioned Amaranthus
*Amaranthus*, a species with much shorter sepals, smaller seeds, etc. The Arizona specimens are small, erect, branched, monoecious annuals with coarse ovate leaves with dichasial cymes extending from the mid-leaf axils into a leafless terminal inflorescence. Stamine flowers have 5 sepals and 5 anthers; pistillate flowers have broad-based, acuminate bracts shorter than or about as long as the pistillate sepals (Fig. 9). The pistillate sepals are oblone, slightly spatulate, but not clawed; the outer sepals are usually acute, somewhat spine tipped, the inner ones are more obtuse or rounded. The sepals are distinctive in being green throughout most of the surface except for the moderately narrow scarious margins. As the sepals mature and dry, they reflex and become thick and rigid. The fruit is dehiscent, about as long as the sepals, with 3–2 styles, and is inflated and roughened above the line of dehiscence (Fig. 9C).

While this appears to be an unremarkable assortment of characters, the plants do not fall into any recognized taxon. Evidence of its possible relationship came from a specimen from Chiapas [32 km. N. Ocozocautla along rd. to Mal Paso, 19 Oct 1965, *Breedlove & Raven 13572* (LL)] annotated by J.D. Sauer as *Amaranthus hybridus* L.—atypical. This specimen has an inflorescence arrangement characteristic of *A. hybridus*, but the pistillate flowers have small bracts and indurated sepals longer than the utricles—very similar to the Arizonan specimens. However, the Arizonan specimens differ in having axillary dichasia and terminate in a single spike of dichasia, an inflorescence type more characteristic of *Amaranthus* species with clawed spatulate pistillate flower sepals, e.g. *A. obovatus* (Gray) Standley, *A. chihuahuensis* S.Wats, *A. torreyi* (Gray) S.Wats. Somewhat similar plants have been found near Alamos in southern Sonora, México. They are similar in development of the pistillate sepals, but in each the bracts are as long as or longer than the sepals and one collection, more reflexed. *Amaranthus hybridus* differs from the new taxon in the overall structure of the inflorescence, it produces a tight series of slender, ascending-spreading shoots, the slender, longer bracts that well exceed the flowers, and the membranous pistillate sepals that are typically green only along the midvein.

A question arises as to the origin of this taxon. Is it just an obscure taxon that has not been previously collected or is it a taxon of recent origin, perhaps a product of hybridization? A brief analysis of pollen stainability of the specimens revealed that pollen in Arizonan specimens varied greatly in stainability with Cotton-Blue in Lactophenol (Radford et al. 1974), with one collection having 99 percent stainability and other collections having 96, 89, 81, 51, and 47 percent stainability. The two collections from Sonora, both had high pollen stainability (97 and 95 percent). My conclusion is that the taxon may be of hybrid origin, perhaps with *A. hybridus* being one
parent, the other parent unknown. The only other species known from the Tucson Mountains are *A. fimбриatus* (Torr.) Benth. and *A. palmeri* S.Wats. (Rondeau et al. 1996), which are not parental candidates based on their characteristics.

The Sonoran specimens both differ from the Arizona specimens. In *Van Devender* 93-386 the pistillate sepals show green mostly along distinct secondary veins and subtending bracts have straight, long slender tips and a membranous ovate base. The other specimen (*Van Devender* 92-1121) has greenish sepals similar to the Arizonan specimens, but the subtending bracts are as long as the sepals, strong reflexed below the tip, and are sharp pointed.

*Amaranthus × tucsonensis* Henrickson, nothosp. nov. (Figs. 5, 9). **Type:**

*Amaranthus hybridus* differ septals multo majoribus firmioribus viridibus scariosi-marginatis (non omnino tenuis scariosis), bracteis floralibus pistillatis sepalis pistillatis aequantibus vel brevioribus (non 1.5–2.0 plo longioribus), axe inflorcentia vestimento sparo trichomatorum glandulosi-capitatorum (non dense villosus eglanduloso) et seminibus 1.2–1.4 mm in diametra (non 1.0 mm in diametro).

Erect, taprooted, mostly single-stemmed or upwardly branched monoeccious annuals to 1.5 dm tall; stems yellowish, sometimes tinged with red, striate, sparsely puberulent-pilose with crinkled, obscurely gland-tipped moniliform hairs to 0.3(–0.6) mm long, glabrate. Leaves alternate; petioles yellowish, 8–32 mm long; leaf blades rhombic to ovate, (13–)20–35(–45) mm long, (7–)10–22(–28) mm wide, obtuse to rounded, often mucronate at the tip, broadly cuneate with the margins narrowly decurrent along the distal petiole at the base, the margins crisped, the lamina grayish-green, glabrous to sparsely puberulent-pilose with crinkled, gland-tipped hairs to 0.3 mm long, the veins yellowish, impressed above, raised beneath. Flower borne in axillary, compound dichasia cymes to 10 mm long, these forming discontinuous glocherales below, but coalescing into terminal, continuous inflorescences 6–15 cm long, 8–10(–16) mm wide, the basal (oldest) flower(s) staminate, developing lateral, sinuous, occasionally branching axes to 1 mm thick, covered with the persistent bracts and bracteoles that subtended the early deciduous male flowers. Stamine flowers: bracts broadly ovate at base, acuminate above with the midvein excurrent, 1.7–2.5 mm long, scarious except along the green midrib; sepals oblong-elliptical to lanceolate, 1.6–2.2 mm long, 0.6–1.0 mm wide, acute-acuminate, scarious except along the short excurrent midrib; stamens 5; filaments 1–1.8 mm long; anthers 0.8–1.0 mm long, yellow. Pistillate flowers: bracts lanceolate to basally ovate, 1.5–3.5 mm long, 0.8–1.4 mm wide, usually shorter than the sepals, broadly scarious below, the green midrib zone 0.2–0.5 mm wide, the midvein ex-
Fig. 9. *Amaranthus × tucsonensis*. A. Growth habit. B. Mature calyx showing short subtending bract. C. Calyx and base of pericarp, tip of pericarp and seed. All from holotype (Pima Co., Ariz. Van Devender 88-676, ARIZ). Magnifications as indicated.
current for 0.5–0.6 mm, bracteoles 2, similar but only 1.4–2.2 mm long; sepal 5, oblong, oblong-spatulate to oblong-elliptical, 2.2–3.1(-4) mm long, 0.6–1.2 mm wide, obtuse, rounded to emarginate, the outer ones more acuminate with the midvein excurrent 0.1–0.3 mm at the tip, entire to crenate distally, green for 0.5–0.9 mm across the back, with scarious margins 0.15–0.2 mm wide, glabrous to sparsely puberulent-pilose with crinkled, obscurely gland-tipped hairs, unequal in size with the outermost sepal larger and more acute than the inner round-tipped sepal, at maturity all sepals strongly reflexing, thickening and uniting at the base and overall becoming indurate. Fruit 2.2–2.5 mm long, circumscissile, the base smooth, the top roughened, inflated above the zone of dehiscence, the 3 style bases with a U-shaped sinus; stigmatic surfaces 1.2–1.3 mm long, puberulent with moniliform hairs. Seeds broadly lenticular, slightly ovate, 1.2–1.4 mm wide, shiny black, with a slight marginal rim.


MEXICO. Sonora. Rancho La Junta, 3.0 km NNE of Burapaco, 27°35′15″N, 108°52′W, 220 m, 17 Mar 1993, Van Devender et al. 93-386 (ARIZ); Mesa Masiaca, 6.5 km WNW of San José de Masiaca, 26°46′4″N, 109°17′9″W, 200 m, 8 Oct 1992, Van Devender et al. 92-1121 (ARIZ).

In the Tucson Mountains, west of Tucson, Arizona, the taxon occurs on rocky slopes in desert scrub and grassland from 790–1430 m elevation (Rondeau et al. 1996). In northern Sonora it is known from elevations about 200 m in fields and roadsides. Flowering occurs from September to November or after rains.

ACKNOWLEDGMENTS

I thank FGH, NY, NY, TEX-LL, UC, US for loan of specimens, Charles Jarvis (BM) for information regarding the type of A. polygonoides, U. Braun (HAL) for information on the type of A. crassipes, Bobbi Angel (NY) for the line drawings, Thomas Wendt for comments on the manuscript and the Spanish translation of the abstract, Guy Nesom for the Latin translations, and the Plant Resources Center at the University of Texas, Austin for use of facilities.

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JOHNSTON, I.M. 1944. Plants of Coahuila, eastern Chihuahua, and adjoining Zacatecas and Durango, V.J. Arnold Arbor. 25:133–182.


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**Index to Scientific Names**
BOOK RECEIVED


Under the Blade is about land use, rural land use in the United States. It is about farms and their conservation. From the back cover: "Under the Blade: The Conservation of Agricultural Landscapes proposes essential principles for sustainable land management. Its seven orienting chapters examine the loss of farmland and other rural lands from the interacting perspectives of law, economics, landscape characteristics, population growth, social and political forces, ethics, and aesthetics. The chapters present as well tools and strategies for preserving farmland and guiding rural development. The application of these tools is illustrated by 22 case studies of towns and regions throughout the United States, each posing variations of challenge, response, and degree of success (or failure)."

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TWO NEW SPECIES OF *TRIPOGON* (POACEAE) FROM INDIA

A.K. PRADEEP

*Department of Botany*
*University of Calicut*
*Kerala 673 635, INDIA*

C.N. SUNIL

*Department of Botany*
*S.N.M. College, Mallankara*
*Kerala 683 516, INDIA*

ABSTRACT

Two new species of Poaceae, *Tripogon sivarajanii* Sunil and *T. vellarianus* Pradeep from the Western Ghats of Kerala, India are described and illustrated.

RESUMEN

Se describen e ilustran dos nuevas especies de Poaceae, *Tripogon sivarajanii* Sunil y *T. vellarianus* Pradeep de los Western Ghats de Kerala, India.

The genus *Tripogon* Roem. & Schult., with about 31 species, is distributed in the Old World tropics (Mabberley 1997). In India, the genus has ca. 12 species most of them occurring at an elevation above 900 m. Four species, *T. bromoides* Roem. & Schult., *T. narayanii* Sreekumar *et al*., *T. ananthaswaratnam* Sreekumar *et al*., and *T. capitellatus* Jau. & Spach. are known from Kerala (Sreekumar & Nair 1991). During the course of floristic investigation on the Western Ghats of Kerala, the authors came across two interesting specimens of *Tripogon* which do not correspond to any of the previously described taxa. We conclude that they represent two new species and we describe them here.

*Tripogon sivarajanii* Sunil, sp. nov. (Fig. 1). TYPE: INDIA. KERALA. Idukki D.: Valakerrimala near Moolamattam, 1020 m, 2 Sep 1997, C.N. Sunil 2117 (HOLOTYPE: MH; ISOTYPES: BRIT, K, L, PBL).

Triphogon triñofo affinis, *T. sivarajanii* ligulis glabris, lemmatis aristis 3–3.5 mm longis, palea apicaliter 2-lobata facile distinguendus.

Tufted perennial herb. Culms 40–70 cm high; nodes glabrous. Leaves with the blades 15–40 cm long and 2–3 mm broad, linear, acuminete, villous

*SIDA* 18(3): 809–814. 1999
on the upper surface with short dense hairs intermingled with long scattered shaggy hairs, glabrous below, the midrib inconspicuous; ligule a fine, glabrous membrane; sheath smooth. Racemes 20–45 cm long, with 25–60 spikelets; rachis smooth, glabrous. Spikelets 5–8-flowered, 7–8 mm long; callus hairy. Lower glume ca. 2 mm, lanceolate, shallowly notched on one side. Upper glume 3–4 mm long, lanceolate, acute or acuminate at the apex. Lemma 3–3.5 mm long, 3-nerved and 1-awned, glabrous, 2-lobed at the apex, the lobes acuminate, awned in the sinus; awns 3–3.5 mm, more or less equal to lemma, scabrid. Palea 2–3 mm, elliptic, 2-lobed at the apex, 2-keeled, winged, the wings narrow, the margins ciliate. Stamens 3; anthers ca. 1 mm, yellow tinged with pink. Ovary 0.25 mm, globose; styles 2; stigma feathery, purple. Grains unknown.

Distribution.—Tripogon sivarajanii is endemic to Kerala and is known only from the type locality, Valakettimala near Moolamattam in Idukki District of Kerala.

Ecology.—This species grows from 1000–1300 m elevation along grassy hill slopes and flowers from September to December.

Tripogon sivarajanii closely resembles, T. trifidus Munro ex Stapf, a species distributed in the eastern part of India in having 20–45 cm long racemes, 5–8-flowered spikelets, laterally lobed and notched lower glumes and the awns of the lemma being neither geniculate nor twisted. The two species can be separated as follows:

1. Ligules ciliate, densely on the margins towards the apex; upper glume 2-awned with a short awn at the apex; lemma bearded at base, 2-lobed at apex, awned in the sinus, the lobes awned at the apex; median awn twice as long as lemma; palea obtuse at the apex ........................................... T. trifidus

1. Ligules glabrous throughout; upper glume never 2-awned or awned at apex; lemma glabrous at base, 2-lobed at apex, awned in the sinus, the lobes never awned at the apex, median awn as long as or shorter than lemma; palea 2-lobed at the apex ........................................... T. sivarajanii

The specific epithet honors the late V.V. Sivarajan, one of the foremost authorities on the flowering plants of Kerala. As a staff member of the University of Calicut, he had published over 25 new species, thus the dedication of this new Poaceae to him is appropriate and well-deserved.

Tripogon vellarianus Pradeep, sp. nov. (Fig. 2). TYPE: INDIA. KERALA. KOZHIKODE DC.: Vellarimala, 11°25.877'N, 76°06.765'E, 1300 m, 17 Oct 1997 (fl), A.K. Pradeep 56110 (HOLOTYPE: MH; ISOTYPES: BRIT, K, L, PBL).

Tripogon vellarianus sine cognato propeque a congeneris aliis habitu valde caespitoso, foliis 8–15 mm latis, spiculis 10–17 mm longis, lemmate 2-lobato 3-aristato vel 1-aristato, aristis lateralibus minutis ad nullis distinguendus.
Tufted perennial herb. Culms 30–90 cm tall, erect; nodes glabrous. Leaf blade 30–60 cm long, 8–15 mm wide, linear, base of blade glabrous. Sheaths closely clasping, rigid, glabrous; ligules indistinct. Racemes 30–40 cm long, rachis stout, glabrous. Spikelets 10–17 mm long, distant, dorsiventrally flattened, 8–10-flowered; callus bearded. Lower glumes 4.3 ± 1.25 mm, lanceolate, acuminate at the apex, purplish tinged dorsally, glabrous. Upper glumes 5.3 ± 1.5 mm, elliptic-lanceolate, acute at the apex, prominently 3-nerved, glabrous. Lemmas (excluding the awn) 5.3 ± 2 mm, ovate-lanceolate, 3-nerved, median awn 3 mm long, lateral awns absent or up to 5 mm long often closely adpressed to the median awn, glabrous. Palea 4.3 ± 2 mm, hyaline, narrowly elliptic, keeled and winged, keels minutely puberulous. Lodicules 2, ca. 0.25 mm, quadrate, apex coarsely 3-toothed. Stamens 3; anthers 1.5 mm long, oblong; filaments 0.7 mm long, slender, glabrous. Ovary 0.25 mm, obovate; styles 2, slender, hyaline, 0.8 mm long; stigmas feathery, purplish, 0.6 mm long. Grains not seen.

**Distribution.**—*Tripogon vellarianus* is known only from Vellarimala on the Western Ghats of Kerala in India. This species is to be expected from adjacent hill ranges of Wayanad and Kannur districts.

**Ecology.**—This species occurs from 1000–1500 m in wet rocky grasslands adjoining evergreen forests. It flowers from October to January.

*Tripogon vellarianus* is a distinctive species characterised by its strongly tussock-forming habit, broad leaves and large spikelets. Thomas A. Cope (Kew, pers. comm.), after examining our material, commented “in majority of the lemmas the lateral awns are minute or absent altogether. I cannot recall another species in the genus that is so reluctant to produce lateral awns.” It does not compare with any of the species so far known under the genus, although its entire lemma sometimes recalls that of *Tripogon major* Hook. f., a species widespread in tropical Africa. Dr. P.V. Sreekumar, Port Blair (pers. comm.) wrote “I find it extremely difficult to accommodate even under *Tripogon*; and I believe lemma is continuous with the awns.” However, apart from the entire lemma, in every other respect it corresponds exactly with the genus *Tripogon*.

**Acknowledgments**

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REFERENCES

BARNEBYDENDRON, A NEW GENERIC NAME (FABACEAE, CAESALPINIOIDEAE, DETARIEAE, BROWNEA GROUP)

JOSEPH H. KIRKBRIDE, JR.
USDA, Agricultural Research Service
Systematic Botany and Mycology Laboratory
Room 304, Building 011A, BARC-West
Beltsville, MD 20705-2350, U.S.A.
jkirkbri@asrr.arsusda.gov

ABSTRACT

A new generic name, Barnebydendron, is proposed for Phyllocarpus Riedel ex Tul. which is an illegitimate, later homonym of Phyllocarpus Riedel ex Endl.

RESUMEN

Se propone el nuevo nombre genérico, Barnebydendron, para reemplazar a Phyllocarpus Riedel ex Tul., ya que, este nombre es ilegítimo y un homónimo posterior de Phyllocarpus Riedel ex Endl.

RESUMO

O novo nome genérico, Barnebydendron, é proposto para substituir a Phyllocarpus Riedel ex Tul., visto que este nome é ilegítimo e homónimo posterior de Phyllocarpus Riedel ex Endl.

In 1842 Endlicher (1842) presented the genus Phyllocarpus Riedel ex Endl. on page 97 of the second supplement to his Generum plantarum:

6720/1 Phyllocarpus RID.

Lonchocarpus pterocarpus DC. Prodr. II. 260. typum distincti generis (Phyllocarpus Riedel msc.), a Platymiscio et Miscolobio (Gen. pl. n. 6719 et 6720) leguminis membranacei sutura vexillari alata diversi, constituit.

Endlicher validly published Phyllocarpus with a single element, L. pterocarpus, which is automatically the type of the genus. He distinguished it from Platymiscium Vogel and Miscolobium Vogel (=Dalbergia L. f.) by its membranous legume with the vexillary suture variously winged. Lonchocarpus pterocarpus DC. (=Deguelia scandens Aubl.) has winged fruits that are somewhat fragile (MacBride 1943), and so the diagnosis could well describe material of L. pterocarpus.

1022 in Guillemin's Brazilian herbarium, and since it was the only species in the genus, it is the type of *Phyllocarpus Riedel* ex Tul. In 1844 Tulasne (1844) republished his generic description verbatim, amplified the description of *P. riedelii*, discussed the generic relations of *Phyllocarpus*, and illustrated the species. He also stated that specimen no. 1022 in the Guillemin herbarium was a Riedel collection. Apparently Tulasne examined Riedel's collection in Guillemin's herbarium, and noted that Endlicher's *Phyllocarpus* did not correspond to what Riedel had intended. Therefore he redescribed *Phyllocarpus* using the material of Riedel, and thereby created a second *Phyllocarpus* which is a later, illegitimate homonym.

Geesink (1984) separated *Deguelia* Aubl. from *Derris* Lour., and placed all the American species of *Derris* in *Deguelia*, including *Lonchocarpus*. He cited Endlicher's *Phyllocarpus* as a later synonym of *Deguelia*. The type of Endlicher's *Phyllocarpus* is now a later synonym of *Deguelia scandens* with the following synonymy:

*Deguelia scandens* Aubl., Hist. pl. Guiane 2:750, t. 300. 1775.

*Lonchocarpus pterocarpus* DC., Prodr. 2:260. 1825.


This species is used as a fish poison (Killip 1936; Uphof 1968) in northern South America.

In 1912 Tulasne's *Phyllocarpus* was discovered in Guatemala, and John Donnell Smith (1913) mistakenly described it as a new species, *P. septentrionalis* Donn. Sm. It was later discovered as far south as Panama (Standley & Steyermark 1946; Woodson & Schery 1951; Holdridge & Poveda 1975). Barneby (1996) reviewed the genus, and concluded that it is monotypic and that *P. septentrionalis* is a later synonym of *P. riedelii*.

*Phyllocarpus* in the sense of Tulasne has traditionally been accepted as a genus in the Fabaceae. It has been used in systems of legume classification (Bentham 1865; Hutchinson 1964; Cowan & Polhill 1981; Polhill 1994), floras (Bentham 1870; Britton & Rose 1930; Standley & Steyermark 1946; Woodson & Schery 1951; Holdridge & Poveda 1975; Isely 1975), and morphological studies (Gunn 1991). From the descriptions in these works, it is obvious that the authors mentioned above were referring to *Phyllocarpus* Riedel ex Tul. However, in Britton and Rose (1930) and Woodson and Schery (1951) its place of publication was given as the second supplement to Endlicher's *Genera plantarum* (1842), and also in Britton and Rose (1930) its type was cited as "*Phyllocarpus Pterocarpus* Riedel," an unpublished epithet.
Isely (1975) was the first to note that Tulasne’s *Phyllocarpus* was a later homonym of Endlicher’s *Phyllocarpus*, and therefore illegitimate. Barneby (1996) also recognized that Tulasne’s *Phyllocarpus* was illegitimate. Therefore the following new name is presented for Tulasne’s *Phyllocarpus*:


I take great pleasure in dedicating this genus to Rupert C. Barneby who has contributed so much to legume systematics. During my doctoral studies, I shared an office with Rupert at the New York Botanical Garden, Bronx, New York. Rupert taught me many things, and significantly contributed to my botanical training.

In his review Barneby (1996) gave the distribution of *B. riedelii* as Central America from Guatemala to Panama, the Purús basin in the southwestern Brazilian Amazon, and the vicinity of Rio de Janeiro. It has recently been collected in Amazonian Peru (N. Begarzo 150, 20 May 1980 [US]) and Venezuela (J. Lissot s.n., 24 Nov 1975 [US]) partially filling the gap between Central America and the southwestern Brazilian Amazon. Barneby (1996) cast doubt on whether it was native to the vicinity of Rio de Janeiro. As far as he knew, it has not been collected as a wild plant near Rio de Janeiro.

*Barnebydendron* has been reported as cultivated in southern Florida, Cuba, Guatemala, Costa Rica, and Panama. Wild trees are 15–35 m tall, and cultivated flowering specimens are 5–12 m tall. It flowers in the dry season without leaves, and is full of flowers that are described as various shades of intense red. Standley and Steyermark (1946) stated, “in general appearance and in the color of its blossoms this tree suggests poinciana (*Delonix*) and is almost equally showy,” and Woodson and Schery (1951) wrote, “the abundant scarlet flowers rivaling in showiness those of the Royal Poinciana (*Delonix regia*).” This beautiful tree merits more widespread cultivation.

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REFERENCES


A NEW ENDEMIC SPECIES OF MENTZELIA SECT. BARTONIA (LOASACEAE) FROM NEW MEXICO

THOMAS K. TODSEN

Department of Biology
New Mexico State University
Las Cruces, NM 88003, U.S.A.

ABSTRACT

Mentzelia conspicua T.K. Todsen, endemic to the Río Chama basin of New Mexico, is illustrated and described. It is compared to a similar species, Mentzelia laciniate (Gray) Darl. The distribution of the two species in Río Arriba County is shown.

RESUMEN

Se ilustra y se describe Mentzelia conspicua T.K. Todsen, endémica de la cuenca del Río Chama en Nuevo México. Se compara con la especie semejante, Mentzelia laciniate (Gray) Darl. Se muestra la distribución de las dos especies en el condado de Río Arriba.

KEY WORDS: Mentzelia, Loasaceae, New Mexico

Mentzelia conspicua T.K. Todsen, sp. nov. (Fig. 1). TYPE: U.S.A. NEW MEXICO. Rio Arriba Co.: W end of El Vado Dam in deep road cut on NM Hwy 112, T28N, R2E, 19 Aug 1991, Todsen 91-8-11 (HOLOTYPE: NMC; ISOTYPE: LA).

Mentzelia laciniate (Rydb.) Darl. Similis sed differt. Differentiae sunt: staminum non-petaloidem; lobos foliorum oppositos; staminum longitudine variante, verticillum intimum 7–10mm, verticillum extimum 25–30mm; paginae superae foliorum virides cum pilis dispersis.

Erect, strict, herbaceous perennial to 60 cm tall, pubescent with small retrorsely barbed hairs and long barbed hairs with tips acute and bases surrounded by support cells. Rosette leaves and cauline leaves pinnately lobed, rachis 2–3 mm wide, lobes usually opposite, 6–15 mm long, 2–3 mm wide, lower surfaces pubescent with stout curved, pointed hairs and fewer, smaller retrorsely barbed hairs, upper surfaces sparsely pubescent with few scattered pointed hairs. Bracts linear, usually entire but occasionally with 2 narrow lobes at base. Flowers opening late afternoon. Calyx lobes 5, 8–12 mm long, deltoid, acuminate, calyx tube 1.5–2 cm long; petals 10, in two whorls, the inner whorl of 5 petaloid staminodes, oviate to lanceolate, golden yellow, glabrous, outer whorl 25–40 mm long, 8–11 mm wide, inner whorl 22–35 mm long, 7–10 mm wide. Fertile stamens numerous, filaments all filiform, outermost whorl filaments 20–27 long, innermost 7–10 mm long, anthers 1 mm long; pistil 1; style 1, 24–32 mm long; stigma 1.5 mm long, at anthesis 9–12 mm above the anthers. Capsule cylindrical, 15–22 mm long, topped by persistent calyx lobes. Seeds lenticular, dark gray to black.
when mature, 2–2.8 mm long, wing narrow, to 0.1 mm wide. Chromosome number n=10. Self compatible.

Distribution and ecology.—In the upper Rio Chama drainage of Rio Arriba County, New Mexico (Fig. 2), 1800–2250 m, on road cuts and steep barren hillsides of gray to red shales and clays of the Mancos and Chinle formations; flowering July to early October.
Additional specimens: U.S.A. NEW MEXICO. Rio Arriba Co.: 8 mi S of Canjilon, 24 Jul 1928, Wolf 2908 (CAS, CH, RSA); El Vado Dam, the Point, 22 Jul 1949, Castetter and Dittmer 6559 (UNM); El Vado Dam, 22 Jul 1949, Castetter and Dittmer 6565 (UNM); 22 mi S of Tierra Amarilla, 1954, Waterfall 11136 (BRIT, COLO); 2.2 mi S of Ghost Ranch Museum, 21 Aug 1964, chromosome voucher n=10, Atsatt 517 (LA); US84, 3.1 mi S of N turnoff to Canjilon, 21 Aug 1964, chromosome voucher n=10, Atsatt 518 (LA, US); US84, 2.4 mi S of Ghost Ranch Museum, fine red soil, 17 Sep 1968, Thompson 3558 (LA); US64, 6 mi E of Tierra Amarilla, 30 Aug 1974, Todsen s.n. (NMC); Echo Amphitheater Campground, 19 Aug 1991, Todsen 91-8-1 (LA, NMC); US84 1 mi S of entrance to Ghost Ranch, 19 Aug 1991, Todsen 91-8-2 (LA, NMC, NY); US84, 4.3 mi S of jct. with US 64E, Todsen 91-8-3 (NMC, LA, NY); US84, 9 mi S of Cebolla, 19 Aug 1991, Todsen 91-8-4 (NMC); NM 95, just W of Rio Chama bridge, 19 Aug 1991, Todsen 91-8-5 (LA, NMC, NY); NM 95, Heron Lake Park Visitor Center, 19 Aug 1991, Todsen 91-8-6 (NMC); Ghost Ranch, Kirchen Mesa Trail, 8 Jul 1994, Sivinsky and Lowery 2768 (NMC, UNM); NM 112, 5 mi W of El Vado Dam, 18 Aug 1994, Todsen 94-8-3 (NMC); NM 312, 3 mi E of US84, 18 Aug 1994, Todsen 94-8-4 (NMC); NM 95, NW end of El Vado Lake, 18 Aug 1994, Todsen 94-8-5 (NMC); Forest Road 151, S of Big Eddy Pullout, Chama River Canyon Wilderness, 6 Oct 1997, Todsen 97-10-1 (NMC). Torrance Co.: 16 mi E of Clines Corners, 17 Aug 1968, Waterfall 15166 (BRIT, OSU, RSA).

Thirty-plus years ago, H.J. Thompson (personal communication) noted that Mentzelia specimens collected from the upper Rio Chama drainage differed from typical Mentzelia laciniata as described by Darlington (Darlington 1934), particularly in the presence of variable stamen lengths. He stated that the only other Mentzelia showing this characteristic was M. crocea Kellogg (=...
M. lindleyi Torr. & Gray), so far as he knew. He later distributed a tentative description of what he called M. conspicua, but never published it.

Since all the earlier collections of *Mentzelia* from the upper Rio Chama basin were identified as *M. laciniata*, the differences between the latter species and *M. conspicua* are emphasized. For *M. conspicua*, 1) leaf lobes are usually opposite vs. usually alternate; 2) upper leaf surfaces and capsules have scattered pubescence vs. dense pubescence; 3) petaloid stamen filaments are absent vs. present; 4) stamen lengths for an individual flower are variable (7–22 mm) vs. about three-fourths the length of the petals. Other more subjective differences are that *M. conspicua* plants are stouter and taller and the flowers are much larger (6–9 cm vs. 3.5–4.5 cm).

There was an anomalous collection of *M. conspicua* from 16 mi E of Clines Corners in Torrance County (Waterfall 15166) 160 km SE of the nearest Rio Chama site. I have examined the specimens at BRIT and RSA and have a photocopy of the specimen at OSU and they are indeed *M. conspicua*. Attsatt, Thompson and I have independently searched the stated location and have found neither specimens nor characteristic habitat. The original site was along US Highway 66, which was completely redone to form Interstate Highway 40. It may be that the location was extirpated by that construction.

**ACKNOWLEDGMENTS**

I am indebted to H.J. Thompson for his sharing research data and advice on *Mentzelia conspicua* as he called the taxon. My thanks go to Linda Reeves for her drawing and to friends and colleagues who have offered advice and encouragement. Finally, my appreciation to the reviewers and the editor for their cogent comments and criticisms.

**REFERENCES**

NOMENCLATURAL NOVELTIES IN NUPHAR (NYMPHAEEAE)

DONALD J. PADGETT  

Department of Biology  
Southwest Missouri State University  
Springfield, MO 65804, U.S.A.

ABSTRACT

Recent revisionary and cladistic studies in Nuphar Sm. resulted in the following nomenclatural amendments: two novel sections are described (sect. Nuphar and sect. Astylus), five new combinations are proposed (N. advena subsp. orbiculata, N. advena subsp. ozarkana, N. advena subsp. nectarae, N. pumila subsp. sinensis, N. pumila subsp. oguraensis), and one species, N. oguraensis Miki, is lectotypified.

Nuphar Sm. (Nymphaeaceae) is a relatively common genus in north temperate regions of North America, Europe and Asia. Inhabiting ponds, lakes, streams and slow moving rivers, these perennial herbs are characterized by floating and submersed leaves and solitary, globose, yellow flowers.

While conducting monographic research on Nuphar, morphological analyses initially suggested that the genus was represented by two sets of species, Old World and New World segregates (Padgett et al. 1996). Cladistic analyses of representative internal transcribed spacer (ITS) sequences (nrDNA) and matK (cpDNA) sequences subsequently offered strong support for the same two infrageneric lineages (Padgett 1997; Padgett et al., in press). Accordingly, the classification of Nuphar is emended to include two sections.

Nuphar sect. Nuphar is characterized by five sepals, anthers no more than half the length of the filaments, and urceolate fruits with elongated necks, or “styles” of some authors. It contains all Eurasian species with a single species (N. microphylla (Pers.) Fern.) represented in northeastern North America. Nuphar sect. Astylus is characterized by 6–12 sepals, anthers 1–2 times the...
length of the filaments, and ovoid fruits lacking apparent necks. It is entirely North American in distribution.


Sepals 6–12; antherae elongatae, filamento suo duplo usque longiores; fructus ovoideus, baud infra discum constrictus; discus stigmaticus integer (rarius crenatus).

Sepals 6–12; anthers long, 1–2 times the length of the filaments, fruit barrel-shaped without a prominent neck, stigmatic disk entire (rarely crenate). North America. Type species: *Nuphar advena* (Ait.) Ait. f.

The synonymy of *Nuphar* is extensive and only recently has been assessed from a world-wide perspective (Beal 1956; Padgett 1997). However, since the primary purpose of this article is to make these new names available, complete synonymy will be withheld for a later publication (or see Padgett 1997). It should be noted, however, that Beal (1955; 1956) greatly broadened the species concept in his revision of *Nuphar*, thus placing into synonymy many previously recognized species under the type species *N. lutea* (L.) Sm. While information gleaned from the recent phylogenetic studies of the genus precludes any attempt to treat North American entities at a subspecific level under *N. lutea* (as urged by Beal [1956]), an alternative classification does adopt infraspecific taxa for some species (Padgett 1997). These taxa, as subspecies, are based on groups of populations with distinctive characters which exhibit geographical, and in some cases ecological, integrity but otherwise fall within the range of morphological variability for the species. A more detailed account of studies that support the taxonomic decisions reflected here will be forthcoming elsewhere (or see Padgett 1997).

As recognized by Padgett (1997), *Nuphar advena* sensu lato is a polymorphic species in section *Astylus* that ranges throughout most of southeastern North America. It is comprised of four recognizable, but morphologically strongly overlapping and inter-grading subspecies.

The reduction in rank of the three taxa that follow is based on examination of numerous herbarium specimens of this species complex from throughout its range, coupled with fieldwork, as well as multivariate statistical analyses (Padgett, in prep.). Infraspecific ranking of most of these formerly recognized species has been supported in opinion by other workers (e.g., Yatskievych & Turner 1990; Wiersema & Hellquist 1997).


As recognized by Padgett (1997), Nuphar pumila sensu lato is a polymorphic species within section Nuphar, largely of northern Eurasia, with three discernible subspecies. This subspecies and the following are restricted to warm regions in eastern Asia. Nuphar pumila, distinct from the American *N. microphylla* (Padgett 1998), is perhaps the most widely distributed species in the genus as a whole.


This subspecies refers to a group of relatively rare plants confined to southern Japan. In the original protologue by Miki (1934) no type was designated. Although an effort was made to locate original material (four specimens cited by Miki), specimens of Miki's collections could not be located in Osaka (OSA). Therefore, the illustration in the original description (Miki 1934; Fig. 7, p. 334) of the taxon has been selected to serve as the lectotype. This plate clearly shows the diagnostic central lacuna of the petiole, a feature scarcely apparent on herbarium specimens.


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REFERENCES


A NEW HYBRID OF SPIRAEA (ROSACEAE) FROM OREGON

WILLIAM J. HESS
The Morton Arboretum
Lisle, IL 60532, U.S.A.
whess@mortonarb.org

NICK A. STOYNOFF
Science Department, Glenbard East High School
Lombard, IL 60148, U.S.A.

ABSTRACT

A new naturally occurring hybrid between Spiraea douglasii var. menziesii and S. splendens var. rosea is described and named S. ×hitchcockii W. Hess & N. Stoynoff. Morphological, chromosome number, and pollen stainability evidence is presented. The hybrid is the first reported triploid for the genus Spiraea.

RESUMEN

Se describe un nuevo híbrido natural entre Spiraea douglasii var. menziesii y S. splendens var. rosea que se nombra S. ×hitchcockii W. Hess & N. Stoynoff. Se presentan evidencias morfológicas, número cromosómico y tinción del polen. El híbrido es el primer triploide citado del género Spiraea.

In the Pacific Northwest, areas where species of Spiraea overlap, hybrids have been produced (Hitchcock et al. 1961). Hess (1969) presented evidence that S. douglasii Hook. var. menziesii (Hook.) K. Presl and S. betulifolia Pallas var. lucida (Greene) C.L. Hitchc. hybridized to produce S. × pyramidata Greene. In at least one area, S. douglasii var. menziesii and S. splendens (Baumann) ex K. Koch var. rosea (Gray) Kartesz and Gandhi (syn. S. densiflora Nutt.) occur together and produce a naturally occurring hybrid herein named Spiraea ×hitchcockii.


Differt a Spiraea splendens var. rosea inflorescentia paniculata, pubescentia puberula et Spiraea douglasii var. menziesii lamina serrulata, calyces lobis puberula, et inflorescentia 1.3–2.8 longiora quam lata.

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Shrubs, forming rhizomatous colonies, 10–12 dm tall. Branches pale brown, becoming dark brown when mature and slightly peeling, lightly puberulent. Leaves (20–)25–45(–60) mm long, (8–)12–18(–21) mm wide; mostly obovate to narrowly elliptic; lightly puberulent above, puberulent below; margins serrate, distal 1/2–1/3. Inflorescences pyramidal, 18–75(–95) mm long, 15–40(–45) mm wide; puberulent. Flowers many, in panicles; hypanthia green, 9–11 mm long, 14–16 mm wide, puberulent within and without; calyx lobes deltoid, 7–10 mm long, 7–9 mm wide, mostly reflexed, puberulent without, densely puberulent along margins within; petals rose-pink, broadly elliptic, 13–15 mm long, 11–13 mm wide; stamens many, pink; carpels 5, separate, follicles glabrous. n = 27.


Distribution.—Scott Lake, in Oregon, is the main locality known to the authors where Spiraea × hitchcockii occurs. It grows around the lake margin with its putative parents, S. douglasii var. menziesii and S. splendens var. rosea. The putative parents occur elsewhere in the Pacific Northwest and other hybrids of these species may be found in localities of overlap. Hess (1962) cited a collection from Pierce Co., WA (Warren 1627, WTU) as a possible hybrid between the putative parents.

Morphology.—The most obvious morphological difference between Spiraea × hitchcockii and its putative parents is a pyramidal inflorescence that is up to three times as tall as wide, versus the inflorescence of S. douglasii var. menziesii that is typically more than three times taller than wide and of S. splendens var. rosea, which has a flat-topped or slightly rounded inflorescence. The inflorescences and calyces of S. × hitchcockii are somewhat puberulent and not tomentulose as those of S. douglasii var. menziesii, or glabrous to lightly puberulent as that of S. splendens var. rosea. The leaves of S. × hitchcockii are mostly obovate to narrowly elliptical, 2.5–4.5 cm long, 1.2–1.8 cm wide, finely serrulate, and finely puberulent; those of S. douglasii var. menziesii oblong-elliptic to obovate-lanceolate, 3–10 cm long, 2–8 cm wide, serrate, and glabrous to lightly pubescent; and leaves ovate-oval to oblong-elliptic, 2–5 cm long, 1–4 cm wide, serrate to serrate, and finely puberulent for S. splendens var. rosea. The intermediate shape of the inflorescence of S. × hitchcockii, when compared with the putative parents, suggest a hybrid. Spiraea × hitchcockii shares the leaf vestiture, length, serrulate margins with those of S. splendens var. rosea and its leaf shape approaches that of S. douglasii var. menziesii. The shared features of the putative parents suggest the hybrid nature of S. × hitchcockii.

Cytology.—Hess (1969) reported the chromosome numbers for Spiraea douglasii var. menziesii as n = 18 and S. densiflora (= S. splendens var. rosea) as n = 9. Until
then, all of the chromosome counts of *Spiraea* in the new world were tetraploids. The count for *S. splendens* var. *rosea* was the first record of a diploid *Spiraea* in the new world. The collecting of flower buds, their preservation, and slide preparation procedures followed Hess (1969). All counts were made on a Zeiss Photomicroscope II with a camera lucida attachment. Chromosome counts were made from microsporocytes of *S. splendens* var. *rosea*, *S. douglasii* var. *menziesii*, and *S. ×hitchcockii*. Counts of \( n = 9 \) for *S. splendens* var. *rosea* confirmed the earlier diploid record (Fig. 1, A). The tetraploid number of 18 bivalents obtained for *S. douglasii* var. *menziesii* (Fig. 1, B) also.

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**Fig. 1.** Camera lucida drawings of chromosomes from microsporocytes of *Spiraea* (× 1000). A. *Spiraea splendens* var. *rosea*, Hess & Stoyhoff 7266: Metaphase I, 9\(_1\). B. *Spiraea douglasii* var. *menziesii*, Hess & Stoyhoff 7281: Metaphase I, 18\(_1\). C. *Spiraea ×hitchcockii*, Hess & Stoyhoff 7283: Metaphase I, 4\(_1\), 17\(_1\). D. Metaphase I, 4\(_1\), 17\(_1\).
confirmed an earlier count of Hess (1969). Camera lucida illustrations of chromosomes are shown for S. ×hitchcockii (Fig. 1, C, D). The chromosomes for the hybrid had mostly univalents evident and a few bivalents. The haploid number is \( n = 27 \). Spiraea ×hitchcockii would appear to be the first known triploid for the genus.

**Pollen stainability.**—Pollen grains were immersed in cotton blue-lactolphenol to test for pollen stainability (interpreted as pollen viability) based on procedures in Hess (1969). The percentage of pollen grains of Spiraea douglasii var. menziesii stained was 84—95%, similar to Hess’s report for the same species in 1969. 84—98% of the pollen grains of S. splendens var. rosea were stained, similar to what Hess reported for the same species in his thesis (1962). Spiraea ×hitchcockii pollen grains stained from 2—14%. Low pollen stainability (i.e. viability) is suggestive of hybridity.

**Etymology.**—*Spiraea ×hitchcockii* is named in honor of the senior author’s first mentor in taxonomy, C. Leo Hitchcock, one of the best taxonomy teachers of his era, a student par excellence on the flora of the Pacific Northwest, and a world class taxonomist.

**ACKNOWLEDGMENTS**

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**REFERENCES**


A NEW COMBINATION IN CROIZATIA (EUPHORBIACEAE)

L.J. DORR

Department of Botany, MRC-166
National Museum of Natural History
Smithsonian Institution
Washington, DC 20560-0166, U.S.A.
dorr@nmnh.si.edu

ABSTRACT

The unspecific genus Pseudosagotia is placed in synonymy under Croizatia and a new combination, Croizatia brevipetiolata (Secco) Dorr, is proposed for its sole species. An emended description is provided for C. brevipetiolata, a dioecious species that was known previously only from female flowers and fruits. Croizatia brevipetiolata is compared to C. neutropica and C. naigutensis, two species from coastal Venezuela, and to C. panamensis, a species from Panama and Pacific Colombia.

RESUMEN

Se ubica el género monoespecífico Pseudosagotia como sinónimo del género Croizatia y se propone una nueva combinación, Croizatia brevipetiolata (Secco) Dorr, para su única especie. Se presenta una descripción corregida de C. brevipetiolata, una especie dioica, de la cual previamente sólo se conocían las flores femeninas y los frutos. Se compara C. brevipetiolata con C. neutropica y C. naigutensis, dos especies de la región litoral de Venezuela, y con C. panamensis, una especie de Panamá y el extremo occidental de Colombia.

When Secco (1985) described the genus Pseudosagotia, he failed to compare it to Croizatia Steyerm., which is not surprising given that the latter genus was then known from two imperfect collections that served as the types of two species. Had Secco read Steyermark's (1952, 1978) descriptions of these species or seen the accompanying figures he undoubtedly would have described his species of Pseudosagotia as a new species of Croizatia because the two genera are identical in all essential characters save one, which appears to have been misinterpreted. Subsequently, Webster et al. (1987) reviewed the genus Croizatia, which they placed in the Phyllanthoideae, and they described a third species. Most recently, Webster (1994) placed Croizatia in the Oldfieldioideae and created a new tribe, Croizatieae, to accommodate the genus, the correct placement of which he continued to debate. Webster and collaborators overlooked Pseudosagotia and its sole species and they cited no other generic synonyms of Croizatia.

Salient characters that Secco (1985) observed for Pseudosagotia, which also define Croizatia, included the following: pistillate flowers pedicellate; ca-
lyx 5-lobed, petaloid; petals 5, minute, alternisepalous; ovary 3-locular, with 2 ovules per locule; style 3-branched, each branch bifurcated; fruit capsular, with persistent sepal lobes; seeds ecatunculate. In addition, while not mentioned by Secco (1985), his illustration (Fig. 1) showed that the sepal lobes of Pseudosagotia are reflexed in fruit like those of Croizatia. Staminate flowers of Pseudosagotia were not available to Secco (1985), but these flowers (described below) also agree in shape, size, and ornamentation with those of Croizatia. Similarly, pollen of Pseudosagotia (described below) agrees with published descriptions (Webster et al. 1987; Levin & Simpson 1994; Simpson & Levin 1994) of pollen of C. naughtensis Steyerm. (The number and nature of the pores of Pseudosagotia pollen were not visible with light microscopy). The only character of Pseudosagotia cited by Secco (1985) that does not agree with Croizatia (as defined by Webster et al. 1987; Webster & Huft 1988; Webster 1994) is the presence of endosperm, which has not been reconfirmed.

**Croizatia Steyerm., Fieldiana, Bot. 28(2):308. 1952. Type: Croizatia neotropica Steyerm.**


Tree, 3–6(–15) m tall; leaf blades elliptic to lanceolate or oblanceolate, long-acuminate at apex, long-attenuate at base, (5–)8.5–21 cm long, (2–)3–6.5 cm broad, inconspicuously strigose or glabrous beneath, lateral nerves ca. 8–9 on each side, prominulous with the fainter and more delicate tertiary veins, glabrous above; petioles 4–6(–10) mm long, slender, canaliculate, strigose or glabrous; stipules subulate, ca. 4–5 mm long, scarious, sericeous, deciduous. Staminate flowers in dense axillary clusters; pedicel 5–8 mm long, strigose; sepals 5, elliptic, entire, more or less equal in size, 5.5–6 mm long, 4–5 mm broad, whitish-cream or yellowish-white; petals 5, obovate, subentire, ca. 1.25–1.8 mm long, ca. 1–1.2 mm broad, glabrous adaxially, densely sericeous abaxially; disk cupuliform, ca. 1 mm tall, 4–5 mm in diam., glabrous; stamens 5, free, filaments ca. 3 mm long, hirsutulous basally; anthers elliptic, ca. 1.5–2 mm long; pistilode 3–4-lobed, 4–5 mm tall, hirsutulous basally. Pollen spherical, ca. 40 μm in diam., and echinate (Cuello et al. 992, US!). Pistillate flowers in 2–3-flowered axillary clusters; pedicel strigose, 12–28 mm long at anthesis and in fruit; sepals (4) 5, elliptic, slightly carinate (hooded), 8–10 mm long, 3–5 mm broad, unequal in size (one larger than the others), strigose adaxially near the base, strigose abaxially, greenish, becoming reflexed and persistent in fruit; petals (4) 5, elliptic, ca. 1.25
mm long, ca. 0.75 mm broad, glabrous adaxially, densely sericeous abaxially, disk cupuliform, ca. 1 mm tall, ca. 5 mm in diam., glabrous; ovary sericeous, hairs white; styles spreading, ca. 3.5 mm long, twice bifid, the undivided portion ca. 1.5 mm long, the primary branches ca. 1.5 mm long, ultimate tips ca. 0.5 mm long. Capsule oblate, 3-lobed, 1–1.5 cm tall, 1.5–1.8 cm in diam., reticulate, strigose to glabrate; columella ca. 7–10 mm tall, wings persistent. Seeds ovoid, flattened on one side, ca. 10 mm long, ca. 6–8 mm broad, testa smooth, hilum medial, exalbuminous (Cuello et al. 990, US!), cotyledons folded (contortuplicate).

**Distribution and ecology.**—Locally common on the slopes of the Andes in Barinas, Lara, Portuguesa, and Trujillo states, Venezuela, where it occurs from 1400–2300 (–2600) m elevation in lower montane (cloud) forest often dominated by *Wettinia praemorsa* (Willd.) Wess. Boer (Palmae). In the Ramal de Guaramacal (Trujillo state) Cuello (1997) found that *Croizatia brevipetiolata* was the most abundant species in vegetation plots she established at 2100 and 2300 m elevation. Also, apparently frequent at 1650 m elevation in dense forest on the slope of Pico Renjiño, Meta, Colombia. In Venezuela, flowering from (April) May through July and fruiting in October and November. In Colombia, known only from fruiting material collected in June.

In some Venezuelan populations, male plants appear to be less common (less conspicuous?) than female plants (fide Dorr & Barnett 8046).


**COLOMBIA. Meta:** Sierra de la Macarena, Central Mountains, Pico Renjiño, 22 Jan 1950 (fr), Philipson et al. 2154 (US).
Fig. 1. Distribution of *Croizatia* species (Euphorbiaceae) in Central and northern South America.

The paucity and incompleteness of the available material make interpreting the species boundaries of *Croizatia* difficult. *Croizatia brevipetiolata* is very similar morphologically to *C. naiguatensis*, which is known from a few collections from the Cerro Naiguatá in the Coastal Cordillera of the D.F., Venezuela. *Croizatia brevipetiolata* differs from *C. naiguatensis*, however, in that the leaf
apices are long-acuminate (versus acute or obtuse) and the leaf bases are long-attenuate (versus attenuate); the staminate flowers are larger in all measurable characters (pedicels 5–8 versus 3–4 mm long; sepals 5.5–6 × 4–5 versus 4–4.5 × 2.5–3 mm; disk 4–5 versus ca. 3 mm in diam.; filaments ca. 3 versus 2.2–2.5 mm long; anthers 1.5–2 versus 1.2–1.4 mm long; and pistillodes 4–5 versus 1.8–2.2 mm tall); and the pedicels of pistillate flowers are longer both in flower and fruit (12–28 versus 8–12 mm long). Collectors’ notes also indicate that the perianth of pistillate flowers of C. brevipetiolata is greenish in color (fide Licata & Cuello 152, Licata & Niño 304, etc.), while that of C. naignatensis is cream-colored (fide Berry et al. 4121, 4125, US!). Both C. brevipetiolata and C. naignatensis can be distinguished from C. panamensis G.L. Webster by having staminate flowers with free (versus connate) stamens. Likewise, the two species can be distinguished from the enigmatic C. neotropica by having shorter (8–28 versus 35–45 mm long) pistillate flower pedicels. Good flowering material (both staminate and pistillate) of C. neotropica is still lacking. Croizatia brevipetiolata and C. naignatensis also can be distinguished from the other two described species by having fewer (7–10 versus 12–15) lateral nerves on each side of the midvein of the leaf blade.

The few collections of Croizatia begin to suggest distinct geographic ranges for the species (Fig. 1). Croizatia brevipetiolata evidently is restricted to forested slopes of the northern Andes at elevations ranging from 1400–2300(–2600) m. Croizatia naignatensis and C. neotropica are both found in the Coastal Cordillera of northern Venezuela, but the former occurs in cloud forest at 1900–2150 m in the central portion of this cordillera, while the latter occurs at 1000–1350 m in the eastern portion of the same cordillera (Steyermark 1978). Croizatia panamensis has been collected only in primary forest at (50–)300–500 m in Panama and the Chocó region of neighboring Colombia. Additional material from Amazonian Ecuador and Peru, which Webster et al. (1987) mentioned, may represent new species and could extend the range of Croizatia further south, but none of this material was examined for this note.

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ABSTRACT

One new species of Abildgaardia, A. papillosa, and seven of Bulbostylis, are described and illustrated, and their relationships to closely allied species are discussed. In addition, an updated description of the genus along with a key to the species of New World Abildgaardia is provided.

RESUMEN

Se describe e ilustra una nueva especie de Abildgaardia, A. papillosa, y siete nuevas especies de Bulbostylis, y se discute su relación con especies cercanas. Además, se ofrece una descripción actualizada del género, acompañada de una clave para identificar las especies del Nuevo Mundo de Abildgaardia.

In our ongoing field-and-herbarium work with American fimbristyloid Cyperaceae, we have eight new species to report, namely one Abildgaardia and seven Bulbostylis. These novelties are all South American, seven from the planalto of Brazil, and one from Bolivia. Decisions on placement of species to genus in this work are based on distinctions between Abildgaardia, Bulbostylis and Fimbristylis as given in Kral (1971).

Since the description of North American Abildgaardia given by Kral (1.c.) has to be amended to include two other taxa, one the new species, the other a species even today referred to by authors as Fimbristylis bahiensis Steudel, we give below a modification that now defines the genus in the New World.


Perennial or annual, glabrous, caespitose. Leaves with sheaths closed save at summit, lacking cilia or fimbriae at orifice, eligulate; blades narrowly
linear to filiform, thickened, flat to variously involute or essentially lacking. Spikelets ovate to linear, either solitary and terminal on wiry culms or few to several in a loose to dense terminal cluster, rarely in a simple dichasium, in any case subtended by a single involucral bract, this shorter than inflorescence or spikelet; spikelet scales loosely imbricate, mostly keeled and subdistichous or arranged so that the spikelet appears compressed and with torque (twisted), the lower 1–2 scales sterile, those above subtending perfect flowers or apical ones male, all with dorsal/midcostal zone of 3–5 costa, these convergent at scale apex and either included or excurrent as a micro. Florets produced on a short pedicel-joint; perianth absent. Stamens 2–3; filaments flat and twisted; anthers basifixed, narrowly oblong or linear, the two thecae at maturity longitudinally and laterally dehiscing. Style 3-branched, the base trigonous, smooth or glandular-puberulent, capping the nipple-like achene apex, dehiscing at achene maturity, upwardly slender, smooth or glandular-puberulent at junction with the linear, glandular-hairy stigma branches. Achene stipitate-ovoid, the stipe stout, the body globose to broadly ovoid, strongly tricostate, apically abruptly narrowed to a pyramidal or truncate-pyramidal nipple, the three convex faces finely lined longitudinally and indistinctly by narrow cancellae, conspicuously roughened by a combination of short, coarse, transverse rugae and/or uniform or uneven coarse, large, low and dome-shaped papillae.

There are, by conservative estimate and in the strictest sense, about 15 species of *Abildgaardia* worldwide in tropical or subtropical regions; only four seem to be known for the Americas. A key to the American species is provided below, followed by detailed descriptions of the two which have bladeless leaves, one of which is new to science.

**KEY TO NEW WORLD *ABILDAARDIA***

1. Plants perennial with well-developed leaf blades; culm bases swollen; spikelets ovate.
2. Spikelets pale, frequently solitary at apex of culms or 2–3 per culm, in which case scattered toward scape apex ................................................................. 1. *A. ovata*
   2. Spikelets red-brown, mostly few in clusters at apex of culms or rarely solitary ................................................................. 2. *A. mexicana*

1. Plants with no leaf blades or at most a cusplike blade no longer than 5 mm; culm bases not swollen; spikelets linear.
   3. Spike and leaf sheath surfaces smooth; apices of leaf sheath and spikelet scales narrowly acute to acuminate; spikelets (5–)17–15 mm long; anthers 1.5–2 mm long ........................................................................ 3. *A. baetothyron*
   3. Spike and leaf surfaces uniformly papillose; apices of leaf sheath and spikelet scales emarginate; spikelets 15–20 mm long; anthers ca. 3 mm long. ........................................................................ 4. *A. papillosa*


This is the generic type from India. It is the only cosmopolitan taxon of the four treated herein. In the Americas, it ranges from peninsular Florida, U.S.A. southward through the West Indies and Mexico through Central America to southern South America (Argentina). It is a plant of basic or calcareous substrates in savannas, grasslands, landward edges of brackish or salt marsh, calcareous outcrop areas, and on dryish to seasonally dry sites, mostly at low to medium (1500 m) elevations.


So far as is presently known, this species is confined to the grasslands of the Mexican high plateau in Aquascalientes, Durango, Guanajuato, Guerrero, Distrito Federal, Jalisco, Mexico, Michoacan, Pubela, Queretaro, San Luis Potosi and Zacatecas. It is found on moist to wet, heavy dark clay earths, typically at elevations over 2000 meters.

It is noteworthy that the above two taxa have achenes over twice as long as those of the following two, but are otherwise so similar to them that drawings of them made equal in size would seem to be of the same species.


[*Abildgaardia ternata* Schrad. ex Nees in Mart., Fl. Bras. 2(1):71. 1842, nom. in syn.]


Fig. 1. Abildgaardia bacotryon St. Hil. (from Kral et al. 72826).—a. Habit sketch.—b. Section of culm showing ventral and dorsal view of leaf sheath.—c. Basal sheaths.—d. Inflorescence.—e. Dorsal and lateral view of spikelet scales.—f. Style (left) and stamen (right).—g. Achene.

Annual or short-lived perennial, densely caespitose, 10–30 cm tall, glabrous. Roots slender, fibrous. Leaves few per culm, essentially sheath, distally opening with scarious entire borders convergent, the dorsal costae forming an acuminate tip or a cusplike blade no longer than 5 mm. Culms stiffly erect, slightly twisted, multicostate, smooth, the ribs interrupted by some deep sulci. Inflorescence terminal, of 1–4(–5) linear, sessile spikelets, 8–15 mm long, subtended by 2–3 short, persistent triangular bracts 3–4 mm long; spikelet scales arranged subdistichously in a long spiral; fertile scales ovate-triangular, navicular, 3–4(–5) mm long, narrowly acute to acuminate, the midzone (keel) thickened, tricostate, pale, the sides stramineous to pale brown, scarious. Stamens mostly 3, the anthers linear, 1.5–2 mm long, apiculate. Achene stipitate-obovoid, tricostate, 0.8–1 mm long, faces gray to white, lustrous, liberally dotted with separate or connected coarse papillae, these often arranged in interrupted, wavy transverse rugae, the ribs broad but low, mostly smooth.

Habitat and distribution.—Abildgaardia baenthryon is found on moist to dryish sands, peats and gravels of savanna and cerrado in the states of Bahia, Distrito Federal, Espírito Santo, Minas Gerais, Pernambuco, and Rio de Janeiro, Brazil, 0–1200 m.

Representative material. BRAZIL. Hab. in siccis prope Ilheos, 1820, Riedel s.n. (US). Bahia: Salzmann s.n. (US); Coastal Zone, 11 km S of Santa Cruz Cabrália, restinga by the sea, with strand vegetation progressively developing into scrub and low forest further inland, 16°22'S, 39°01'W, sea level, 17 Mar 1974, Harley, Revolve. Erskine, Brightton & Pinheiro 17074 (US); Coastal Zone, on the coast between Alcobaça and Prado, 7 km NW of Alcobaça and 1 km N along road from the Rio Iraanhentinga, restinga, 17°31'S, 39°13'W, sea level, 15 Jan 1977, Harley, Mayo, Storr, Santos & Pinheiro 17972 (US); Serra das Almas, lower NE slopes of the Pico das Almas, ca. 25 km WNW of the Vila do Rio de Contas, sandstone, metamorphic and quartzite rock outcrops with associated marsh and damp flushes, 13°33'S, 41°57'W, 1500 m, 17 Feb 1977, Harley, Mayo, Storr, Santos & Pinheiro 19536 (US); Serra do Sincorá, by Rio Cumbuca, ca. 3 km S of Mucugé, near site of small dam on road to Cascavel, riverside, damp sandy soil, sandstone rocks and partly burnt-over vegetation, ca. 13°01'S, 41°21'W, ca. 850 m, 4 Feb 1974, Harley, Revolve. Erskine, Brightton & Pinheiro 15947 (US); Serra do Sincorá, 9 km SW of Mucugé, on road from Cascavel, waste ground by Rio Paraguacu, with damp grassland and scattered woodland, ca. 13°02'S, 41°25'W, 950 m, 7 Feb 1974, Harley, Revolve. Erskine, Brightton & Pinheiro 16101 (US); Serra do Sincorá, So of Andaraí, 16 km along road to Mucugé, near small town of Xique-Xique, sandstone rocks intersected by small streams, with some disturbed areas by roadside, 12°54'S, 41°19'W, 700–900 m, 14 Feb 1977, Harley, Mayo, Storr, Santos & Pinheiro 18692 (US); Mun Rio de Contas, by road to Salto of Rio Brumado, 2 km SE of Rio de Contas, sandy peat of swale in arenaceous campo, ca. 900 m, 13 Jul 1985, Kral, Wanderley, Cerati & Lima 72737 (SP, VDB); Mun. Palmeiras, moist sandy intervals in scrub-dotted arenaceous-rocky E-aspect campo, Serra da Larguinha, ca. 15 km S Palmeiras by the Palmeiras-Capão estrada, ca. 950 m, 19 Jul 1985, Kral, Wanderley, Cerati & Lima 72826 (GH, K, NY, SP, US, VDB); In moist sandy
intervals amongst arenaceous boulders and outcrops, campo by Mucujé-Andaraí road, ca.
15 km N of Mucujé, just S of Rio Piaba bridge, ca. 940 m, 21 Jul 1985, Kral. Wanderley. Cerati & Lima 72861 (MICH, MO, NY, SP, US, VDB); Rocky summit, E facing slope just
below TV transmission tower N of BR 242, ca. 5 km W of paved road to Lençóis, damp
sandy sites, ca. 1200 m, 9 Nov 1988, Kral. Wanderley & Funch 75588 (GH, MO, NY, SP,
TEX, US, VDB); Sandy-rocky campo along Rio Piaba, bridge area, by road to Mucujé from
Andaraí, sandy areas between rocks, 900 m, 10 Nov 1988, Kral. Wanderley & Lima 75616
(MO, NY, US, VDB, VSC); 5-7 km W of Alcobaça on road to Teixeira de Freitas, moist
white sand clearings in coastal scrub, 0-50 m, 13 Nov 1988, Kral. Wanderley & Lima 75685
(Recreio dos Bandeirantes), 23°00'13'S, 43°20'49"W, ao nível do mar, 4 Apr 1952, Smith
6377 (US). Espírito Santo: Municipio de Vila Velha, Lagoa do Milho, beira da lagoa, substrato
encharcado, 14 Jan 1975, Peixoto 369 (US); Mun. Linhares, Rod. BR-101, Res. Flor. da
Sooretama, solo arenoso úmido, 8 Apr 1984, Hatschbach 47722 (US). Minas Gerais: Sandy
areas between sandstone boulders, cerrado ca. 2 km N of Cristalina on road to Grão Mogul,
2 Nov 1988, Kral & Wanderley 75464 (GH, MO, NY, SP, US, VDB, VSC); Campos Rupestres,
BA-Chapada Diamantina, summit near Fumaça Falls, campo rupestre, 16 May 1992, Alves.
Becker & Roppa 4148 (US). Pernambuco: Prazeres, 7 Sep 1924, Pickel 798 (US); Prazeres,
Litoralgegend, 30 Oct 1952, Pickel 3140 (US); In sandy soil, Recife, Oct 1933, Pickel 3140
(US). Rio de Janeiro: 18 Aug 1896, Ule 4155 (US); Municipio de Cabo Frio, Cabo Frio,
Praia do Pontal, 22°56'48"S, 42°01'54"W, ao nível do mar, 17 Apr 1952, Smith 6563 (US).

4. Abildgaardia papillosa Kral & M. Strong, sp. nov. (Fig. 2). Type: SOUTH
AMERICA. Brazil. Bahia: Mun. Palmeiras, sandy peaty seep areas around arena-
cceous boulders and outcrops, Serra do Larguinha (Sincorã?) ca. 20 km S of Palmeiras
and due E of Capião by trail, ca. 1000 m, 19 Jul 1985, Kral. Wanderley. Cerati & Lima
72808 (holotype: SP; isotypes: GH, K, MICH, MO, NY, TEX, US 3375813, VDB,
VPI, VSC).

A. haenthery St. Hil. species Brasiliæ affinis, a qua imprimis differt habitibus altioribus;
paginis foliorum et scaporum papillosis, apicibus vaginaeum emarginatis; antheris longioribus
(3 mm longis).

Plant annual or short-lived perennial, densely caespitose, 30–40 cm tall.
Roots fibrous. Leaves entirely sheath, the outer ones more scale-like, ovate
to lanciform, to 2 cm long, the principal ones 6–7 cm long, loosely tubu-
lar, papillate, multistate save on scarios inner band, this distally becoming
the scarios border of the open sheath apex, the margin entire, scabrous,
converging retusely above a short micro comprised of convergent costae.
Culms slightly twisted, linear, stiff, 0.8–1 mm thick, multistate, 1-2-
sulcate, the costae fine or coarse, the surfaces dull gray-green, appearing
glaucescent because of dense papillosity. Inflorescence terminal, usually of 1
(rarely 2) lance-linear to elliptic-linear spikelet(s), 1.5–2 cm long, of many
scales arranged subdistichously in a long spiral; sterile scales 4–5, narrowly
ovate to oblong, 3.5–4 mm long, obtuse and slightly emarginate, the dor-
sal area thickened with 3–5 costae converging to a subapical blunt micro;
fertile scales mostly oblong to elliptic, 5–6(–7) mm long, apically narrowly
rounded or emarginate, convex, the dorsal area likewise thickened, with 3
Fig. 2. Abildgaardia papillosa Kral & M. Strong (from the type, Kral et al. 72808)._a. Habit sketch._b. Section of culm showing dorsal and lateral view of sheath._c. Inflorescence after spikelet scales and achenes have shed._d. Inflorescence (spikelet)._e. Detail of section of culm showing papillose surface._f. Sterile basal spikelet scale (left) and fertile spikelet scale (right)._g. Stamen._h. Achene and style.
coarse, usually pale costae, the scarious matrix pale brown to castaneous with a pale border. Stamens 3, the anthers narrowly linear, apiculate, ca. 3 mm long. Achene stipitate-ovoid, 1–1.2 mm long, apically obscurely trigonous but angles low, rounded, the faces convex, transversely irregularly pale-rugose with large variously interconnected papillae, ridges and papillae connected by gray, finely vertically striolate intervals.

While *Abildgaardia papillosa* is obviously closely related to *A. baebhtyron*, it is at once distinguished by its taller habit, its papillosae (rather than smooth) foliage and culms, its emarginate or retuse sheath apices and fertile scale tips (versus acuminate or cuspidate), its longer spikelets which are usually solitary (rather than clustered) at scape tips, and its longer spikelet scales and anthers. In the field, the papillate surfaces of leaf and scape make the plant appear glaucous.

**BULBOSTYLIS** Kunth, Enum. Pl. 2:205. 1837, nom. cons. (neither *Bulbostylis* Steven, 1817, nor DC, 1836, nom. rej.).

*Stenobaphus* Raf., Neog. 4, 1825, nom. rej.

*Onosystis* Mart. ex Nees in Mart., Fl. Bras. 2(1):80. 1842.

These plants make up what must approach 100 species, mostly with wiry culms and leaves and of acidic, moist to dry, upland habitats in temperate to tropical climates worldwide. They have been considered by some as a section of *Abildgaardia*, by others as a part of *Fimbriostylis*. However, in the *Bulbostylis* we have studied, there is but one example (*B. truncata* (Nees) M. Strong) in which the leaf sheath apex is not fimbriate. All save one of these tricarpellate species have a persistent tubercle that is seated above a distinct suture or atop an achenial “neck.” In the latter instance there is a dramatic difference in texture and color between the achenial apex and the style base or tubercle. One becomes accustomed in the field to note a distinctive ecology for most *Bulbostylis*, nearly all of which are wiry-leaved-and-sca ped physiological xerophytes, denizens of seasonally doughty, mostly sandy and acidic sites, such as grassy uplands and fire-controlled open woodlands or savanna. Since these *Bulbostylis* are so uniform in surface characters and in ecology, we continue to treat such plants as a distinct genus. The species are given in alphabetical order.

*Bulbostylis carajana* Kral & M. Strong, sp. nov. (Fig. 3). Type: SOUTH AMERICA.

_Brazil_. Para: Setta dos Carajas, 2 km west of AMZA camp N-5, 6°4’S, 50°8’W, ca. 700 m, scrubby vegetation on ferric rock outcrops, moist low area on outcrops, 13 May 1982, Sperling. Condord. Mesquita. Ribeiro & Marinho 5649 (holotype: INPA; isotypes: NY, VDB).

Herba annua, dense caespitosa, subglabra, pumila, 9–15 cm alta. Radices delicatula, tenues. Folia polysticha, gracies, usque ad 5 cm longa; vaginae tubulosae, late dorsaliter viridicarinata, paucicostatae, glabrae, marginibus latis, scariosis, rufobrunneolis, ad apicem in laminas
Fig. 3. *Bulbostylis carejana* Kral & M. Strong (from the type, Sperling et al. 5649).—a. Habit sketch.—b. Leaf apex.—c. Sector of leaf midblade.—d. Leaf sheath and lower blade, adaxial view.—e. Leaf sheath and lower blade, oblique view.—f. Spikelet.—g. Fertile spikelet scale.—h. Sector of scape.—i. Anther.—j. Style and stigmas.—k. Achene.
abrupte contractis, longifimbriatis; laminae capillares e basim canaliculatae, crassimarginatae, dorsaliter valde paucinervosae, apicem versus triquetrac, anguste acutae. Scapi tenues, leviter torti, 5–7–costati, 0.3–0.4 mm crassi, unispiculati. Spicae florisae, lanceolato-ovoideae, 6–9 mm longae, acutae; squamis fertilibus, tenuibus, spiraliter imbricatis, rufo-brunneolis, oblongs, 3–4 mm longis, convexis, mediane tricostatis, ad apicem ciliatis. Stamina 3; antherae anguste oblongae, ca. 2 mm longae, apiculatae. Achaenia obovoidea, ca. 1 mm longa (tuberculo inclusa), valde trilobata et tricostata, atrobrunnea, faciebus valde transverse rugosis, angulatis umbonatis. Tuberculum globosum, ca. 0.2 mm longum, atrobrunneum.

Annual, densely caespitose, subglabrous, low, 9–15 cm tall. Roots delicate, slender. Leaves polystichous, few, slender, up to 5 cm long; sheaths tubular, broadly dorsally green-carinate, few-nerved, ventrally thin, pale red-brown, abruptly narrowed into leaf blade, there long-fimbriate; blades capillary, at base canaliculate, thick-margined, dorsally strongly few-nerved, triangulate towards tip, narrowly acute. Culms filiform, slightly twisted, 5–7–costate, 0.3–0.4 mm thick, unispiculare. Spikelets many-flowered, lance-ovoid, 6–9 mm long, acute; scales thin, spirally imbricate, the sterile ones usually 2, shorter than the fertile, acute, the fertile ones oblong, 3–4 mm long, broadly rounded, scarious for median costal area, red-brown, apically ciliate. Stamen 3, the anthers narrowly oblong, ca. 2 mm long, apiculatae, tetrasporangiate. Achene obovoid, ca. 1 mm long (tubercle included), strongly trilobed and tricostate, umbilicate, dark brown, the faces strongly transversely rugose, lustrous, the angles umbonate; tubercle round, ca. 0.2 mm long, dark brown.

Habitat and distribution.—Thus far known only from the type collection. Bulbostylis carajana is very similar to the widespread savanna species B. conifera (Kunth) C.B. Clarke, but is definitely annual, the foliage and culms smooth, the spikelets lance-ovoid (rather than cylindric), the achene more lustrous, more coarsely rugose, and umbilicate.

Bulbostylis eleocharoides Kral & M. Strong, sp. nov. (Fig. 4). Type: SOUTH AMERICA. BOLIVIA. Prov. Iturralde. Depto. La Paz: Luisita, 13°05’S, 67°15’W, 180 m s.m.s., sabana humeda, al W del rio Beni, 24 Feb 1988, Hase 899 (Holotype: LB; Isotype: DB).

Herbe perennis, 60–80 cm alta, subglabrata, culmis basi sub-bulbosus, cum folis exterioribus squamiformibus, glabris. Folia principalia 25–40 cm longa, vaginis proxime conduplicatis, glabris, ad apicem pallide longifimbriatis; laminis lineari-filiformis, involutis, 0.7–1 mm latis, vaginis 10–plo longiore. Scapi torti et flexuosi, retetes vel subtriquetrati, ca. 1 mm crassi, glabri. Spiculae solitariae, ovoideae, 8–10 mm longae, squamis numerosis, spiraliter imbricatis; squamis sterile plures infinis spiculis longiora vel breviora; squamis fertiles ellipticae vel obovatae, 4.5–5 mm longae, late acute, convexae. Stamina tria; antheris 2.5 mm longis. Achaenia obovoidea, ca. 3 mm longa, obscure trigona, vaginis concavis, minute foveolatis.

Perennial rhizomatous herb 60–80 cm tall. Roots fibrous. Culms closely set along an imbricate-scyal rhizome. Leaves erect or ascending, 25–40 cm
Fig. 4. *Bulbostylis eleocharoides* Kral & M. Strong (from the type, *Hasse 899*).—a. Habit sketch.—b. Leaf apex, adaxial side (left), abaxial side (right).—c. Sector of leaf blade adaxial side (left), abaxial side (right).—d. Leaf base.—e. Spikelet and upper scape.—f. Fertile spikelet scale.—g. Anther (left), achene (right).
long; the outermost appressed chaffy rhizomal scales, grading up culm to more erect, scale-like basal culm leaves; principal leaves 25–40 cm long, the sheaths proximally conduplicate with the convex backs striately multinerved, glabrous, tan, with broad scarious borders pale-fimbriate at convergence with blade; blades filiform-linear, to 10 times longer than sheaths, 0.7–1 mm wide, apex subulate, shallowly concave adaxially, the involute margin thickened, pale, proximally scabrid, otherwise smooth. Culms twisted, flexuous, terete to subtriquetrous, ca. 1 mm thick or wide, glabrous. Inflorescence a single erect to ascending, ellipsoid, acute spikelet 8–10 mm long, of many tightly spirally imbricate scales with pale firm centers, brown puberulent sides and broad, dark brown erose and ciliate borders; sterile scales several, the lowermost broadly triangular, carinate-keeled, acute or with midcostae excurrent as a green cusplike blade, this shorter or slightly longer than the spikelet, those above gradually becoming longer, grading into the fertile; fertile scales elliptic to obovate, 4.5–5 mm long, broadly acute, convex, the midcostal zone thickened, with pale border and a green median. Stamens 3, the anthers linear, 2.5 mm long, apiculate. Achene ca. 3 mm long, the body obovoid, 2.5 mm long, obscurely trigonous, pale brown with transversely wavy lines of minute pits on the concave faces, the three angles broadly rounded and but slightly raised, the achene apex narrowed distally to a distinct neck ca. 0.2 mm long, this capped by a dark, conic tubercle ca. 0.3 mm long.


Habitat and distribution. Humid grasslands, savannas, Bolivia and Paraguay.

The name of this species alludes to its significant difference from other Bulbostylis. Its single spikelet bears a strong resemblance to those of many Eleocharis except for the unusual cuspidate lower sterile bract. Its achenes are again similar to Eleocharis in that many of the latter are species with “necked” achenes. The strongest evidence for such a plant to be Bulbostylis is, of course, the strongly fimbriate leaf–sheath apex and the well-developed lamina above it.

Bulbostylis latifolia Kral & M. Strong, sp. nov. (Fig. 5). Type: SOUTH AMERICA. Brazil. Goias: sandy intervals in rocky sandy cerrado on E side BR 040, ca. 4 km N of Cristalina, ca. 900 m, 6 Dec 1988, Kral. Wanderley & Pereira 75909 (holotype: SP; isotypes: MO, US 3375811, VDB).

Planta perennis, caespitosa, 70–90 cm alta, basibus culmorum subbulbosum cum foliis exterioribus squamifolibus. Folia propria plantam 1/5–1/3 aequantia; vaginis late convexit, glabris, ad apicem longishmiatriis; laminis vaginis 4–7–plo longiora, 1.5–2.2 mm latis, planis vel leviter involutiis. Scapi anguste lineares, subtriangularares, ca. 1 mm crassi, glabr. Inflorescentia diffusa, anguste turbinata. Spiculae in parvis fasciculis [(1–)3–5(–6) per fasciculum],
Fig. 5. *Bulbostylis latifolia* Kral & M. Strong (from the type, *Kral et al.* 75909).—a. Habit sketch.—b. Leaf apex.—c. Sectors of leaf midblade, adaxial (left), abaxial (right).—d. Leaf base, abaxial view.—e. Young offshoot from plant base.—f. Enlarged leaf blade sectors, adaxial (left), abaxial (right).—g. Inflorescence.—h. Spikelet.—i. Fertile spikelet scale.—j. Anther on filament apex.—k. Style and branches.—l. Achene.
anguste ovoidae vel lanceoloidae, 4–5 mm longae, acutae, brunncae vel pallide ferruginae. Squamae fertiles anguste ovatae, 4–5 mm longae, acuminate, naviculare. Stamina duo vel tria; antheris 2 mm longis, longiapiculatis. Achaenia trigono-obovoidea, trilobata, ca. 1 mm longa (tuberculo includens), subtiliter foveolata; tuberculo conico.

Perennial, caespitose, 70–90 cm tall. Roots diffuse-fibrous. Culm bases sub-bulbous, firm, with short, scaly bulbous offshoots. Leaves sub-basal, few per culm, the lowest scale-like, bladeless or with blades shorter than sheaths; principal leaves 1/5–1/3 as long as the plant, erect or ascending, 15–25 cm long; sheaths abaxially convex, strongly multi-ribbed, glabrous with broad scarious red-brown to brown borders acutely converging to blade, there long-fimbriate; blades linear, 4–7 times longer than sheaths, level or slightly concave adaxially, 1.5–2.2 mm wide, obliquely broadly acute, greenish-brown, margins slightly thickened, pale, densely ciliate or ciliolate, surfaces smooth save for scabrellous adaxial apex, abaxially multicostate. Culms narrowly linear, multi-costate, subtriangular, green, glabrous. Inflorescence a narrowly turbinate compound of variously peduncled fascicles, this much exceeding short-bladed lanceolate involucral bracts 1–3 cm long; branches several, mostly ascending around subsessile central fascicles, the longer ones 5–10 cm long, either terminating in single spikelet clusters or there re-branching in compact or open fashion; spikelets (1–)3–5(–6) per fascicle, narrowly ovoid or lanceoloid, 4–5 mm long, acute, brown to pale red-brown; fertile scales 3–6, narrowly ovate, 4–5 mm long, navicular, acuminate. Stamens (2–)3; anthers oblong, ca. 2 mm long, long-apiculate. Achenes trigonous-obovoid, ca. 1 mm long (tubercle included), apically trilobed, the faces dark-foveolate-puncticulate, gray, the angles paler, rounded; tubercle conic.

Paratypes. Brazil. Goias: sandy intervals in rocky sandy cerrado on E side BR 040, ca. 4 km N of Cristalina, ca. 900 m, 6 Dec 1988, Wanderley et al. 1877 (SP, VDB); rocky campo, 5–6 km by road N of Alto Paraiso, sandy peat of E and NE aspect, ca. 1000 m, 30 Nov 1988, Kral. Wanderley. Cavalcanti & Pereira 75757 (SP, US, VDB); 4 km N of Cristalina off E side BR 050 sandy intervals in rocky cerrado, ca. 1000 m, 6 Dec 1988, Kral. Wanderley & Pereira 75909 (SP, US, VDB).

Habitat and distribution.—Rocky, sandy cerrado, 900–1000 m, Goias.

This species is distinctly allied to Bulbostylis junciformis (Kunth) C.B. Clarke but is readily distinguished by its broader, smoother, ciliate-margined leaves and fertile spikelet scales with apex not excurred and midcosta not excurrent. The grayish achene surfaces are distinctly foveolate-puncticulate, the pits short-rectangular.

Bulbostylis lombardii Kral & M. Strong, sp. nov. (Fig. 6). Type: SOUTH AMERICA. BRAZIL. Minas Gerais: Serra do Cipo, Santana do Riacho, afloramento rochoso das Canela-de-Ema-Gigantea, proximo a portaria do IBAMA Alto Palacio, 16 Nov 1995, J.A. Lombardi 1029 (holotype: BHCB; isotype: VDB).

Planta perennis, 15–30 cm alta, rhizomatosa, rhizomate crasso, caudiciformis, dense piloso,
Fig. 6. Bulbostyli lombardii Kral & M. Strong (from the type, Lombardi 1029).—a. Habit sketch.—b. leaf apex.—c. Section through midblade showing adaxial and abaxial surface.—d. Detail of sheath apices.—e. Inflorescence.—f. Involucral bracts.—g. Fertile spikelet scales and achene.—h. Achene.
Bulbostylis squamoso et fibroso. Folia extensora squamiformia, margine dense albopilosis; folia principalia vulgo expansa, 5–8 cm longa; vaginis convexis, prominente 3–5-costatis, ad apicem longe ciliatis; laminis vaginis 4–6-plo longioribus, rigidis, 0.5–1 mm latis, dorsaliter scabridis. Scapi erecti, rigidi, subteretes, ca. 1 mm crassi, dense pallide puberuli. Inflorescentia capitata, involucrata, late ovoidea vel hemisphérica aut subglobosa, 1–1.5 x 1–1.5 cm; bracteae involucralis extimae ovatae, 5 mm longae, piluso-ciliatae, mucronatae, mucrone 2–3 mm longae; bracteae involucralis interiores ovatae, 3 mm longae, mucronulatae. Squamae fertiles naviculares, ca. 5 mm longae, obtusae vel emarginatae. Stamina tria; antheris ca. 4 mm longis. Achaeonia lata obvoidea, triloba et tricostata, 1.2–1.5 mm longa, umbilicata, valde transverse rugosa, tuberculo conico, ca. 0.3 mm longo.

Perennial densely caespitose rhizomatous herb, 15–30 cm tall. Roots thickened (for a Bulbostylis), fibrous. Rhizome stout, knotty, ascending, caduciform, the newer surfaces (internodal) densely white-piliferous. Shoots numerous, densely spirally arranged around caudex, there persisting as an often burnt stubble of fibers, hairs, and old leaf sheaths, the newer (distal) caudex producing rosettes of a season. Outer rosette leaves invested in tufts of white trichomes, mostly scale-like, mostly sheath, white-pilose-ciliate, thence grading progressively longer distally on culm, the costae of the dorsal median area converging to form increasingly longer blades, the scarious sheath borders with ciliae concentrated more at apex; principal leaves spreading, 5–8 cm long, sheaths convex with 3(–5) broad costae and broad, scarious, brown, apically white-pilose borders; blades 4–6 times longer than sheaths, linear-filiform, 0.5–1 mm wide, adaxially shallowly involute or plane, with pale incrassate borders, abaxially convex 3(–5)-costate, sparingly scabrid, pale green. Culms stiffly erect, linear, subterete, ca. 1 mm thick, several-costate, costae densely pale-puberulent. Spikelets in dense broadly ovoid to hemispheric or subglobose involucrata heads 1–1.5 x 1–1.5 cm; involucral bracts in series, mostly broadly ovate, ca. 5 mm long, brown, ciliate, puberulent, convex, the lowermost with costal area excurrent as cusp 2–3 mm long, those above grading shorter to mucros, thence inward to fertile scales, these oblong to elliptic, navicular, ca. 5 mm long, obtuse or emarginate, the tricostate scabrellous keel not excurrent, the margin entire. Stamens 3; anthers linear, ca. 4 mm long, apiculate. Achene trigonous-obovoid, 1.2–1.5 mm long, apically strongly lobed, umbilicate, each lobe with a pale crest, the shallowly convex lobe faces dark brown to nearly nigrescent, strongly transversely rugose; tubercle nearly black, depressed-conic, 0.3 mm long.

Habitat and distribution.—This species of the planalto of Brazil is yet known only from the type.

Bulbostylis pachypoda Kral & M. Strong, sp. nov. (Fig. 7). TYPE: SOUTH AMÉRICA. BRAZIL. Minas Gerais: Cerro do Cabral, Armazém de Lage, ca. 15 km above and NNW of Joaquim Felício, ca. 1100 m, sandy campo-cerrado transition, 30 Oct 1988, Kral, Wanderley & Lima 75381 (HOLOTYPE: SP; ISOTYPES: GH, MO, NY, US, VDB).
Fig. 7. *Bulbostylis pachypoda* Kral & M. Strong (from the type, Kral et al. 75381).—a Habit sketch—b. Leaf apex—c. Sector of leaf midblade, adaxial (left), abaxial (right).—d. Sector of leaf midblade (Kral et al. 75175).—e. Leaf base.—f. Upper portion of leaf sheath and scape base (upper left); idealized sketch of a young outer leaf transitional to inner principal leaf (lower right).—g. Inflorescence.—h. Lower fertile spikelet scale.—i. Fertile spikelet scale.—j. Two achenes.—k. Anther.
Plants perennial, densely cespitose, 20–35 cm tall, the culm bases bulbous, closely interconnected at base, forming short thick lines radiating from clump center. Outer leaves scale-like, triangular, strongly nerved, the broad, scarious borders long-fimbriate. Principal leaves ascending to spreading, (5–)8–15 cm long, the sheaths pale brown, convex, sparsely fimbriate or smooth at the acute to acuminate apex; blades filiform, involute, 1–2 times longer than the sheaths, ca. 0.2–0.4 mm wide, abaxially tricostate, the lateral costae forming smooth or remotely scabridulous margins. Culms filiform, flexuous, 0.4–0.5 mm thick, few-costate, glabrous. Inflorescence terminal, spikelets in an involucrate, head-like, ovoid to turbinate or hemispherical fascicle, or this directly subtended by an additional but smaller fascicle, sometimes reduced to a single spikelet. Involutrular bracts several, setaceous-tipped, the lowest bract slightly to much exceeding the inflorescence, those at higher levels progressively shorter-bladed, those subtending individual spikelets mostly cuspidate or mucronate. Spikelets ovoid, 4–5 mm long, mostly acute, of several loosely spirally imbricate scales; fertile scales mostly ovate, 3.5–4.5 mm long, strongly convex, strongly curvate-keeled, the sides deep red-brown to castaneous, the keel area tricostate and conspicuously paler. Stamens 3; anthers oblong-linear, ca. 2 mm long, apiculate. Achenes narrowly to broadly trigonous-obvoid, ca. 1–1.2 mm long (tubercle included), slightly trilobed, tricostate, the surfaces a lustrous gray-white or pearl, finely longitudinally striolate, the costae strong, smooth, contrastingly pure white.


The affinities of *Bulbostylis pachypoda* are perhaps most with the ubiquitous *B. juncoides* (Vahl) Kük. ex Osten, particularly examples from southern Brazil, Paraguay or Argentina, in which spikelets are often dark and crowded into head-like terminal involucral fascicles. However, *B. pachypoda* has thicker, more bulbous culm bases, these connected in ascending lines
from a clump center; its leaves and culms tend to be narrower, more smooth; its achenes, which are paler, are usually a lustrous "pearly" white, and are so finely striolate as to appear smooth. The young lower (outer) leaves, usually concealed by a stubble of burned back or dried older foliage, tend to have completely fimбриate margins and appear to be transitional to the even hairier-sheathed *B. jacobiniae* (Steed.) Lindm. and allies. The anthers reach 2 mm in length, which puts them in a range longer than that for *B. juncoidea* (Vahl) Kük. ex Osten and allies.

**Bulbostylis scirpoidea** Kral & M. Strong, sp. nov. (Fig. 8). Type: South America. Brazil: Goias: ca. 5 km N of jct. road W to Pires do Rio by BR 050, seep meadow and associated cerrado by pond, ca. 800 m, seep by pond, 900–1000 m, 7 Dec 1988, Kral & Wanderley 75942 (holotype: SP; isotypes: US, VDB).

Planta perennis, 60–80 cm alta, caespitosa, culmis basi bulbosis, caudiciformibus, longipilosis, cum foliis exterioribus squamiformibus. Folia principalia propria plantam l/3–2/3 aequantia; laminis filiformis involucris, vaginis 4–6-plo longiora, tricostatis, triquertro-subulatis. Scapi lineares, subteretes, 0.6–0.7 mm crassi, glabri. Inflorescentia involucrata, receptaculo piloso, spiculis sessilis, (1–)2–3(--5), ovoidis vel lanceoloides, rufobrunneolis, squamis fertiles anguste ovatis vel late ellipticis, curvato-carinoalis, obtusis, ad apicem ciliatis. Stamina tria; antheris ca. 3 mm longis. Achaenia lato-obovoidea, ca. 1.2–1.4 mm longa, prominente tricostata.

Perennial, caespitose, 60–80 cm tall, the shoots arising from bulbous short stems; receptacle and lower shoot internodes with dense, pale, red-brown pilosity, 1–2 cm long. Roots fibrous. Lowest leaves scale-like, ovate to lanceolate, to 2 cm long, the inner ones cuspidate with sheath borders pilose apically; principal leaves ascending to erect, 40–60 cm long, the sheaths to 10 cm long, narrowly convoluted with 3–5 strong medial costae, the sides with several fainter costae and scarious red-mottled borders, gradually tapering, then abruptly joining blade, there long-villous-fimbriate; blades 4–6 times longer than sheaths, filiform, ca. 0.5 mm thick, adaxially concave with 2 pale costae marginally, abaxially strongly convoluted with 1 strong costa, the marginal costae with sparse, appressed, inward or retrorsely directed stiff hairs, distally tapering to triquertrous subulate tips. Culms erect, subterete, ca. 0.6–0.7 mm thick, coarsely 4–6-costate, glabrous. Inflorescence (1–)2–3(--5)-spicate, spikelets sessile above an involucre, the receptacular surface sparsely pilose, the lowest involucral bract longest, ovate to lanceolate, tricostate-keeled, slightly longer to slightly shorter than subtending spikelet(s), slightly to much exceeding the inflorescence, to 3 cm long, the base ovate, keeled, long-ciliate, the midcostae excurrent as a macro, cusp, or linear blade; spikelets mostly ovate, 8–10 mm long, acute, with fertile scales narrowly ovate to broadly elliptic, mostly 5 mm long, curve-keeled, obtuse or emarginate, apically ciliate. Stamens 3, the anthers linear, ca. 3 mm long, apiculate. Achene body obovoid-trigonal, 1.2–1.4 mm long, rib-angled, pale brown, angles
smooth, faces shallowly convex, lustrous, shallowly transversely rugulose with very fine vertical striolae; tubercle either deciduous or short-persistent, oblong, 0.3–0.4 mm long.

**Paratypes.** **BRASIL.** **Distrito Federal:** Chapada da Contagem, 23 km NNW do Centro de Brasilia, brejo estacional, a beira da estrada, 19 Apr 1979, Rodrigues 16 (NY, VDB). Goias: ca. 5 km N of jct. road W to Pires do Rio by BR 050, seep meadow and associated cerrado by pond, ca. 800 m, seep by pond, 900–1000 m, 7 Dec 1988, Wanderley 1910 (SP, VDB).

_Habitat and distribution._—Sandy marshy grass-sedge campo, Goias.

This is again an example of that complex of _Bulbostylis_ in which the central axis of the plant is compact, pilose-vestite, a feature also displayed on the inflorescence axis (receptacle).

**Bulbostylis spectabilis** Kral & M. Strong, sp. nov. (Fig. 9). **TYPE: SOUTH AMERICA.** **Brazil.** Parana: Vila Vellia, abundant in occasional wet sand, SW-facing slope covered by savanna type vegetation, 5 Mar 1970, Koyama. **Koyama, Hatchbach & E. de Lima 13848 (HOLOTYPE: NY; ISOTYPE: VDB).**

Planta perennis, 4–55 cm alta, caespitosa, subglabrata, crassirhizomatosa, culmis basi bulbosis, cum foliis exterioribus squamiformibus, glabris. Folia principalia 15–25 cm longa; vaginis pallide brunneo-obscuris, convexis; laminis filiformis involucris, multi-vel compluribus vaginis longiore, ca. 0.3–0.5 mm latis. Scapi lineares, subteretes, ca. 1 mm crassi. Inflorescentia capitata, involucrata, ovoidea vel hemisphaerica, multispiculata, usque ad 1.5 cm lata, bracteis 1–3, valde caudati inflorescentiam excedens; spiculae lanceolato-ovatae, 8–10 mm longae, squamis fertile anguste ovariis, 4.5–5.5 mm longae, acuminatis. Stamina tria; antherae ca. 1 mm longis. Achenes obovoida, 1–1.2 mm longa, tricostata, minute cancellata.

Caespitose perennial 4–55 cm tall, producing rhizomes which are interconnected bulbous bases of culms. Roots fibrous. Outer culm leaves scale-like, 4–10 mm long, strongly nerved, brown, glabrous; inner leaves progressively elongating; principal leaves erect to strongly ascending, 15–25 cm long; sheaths pale brown, scarios, multicostate, convex-backed, the scarios, pale red-brown, friable borders acutely converging to blade, there pale-fimbriate; blades several to many times longer than sheaths, filiform, 0.3–0.5 mm wide at midblade, apex filiform-setaceous, triquetro-denticulate, subulate, surface pale yellow-green, essentially glabrous save for a few scabrellae toward blade base, adaxially concave to canaliculate, abaxially mostly tricostate, narrowly sulate. Culms linear, several-costate, terete, ca. 1 mm thick, pale yellow-green. Inflorescence capitata, involucrata, broadly ovoid to hemispheric, 1–1.5 cm broad; outer involucral bracts lanciform or narrowly ovate, 5–7 mm long, slightly keeled, costae excurrent as cusp or narrowed acuminately to filiform-setaceous blades to 8(–9) cm long; fertile scales narrowly ovate or oblong, 4.5–5.5 mm long, acuminate, convex-based, apically keeled, with 3 costae. Stamens 3; anthers elliptic-linear, ca. 1 mm long, apiculate. Achenes narrowly obovoid, trigonous,
Fig. 9. Bulbostylis spectabilis Krai & M. Strong (from the type, Koyama et al. 13848).—a. Habit sketch.—b. Leaf blade apex.—c. Adaxial (left) and abaxial (right) sectors of leaf midblade.—d. Leaf sheath, abaxial side.—e. Inflorescence.—f. Spikelet.—g. Involucral bract.—h. Fertile spikelet scale.—i. Stamen.—j. Achene, abaxial faces (above), idealized enlargement of some cancellae (left), cross-section (right).
1–1.2 mm long (tubercle included), the adaxial side broadest, abaxial faces more convex, pale brown, angles dark brown, surfaces minutely cancellate.

_Habitat and distribution._—Thus far known only from the type collection.

This plant, superficially resembling robust examples of _Bulbostyli sphaerocephala_ (Boeck) C.B. Clarke or capitate forms of _B. junciformis_ (Kunth) C.B. Clarke, differs most significantly in the peculiar rhizome of interconnected bulbous culm bases, in having perhaps the most glabrous foliage of its complex with hairs confined essentially to the pilosity of leaf sheath apex, and in the distinctive involucre, some bracts with setaceous tips to nearly 1 dm long.

**ACKNOWLEDGMENTS**

We would like to thank Dr. Richard Carter (VSC) and Dr. Dan Nicolson (US) for reviewing the manuscript; curators at MO and NY for loan and/or exchange material; José Cedeño-Maldonado for translating the abstract from English to Spanish; and the National Geographic Society for its travel grant to R. Kral during 1988. These aids are gratefully acknowledged.

**REFERENCES**

BOOKS RECEIVED


From the Preface: The flora serves a dual purpose according to the author. First, it deals with the alpine plants within the political boundaries of the state of Wyoming; second, it treats the more natural physiographic unit, the Middle Rocky Mountains, which encompasses the states of Montana, Wyoming, and Utah, and a very small bit of Idaho.

From the Flora: All the flowering plants and vascular cryptogams known to occur above timberline in the Middle Rocky Mountains are described in the manual, as are the timberline conifers. The flora consists of 700 taxa including 55 subspecies and 314 varieties. The taxa included in this manual are based on specimens collected throughout the Middle Rocky Mountain region. The taxonomic treatment begins with a dichotomous key to all the families. The families are then presented in alphabetical order for ease of location, and each family is also organized alphabetically by genus and species. Dichotomous keys are provided for each taxonomic rank, ultimately leading to the species treatment. Infraspecific taxa are treated within the species. Each species description is based on personal observations of plants in the field, herbarium specimens, and references from regional manuals and floras. The species description is followed by a short habitat description. Next the Middle Rocky Mountain distribution is given by mountain range. Comments on infraspecific taxa and how to distinguish them follow the distribution information. The distribution maps show the distribution pattern of each species in the alpine flora. The dots are based on herbarium specimens and, in a very few cases, field observations when no specimens were available.

Contents include:
- Preface
- Acknowledgments
- Introduction
- The Alpine Zone
- The Middle Rocky Mountains
- The Flora
- The Middle Rocky Mountain Alpine Flora
- Appendices, Bibliography
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- Index to Latin Names
THE FLORA OF INDIAN SHELL RINGS FROM COASTAL SOUTH CAROLINA TO NORTHERN FLORIDA

RICHARD STALTER and MARITESS LEYVA

Department of Biological Sciences
St. John's University
Jamaica, NY 11439, U.S.A.

DWIGHT T. KINCAID

Department of Biological Sciences
Lehman College CUNY
Bronx, NY 10468, U.S.A.

ABSTRACT

Native American shell rings are composed almost exclusively of shellfish remains, and occupy coastal sites. The nine shell rings and one shell mound selected in this study range approximately 40 kilometers north of Charleston, South Carolina to 10 kilometers north of St. Augustine, Florida. The vascular flora consists of 241 species within 182 genera in 80 families. The Poaceae and Asteraceae are the largest families in the flora. Soil salinity and daily flooding affect the distribution of vascular plants at the tidal shell rings. Calcareous soils influence species distribution at inland shell ring sites. Each taxonomic entry in the checklist is accompanied by an annotation, which includes frequency of occurrence, rarity status and pertinent synonyms.

KEY WORDS: Indian Shell Rings, flora, distribution, biodiversity.

INTRODUCTION

The shell rings of the South Atlantic Coast are ring or arch-shaped ridges consisting primarily of shellfish remains, which were constructed by prehistoric Native Americans. They are located approximately between 32° 55' N (Sewee Shell Ring, SC) to 30° 05' N (Guana River State Park, FL).
All known shell rings are located on estuaries or tidal creeks. They occupy high ground immediately adjoining salt marshes or occasionally are isolated in salt marshes a few hundred feet offshore. Interiors of shell rings at tidal sites are marshy, while the higher sites usually support a heavy growth of vegetation. The circular shell ridges range from about 33 to 66 m in outside diameter, 0.5 to 2.5 m in maximum height and 6.4 to 17.8 m in basal width. They are covered with vegetation and are composed almost exclusively of shells, mainly those of oysters. Shells of periwinkle, knobbed whelks, clams and mussels are present in reduced amounts (Dorroh 1971; DePratter 1976; Trinkley 1985).

Rings occur in complexes as well as in isolation. The largest known ring is at Sapelo Island, Georgia and is associated with two smaller rings. At the Skull Creek Shell Ring, Hilton Head Island, South Carolina, the rims of two rings are superimposed at one point (Hemmings 1970). Shell specimens from rings in South Carolina and Georgia have been radiocarbon dated and are approximately 3900 to 3100 years old (Calmes 1967; Waring & Larson 1968).

Numerous uses for the rings have been postulated, including ceremonial, recreational, and exploitative functions, e.g. fish traps, (Edwards 1965). Recent investigations suggest that at least some of the rings were habitation sites, with the rings gradually developing from kitchen refuse associated with house middens arranged in a circular fashion (DePratter 1976; Trinkley 1985). The relatively clear interiors of the shell rings may have functioned as areas of communal activity (Trinkley 1985).

The objective of this study is to determine the vascular flora at shell rings on the coast of South Carolina, Georgia, and Florida, the only sites on the east coast where shell rings are known to exist. Several calcareous plants, including the rare Sagertia minutilora, grow almost exclusively at these sites.

Several well known individuals have examined shell mounds or rings along the Atlantic coast. William Bartram described the flora of shell mounds along the coast of South Carolina bordering the sounds and inlets near Hilton Head in 1773. Among the plants listed by Bartram at shell mounds were Magnolia grandiflora, Pinus taeda, Laurus borbonia (Persea borbonia), Quercus semprevirens (Quercus virginiana), Corypha palma (Sabal palmetto), Prunus laurocerasus, Ilex aquifolium (L. opaca), and Juniperus americana (Juniperus virginiana).

There are several studies of the vascular flora of shell mounds along the southeastern and Gulf coasts of the United States. Brown (1936) reported that the most common plants found on Louisiana shell mounds are Juncus roemerianus, Spartina patens, Scirpus olneyi, Limnrostris castanea, Iva frutescens, and Salicornia spp., all salt marsh species. Laessle (1942) noted that certain plants occupying the Orange Point shell mound in Florida, “seem to persist on the highly calcareous soil,” and are found, “nowhere else in the area.”
Griffen (1948) reported that the Florida shell middens are "extremely interesting," and that they support, "a more or less specialized vegetation." Kurz and Wagner (1957) studied the distribution of salt marsh vegetation along an elevation gradient at the Buzzards Island shell ring, South Carolina, but did not recognize the site as a shell ring. Eleuterius and Orvoss (1979) surveyed a shell mound at Cedar Island, Mississippi, and reported a vascular flora of 62 species. They reported that a number of plants were calciphiles including *Aesculus pavia*, *Elymus virginiana*, *Maclea caroliniana*, *Sageretia minutiflora*, and *Yucca aloifolia*.

The most inclusive study of the vascular flora at Indian middens including shell mounds and rings is that by Dorroh (1971) along the South Carolina coast. A shell mound is a solid mass of shellfish remains; and a shell ring is a circular or arc-shaped ridge consisting of shellfish remains. Dorroh sampled eleven mounds and eight shell rings during the summer of 1970 by transects. At each site, a north south and east west compass line was followed, and species were identified if they were encountered at the transect and approximately two yards on either side of the transect. Dorroh's (1971) transect approach yielded 136 species in 59 families. The present study, a comprehensive inventory of 9 shell rings and one shell mound, yielded 241 species.

There are several archeological surveys of shell rings, including one by a future president, William McKinley, who described and measured three shell rings at Sapelo Island, Georgia, for the Smithsonian Institution in 1872 (Calmes 1967). Waring and Larson (1968) studied the shell rings at Sapelo Island and Porcher's Bluff, South Carolina, just north of Charleston. Cameron (1976) presented an ethnobotanical and floristic reconstruction of the Sapelo Island Shell Ring. Dr. Warren Moorehead examined the Chesterfield site, a horseshoe shaped structure along the Broad River near Port Royal Sound, South Carolina, (Flannery 1943). The Sewee Ring, a horseshoe shaped midden near the Santee River, South Carolina, was examined by Edwards (1965) who postulated that the site may have served as a fish trap by native Americans. Calmes (1967) examined the Ford's Skull Creek and Sea Pines rings at Hilton Head Island, South Carolina.

The Fig Island Shell Ring near the northeast end of Edisto Island, South Carolina, was examined by Hemmings (1970). Trinkley (1980, 1985) has done extensive work on the archeology of various shell rings and middens in South Carolina including Buzzards Island, and Crow Island at the Francis Porcher property north of Charleston.

**METHODS**

Nine shell rings and one shell mound were selected for the present study. These include four rings in South Carolina: Sewee, Buzzards Island, Ford's Skull Creek, Sea Pines and the Auld Mound; three rings in Georgia: Oemler,
Romerly Marsh and Sapelo Island; and two rings in Florida: Fort George and Guana River State Park (Figure 1). Of the four shell rings extant in Florida; two are in this study. In South Carolina there were over 100 shell rings but many of these no longer exist due to shell removal for road building. Criteria for selecting sites include permission from private, state and federal authorities, lack of human disturbance and accessibility. The study was initiated in February 1993 and was completed in October 1994. Each site was sampled a minimum of 6 times during the growing seasons of 1993 and 1994 for a total of about 40 field days. Herbarium vouchers of each taxon were prepared and deposited at the University of South Carolina Herbarium: some are also housed at the Brooklyn Botanic Garden (BKBL), Missouri Botanical Garden (MO), and the New York Museum at Albany, N.Y. (NYS).

The species checklist (Appendix 1) contains an inventory of the vascular plants that reproduce spontaneously and persist for more than one year without cultivation, including native taxa, naturalized and adventive weeds, and escapes from cultivation. The checklist is divided into the following categories: vascular cryptograms, gymnosperms, dicots, and monocots. Nomenclature follows Kartesz (1994); when differences occur, the name as presented in Radford et al. (1968) is listed as a synonym and enclosed in brackets. The concept of families follows Kartesz (1994).

Mineral analysis of the soils of the shell rings was provided by the Cornell Nutrient Analysis Laboratory, Cornell University.

RESULTS AND DISCUSSION

The vascular flora of ten shell sites (9 rings, 1 shell mound) from South Carolina to Florida consists of 80 families, 182 genera, and 241 species of which 216 (89.6%) are native (Table 1). There is a higher percentage (89.6%) of native flora at the shell midden than at Fort Moultrie, South Carolina, where 77% of the flora are native (Stalter & Lamont 1993). The native flora at the Outer Banks of North Carolina, Ocracoke Island to the Virginia border, is 78% (Stalter & Lamont 1997).

The Poaceae, with 30 genera and 49 species and the Asteraceae, with 24 genera and 29 species are the largest families in terms of taxa. Together they comprise 30% of all genera and 33% of all species. Other large families are the Fabaceae and Cyperaceae. The largest genus is *Dichanthelium* with 8 species followed by *Quercus* with 6 species. The rarest species encountered is *Sageretia minutiflora* (Radford et al. 1971), though this species is common at shell ring sites examined in the present study. A summary of the vascular flora is given in Table 1.

The Sewee Shell Ring, South Carolina, was visited by Dr. R. Mohlenbrock in 1979. Notable species on Mohlenbrock's list at the Sewee Shell Ring included small-leaved buckthorn (*Bumelia tenax*) and basswood (*Tilia caroliniana*).
Shumard's oak (*Quercus shumardii*), as well as climbing hydrangea (*Duscmerea barbara*), grew only in the nearby forest. The forest was leveled by Hurricane Hugo, September 21 and 22, 1989, and was severely burned by a devastating wildfire in 1991. The vegetation on the shell ring escaped the fire, but not the powerful winds of Hurricane Hugo.

Several factors may account for the assemblage of species on the shell sites at the time this study was conducted. Hurricane Hugo, September 1989, savaged three shell middens: Sewee, Auld and Buzzard's Island, South Carolina. Four study sites, Auld, Buzzard's Island, Roemerly Marsh and the Oemler Ring are islands surrounded by a sea of *Spartina alterniflora*. Two shell rings, Sewee and Sapelo Island border salt marshes; the vegetation of these two rings and the four previously mentioned island rings are strongly influenced by tidal inundation. Sea Pines, South Carolina, Ford Skull Creek, South Carolina, Fort George and Guana River State Park, Florida are inland rings not influenced by tidal flooding. The calcareous nature of the soil also affects species distribution. Human activity (disturbance) in the form of occasional mowing at Sea Pines, archaeological excavation by Waring and Larson (1968) at Sapelo Island and light cattle grazing at Sapelo Island, play a role in species distribution at these shell rings. A final obvious factor is climatic differences. The winters at St. Augustine, Florida, are milder than the winter climate at the most northern Sewee Shell Ring site.

Sewee, Auld and Buzzards Island, South Carolina, were ravaged by Hurricane Hugo, September 21 and 22, 1989. Hurricane Hugo, a category 4 hurricane, was one of the most powerful storms of this century to strike the South Carolina coast. The hurricane surge in the vicinity of Charleston, South Carolina, was 4m; the surge reached 6m at McClellenville, 50km northeast of Charleston. Hurricanes with winds as severe as those of Hugo strike portions of the South Carolina coast approximately once every 200 years (Anonymous 1974). The vegetation on the above three shell rings was severely damaged by wind. Additional damage to shell ring vegetation may have occurred in one or more of the following ways: inundation by the storm surge; salt water immersion and residual effect of salt water desiccation; smothering by deposition of soil and rafts of vegetation (Stalter & Lamont 1993).

<table>
<thead>
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<th></th>
<th>Ferns</th>
<th>Conifers</th>
<th>Dicots</th>
<th>Monocots</th>
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</tr>
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</table>
Stalter and Lamont (1993) recorded 218 species at Fort Moultrie, South Carolina, a site just north of Charleston, one year after Hurricane Hugo, including coastal plants, e.g. *Quercus virginiana*, *Ilex vomitoria*, and *Juniperus silicicola* that are common along the southeast coast. Stalter and Lamont (1993) reported that many of the plants at Fort Moultrie and Fort Sumter survived Hurricane Hugo. *Liriodendron tulipifera* and *Podophyllum peltatum*, two species recorded by Gregory (1925) and Dorrah (1971) at the Auld Shell site were probably killed by Hurricane Hugo. Yet many species identified by Dorrah (1971) at the Auld site, e.g. *Quercus virginiana*, *Smilax spp.* survived Hurricane Hugo.

The Sea Pines, South Carolina Shell Ring is maintained by occasional mowing as an “archeological show piece” of the Sea Pines Development community. Common shrubs, e.g. *Myrica cerifera* and *Quercus virginiana* and saplings of *Quercus laurifolia*, abundant in the surrounding forest, have been removed from this shell ring. *Dichanthelium* spp., *Oplismenus setarius* and *Arisaema spp.* provide conspicuous seasonal ground cover at this site in the absence of dense shrub cover. The nearby Ford Skull Creek Shell Ring, a historically “disturbed” inland shell ring, was once used as a source of oyster shells, as building materials. At the time the present study was conducted, the Ford Skull Creek Shell Ring was undisturbed. Past oyster shell harvesting may have an effect on the present floristic composition at this shell ring.

The Sapelo Island, Georgia, Shell Ring, the most floristically rich shell ring of this study, has been disturbed in the past. Waring and Larson (1968) excavated shells from a portion of this shell ring bordering the salt marsh. Today, feral cattle occasionally graze portions of the shell ring, though grazing appeared to be negligible at the time of the present study. The presence of enclosures at this shell ring, might enable future investigators to determine the impact of cattle grazing on the flora of this shell ring.

Two Florida shell rings, Fort George, 23 km east of Jacksonville and Guana River State Park, just north of St. Augustine, are undisturbed inland shell rings. *Vernonia gigantea*, *Psychotria nervosa*, *Peperomia humilis* and *Bidens alba* var. radiata were found only at the Florida shell rings; they were not observed at the other shell rings. *Corallorhiza wisteriana* was observed in flower in mid February, 1994, at the Guana River site, while at Fort George, 55 km north, *C. wisteriana* did not flower until late March, 1994. Yet, the climatic differences between the two sites are minimal (Anonymous 1974). The difference in flowering of *C. wisteriana* at the two sites may reflect significant differences in minimum temperature at these sites during the winter of 1994.

Eleuterius and Otvos (1979) report that *Juniperus silicicola*, *Aesculus pavia*, *Erythrina herbacea*, and *Morus rubra* are reliable indicators of the shell deposits on Indian middens. All of the aforementioned species were found at
one or more of the shell rings in the present study. *Sageretia minuta* and *Hexalectris spicata* may also be included as "indicator species" as these species favor the calcareous soils of Indian middens (Wunderlin 1998) but are found at non-ring sites as well.

The soils at the shell rings are neutral to slightly basic with a pH range of 6.82 at Sea Pines to 7.69 at Guana River State Park. Available Ca was high at all sites with a range of 1497 mg/Kg at Buzzard Island to 29,706 mg/Kg at Sea Pines. Available Mg ranged from 139.9 mg/Kg at Sapelo to 921.1 at Buzzards Island, while available Mn ranged from 5.4 at Fort George to 62.5 mg/Kg at Sea Pines. Available P ranged from 19.2 at Fort George to 221.0 mg/Kg at Sapelo, while K ranged from 42 at Guana River to 207 mg/Kg at Buzzards Island. Available nitrates ranged from undetectable at Buzzards Island to 190.61 at Sea Pines. The range of all these nutrients is highly variable among the sites.

Several shell rings occur as islands in salt marshes. The distribution of salt marsh species on the sides of these rings is related to tidal flooding and soil salinity. *Spartina alterniflora* occupies the lowest daily flooded base of the shell ring. Less flood tolerant salt marsh species are *Salicornia* spp., *Batis maritima*, *Distichlis spicata*, *Borrichia frutescens*, and *Spartina patens*. These form distinct zones above the more flood tolerant *Spartina alterniflora*, *Iva frutescens* and *Baccharis halimifolia* border *Borrichia* and *Spartina patens*, on the upland side. By contrast, the vegetation on shell rings not bordering salt marshes includes *Arisaema dracontium* and *A. triphyllum* at Sea Pines and Ford's Skull Creek, South Carolina, while *Corallorbiza wisteriana* and *Hexalectris spicata* were observed at the two Florida shell rings. *Psychotria nervosa*, *Peperomia humilis* and *Bidens alba* var. *radiata*, three subtropical species, were exclusively at the Florida shell ring sites, and are not part of the Carolina flora.

The most common woody species found on the salt marsh island shell rings are *Juniperus silicicola*, *Quercus virginiana*, *Sabal palmetto*, *Ilex vomitoria*, *Myrica cerifera* and *Smilax* spp. The most notable plant records, exclusive of the rare *Sageretia minuta*, are *Liriodendron tulipifera*, *Podophyllum peltatum*, and *Trillium* spp., known only from historical records at the Auld South Carolina Shell site (Gregorie 1925). Dorroh (1971) reported *Liriodendron* and *Podophyllum* at Auld in her study. These aforementioned taxa are usually not found at coastal barrier islands, although Stalter and Lamont (1987) reported a small population of *Podophyllum peltatum* and a single *Liriodendron tulipifera* at Assateague Island, Virginia. *Liriodendron*, *Podophyllum* and *Trillium* were absent at the Isle of Palms, South Carolina (Stalter 1976), Turtle Island, South Carolina (Stalter 1973), coastal Brookgreen Gardens, South Carolina (Stalter 1972), the Outer Banks of North Carolina (Stalter and Lamont 1997), and Fisherman Island, Virginia (Stalter et al. 1997). The *Liriodendron* at the Auld Shell mound
may have been toppled by Hugo's hurricane winds while *Podophyllum* may have been killed by saltwater inundation during the storm surge associated with Hurricane Hugo, September 1989. Radford et al. (1971) report that *Liriodendron, Podophyllum* and *Trillium* are present at Charleston County, South Carolina, though these taxa may have been collected at inland sites.

Many plants may be "rare", rare being defined as scarce, less than 5 populations, at a study site (Stalter & Lamont 1997). Stalter and Lamont (1997) recorded 336 "rare" plants, 45.3% of the flora, at the Outer Banks of North Carolina.

Plants are rare for a multiplicity of reasons. Plants may be rare because they exist at the edge of their normal range. Plants may be rare if they have narrow habitat requirements that are met in only a few areas, such as the calciphile, *Sageretia nitidiflora*. Plant succession, climatic events such as drought, severe cold or hurricanes can reduce the number of species, especially plants in restricted habitats such as shell rings. Human activities such as development, introduction of non-native plants, pollution and overcollection of attractive plants such as *Corallorhiza wisteriana* may also contribute to the rarity of species (Stalter & Lamont 1998).

Sea level along the Atlantic coast was 120 meters lower than today 12,000 years ago. Dolan et al. (1980) report that sea level continued to rise for 8,000 years, "reaching within a few meters of the present level 4–5000 years ago." Sea level has risen several meters in the past 2,000 years, and over the past 100 years, sea level has risen over 30 cm (Dolan et al. 1980). It is possible that some of the present salt marsh island shell rings may have been initially located on upland sites when they were built by Native Americans, several thousand years ago, when the sea level was several meters lower than it is today (Dolan et al. 1980). All the present shell ring sites selected in this study may have been built close to, or on the coast, where oysters were abundant. However, the precise location of the shell rings examined in this study relative to the coastline, salt marsh creeks and/or salt marshes at the time of their construction cannot be accurately determined.

**APPENDIX I**

**ANNOTATED CHECKLIST OF SPECIES**

The vascular plant taxa found at ten shell sites have been arranged according to the following categories: vascular cryptogams, gymnosperms, dicots, and monocots. Within each category, families and lower taxa are arranged alphabetically. Nomenclature primarily follows Kartesz (1994).

Each entry includes the following information sequence: scientific name; pertinent synonym, enclosed in brackets; and frequency relative to the shell rings, using the categories: rare (scarce, less than 5 populations), infrequent (uncommon, occasional, 5 to 20 populations), frequent (common, more than 20 populations).
POLYPODIOPHYTA

POLYPODIACEAE
Pileoptilis polypodioides (L.) Andrews and Windham spp. michauxiana (Weatherby)
Andrews & Windham [Polypodium polypodioides (L.) Watt. var. michauxianum Weatherby]; infrequent

ASPLENIACEAE
Asplenium platyneuron (L.) BSP.; frequent

PITrophyTA

CUPRESSACEAE
Juniperus virginiana L. var. silicola (Small)
E. Murray [Juniperus silicola (Small) Bailey]; infrequent

PINACEAE
Pinus taeda L.; infrequent

MAGNOLIOPHYTA

MAGNOLIOPSIDA (DICOTS)

ACANTHACEAE
Ruellia carolinensis (J.F. Gmel.) Steudel; infrequent

ACERACEAE
Acer rubrum L.; infrequent

AMARANTHACEAE
Iresine rhizomatosa Standley; rare

ANACARDIACEAE
Toxicodendron radicans (L.) Kuntze [Rhus radicans L.]; frequent
Rhus copallium L. [Rhus copallina L.]; infrequent

ANNONACEAE
Asimina triloba (L.) Dunal; rare

APIACEAE
Sanicula canadensis L.; infrequent

AQUIFOLIACEAE
Ilex vomitoria Aiton; infrequent

ARALIACEAE
Aralia spinosa L.; rare

ASCLEPIADACEAE
Cynanchum angustifolium Pers.; [Cynanchum palastrae (Pursh) Heller]; infrequent
Metelea gomotarpa (Walter) Shinners [M. suberosa (L.) Shinners]; rare

ASTERACEAE
Ambrosia artemisiifolia L.; rare
Arnoglossum ovatum (Walt.) H.E. Robins.
[Callicarpa lanceolata Nutt.]; rare
Aster tenuifolius L.; infrequent
Baccharis augustinfolia Michx.; rare
Baccharis halimifolia L.; frequent
Bidens alba (L.) DC. var. radiata (Schultz-Bip.) Ballard ex T.E. Melchert [Bidens pilosa L. var. radiata Schultz – Bip.]; frequent at Florida Shell Rings
Bidens bipinnata L.; infrequent
Borrichia frutescens (L.) DC.; frequent
Carduus marri (Britton) Ashles. [Cirsium horridulum Michx.]; rare
Lencanthenum edgare Lam. [Chrysanthemum lecanathrenum L.]; infrequent
Conyza canadensis (L.) Cronq. var. pusilla (Nutt.) Cronq.; infrequent
Elephantopus tomentosus L.; frequent
Elechites hieracifolia (L.) Raf.; frequent
Erigeron quecifolius Lam.; frequent
Eupatorium capillifolium (Lam.) Small; frequent
Eupatorium hyssopifolium L.; frequent
Eupatorium serotinum Michx.; rare
Enanthia graminifolia (L.) Nutt. [Solidago graminifolia (L.) Salisbury]; infrequent
Gamochaeta purpurea (L.) Cabrera [Gnaphalium purpureum L. var. purpureum]; infrequent
Hieracium gronovii L.; infrequent
Iva frutescens L.; infrequent
Lactuca floridana (L.) Gaertn.; infrequent
Lactuca graminifolia Michx.; infrequent
Mikania scandens (L.) Willd.; frequent
Smallanthus uvedalia (L.) MacKenzie ex Small
[Polymnia uvedalia (L.) L.]; rare
Solidago sempervirens L. var. mexicana (L.) Fern.; frequent
*Sonchus asper (L.) Hill; frequent
Verbesina occidentalis (L.) Walter; rare
Veronica gigantea (Walt.) Trel.; rare

BATACEAE
Batis maritima L.; rare

BERBERIDACEAE
Podophyllum peltatum L. Reported by Gregoric (1925) and Dorrnh (1971) at Auld, SC; not recently observed
BIGNONIACEAE
Bignonia capreolata L. [Anisostichus capreolata (L.) Bureau]; infrequent
Campsis radicans (L.) Seemann; infrequent

BORAGINACEAE
Heliotropium carassavicum L.; rare

BRASSICACEAE
*Cardamine hirsuta L.; infrequent
Decurania pinata (Walter) Britton ssp.
  brachycarpa (Richardson) Delping {D.
  brachycarpa (Richardson) O.E. Schultz};
  rare
Lepidium densiflorum Schader; rare
Lepidium virginicum L.; frequent

BUDDLEIACEAE
Poly裨mune procumbens L.; infrequent

CACTACEAE
Opuntia biuniflora (Raf.) Raf. {O. compressa
  J.F. Macbride}; infrequent
*Opuntia monacantha (Willd.) Haw. {O.
  vulgaris P. Mill.}; rare

CAMPANULACEAE
Trindana perfoliata (L.) Neuw. {Specularia
  perfoliata (L.) A. DC.}; frequent

CAPRIFOLIACEAE
*Lonicera japonica Thunb.; infrequent
Lonicera sempervirens L.; infrequent
Viburnum nudum L.; rare

CARYOPHYLLACEAE
Arenaria lanuginosa (Michx.) Rohrb.; rare
Arenaria serpyllifolia L.; infrequent
*Geranium fontanum Baumg. subsp. vulgar
  (Hartman) Greuter & Burder {C.
  holostoides Fries var. vulgar (Hartman)
  Hylander; C. vulgarum L.}; infrequent
Silene antirrhina L.; rare
*Spergularia marina (L.) Griseb. {S. salina
  J. & K. Presl}; infrequent

CELASTRACEAE
Enonymus americannus L.; rare

CHENOPODIACEAE
Atriplex patula L.; infrequent
*Chenopodium album L.; infrequent
*Chenopodium ambrosioides L.; frequent
*Salsola maritima Wolff & Jeffries
  {Salsola europaea auct. non L.}; infrequent
Salsorria virginica L.; frequent
Suaeda litoralis (Elliot) Moq.; infrequent

CONVOLVULACEAE
* Dichondra carolinensis Michx.; infrequent
* Ipomoea pandurata (L.) G.F.W. Mey.;
  infrequent
* Ipomoea sagittata Poir.; frequent

CORNACEAE
Corylus asperifolia Michx.; rare
Corylus florida L.; rare
Corylus striata Lam. {C. formosa P. Mill.};
  infrequent

CUSCUTACEAE (Formerly Convolvulaceae)
Cuscuta gronovii Willd.; rare

ERICACEAE
Vaccinium corymbosum L. {V. atroroccruum (A.
  Gray) Porter}; rare

EUPHORBIACEAE
Acalypha racemosa A. Gray; rare
*Obourryce maculata (L.) Small {Euphor-
  bia maculata L.; E. sapina Raf.}; infrequent
Cuscuta stimulans (Michx.) Engelm. &
  A. Gray; frequent
Euphorbia cyathophora Murray {E. heterophylle
  L. var. cyathophora (Murray) Griseb.}; rare

FABACEAE
Casina nititans L.; infrequent
Cercis canadensis L.; rare
Clitoria mariana L.; rare
Crotalaria rotundifolia Walt. ex. J.F. Gmel.
  {C. angustata auct. non P. Mill.}; rare
Decumum niadiform (L.) DC.; rare
*Decumum nigrotor (L.) DC.; frequent
*Erythyraea herbacea L.; frequent
Galactia regularis (L.) BSP.; infrequent
Lepedeza sp.; infrequent
Lepedeza stratiata Nutt.; infrequent
*Melilotus officinalis (L.) Lam.; infrequent
*Wisteria sinensis (Sims) DC.; rare

FAGACEAE
Quercus laurifolia Michx.; rare
Quercus myrtifolia Willd.; rare
Quercus nigra L.; rare
Quercus phellos L.; rare
Quercus stellata Wangenh.; rare
Quercus virginiana Miller; frequent

GERANIACEAE
Geranium carolinianum L.; infrequent
HAMAMELIDACEAE
Hamamelis virginiana L.; rare
Liquidambar styraciflua L.; rare

HIPPOCASTANACEAE
Aesculus pavia L.; frequent

JUGLANDACEAE
Carya glabra (P. Mill.) Sweet; infrequent

LAMIACEAE
Salvia lyrata L.; rare
Teucrium canadense L.; frequent
Trichostema dichotomum L.; rare

LAURACEAE
Persea borbonia (L.) Spreng.; infrequent
Sassafras albidum (Nutt.) Nees.; infrequent

MAGNOLIACEAE
Liriodendron tulipifera L. Reported by Gregorie (1925) and Dorroh (1971) at Auld, SC. Possibly destroyed by Hurricane Hugo in 1989.
Magnolia grandiflora L.; infrequent
Magnolia virginiana L.; infrequent

MELIACEAE
* A[elia azedarach L.; rare

MENISPERMACEAE
Cocculus carolinus (L.) DC.; rare
Menispernum canadense L.; rare

MORACEAE
* Morus alba L.; rare
Morus rubra L.; rare

MYRICKACEAE
Myrica cerifera L.; frequent

NYSSACEAE
Nyssa sylvatica Marsh.; infrequent
Nyssa biflora Walt. [N. sylvatica Marsh. var. biflora (Walt.) Sarg.]; infrequent

OLEACEAE
Fraxinus caroliniana P. Mill.; rare
*Ligustrum amurense Carr.; infrequent
Osmanthus americanus (L.) A. Gray; infrequent

ONAGRACEAE
Oenothera fruticosa L.; frequent
Oenothera laciniata Hill; infrequent

OXALIDACEAE
Oxalis dillenii Jacq.; infrequent
Oxalis stricta L.; infrequent

PASSIFLORACEAE
Passiflora lutea L.; infrequent

PHRYMACEAE
Phryma leptostachya L.; rare

PHYTOLACCACEAE
Phytolacca americana L.; frequent

PIPERACEAE
Peperomia hamieli A. Dietr.; rare

PLUMBAGINACEAE
Linumum carolinianum (Walt.) Britt. [L. nasbii Small]; infrequent

POLYGONACEAE
Rumex bastalinos Baldw.; frequent

RANUNCULACEAE
*Clematis crispa L.; infrequent
*Clematis terniflora DC. [Clematis dioscoreifolia Levl. and Vaniott]; infrequent
*Clematis virginiana L.; rare

RHAMNACEAE
Berchemia scandens (Hill) K. Koch; infrequent
Frangula caroliniana (Walt.) Gray [Rhamnus caroliniana Walt.]; rare
Sageretia miniatiflora (Michx.) C. Mohr. [Rhamnus miniatiflora Michx.]; infrequent

ROSACEAE
Crataegus uniflora Muenchh.; rare
Prunus caroliniana (P. Mill.) Ait. [Laurocerasus caroliniana (P. Mill.) M. Roemer]; infrequent
Prunus serotina Ehrhr.; infrequent
Rubus trivialis Michx.; frequent

RUBIACEAE
Galium pilosum Aiton; infrequent
Psychotria nervosa Sw. [Psychotria undata Jacq.]; rare

SAPOTACEAE
Sideroxylon tenax L. [Bumelia tenax (L.) Willd.]; infrequent
SCROPHULARIACEAE
Gratidia pilosa Michx.; rare
Nuttallanthus canadensis (L.) D.A. Sutton.
[Litaria canadensis (L.) Chaz.], frequent
*Verbascum thapsus L.; frequent
*Veronica arvensis L.; frequent

SOLANACEAE
Physalis alkekengi Nutt. [P. viscosa L. subsp. maritima (M. A. Curtis) Waterfall]; infrequent

TILIACEAE
Tilia americana L. var. caroliniana (P. Mill.) Castigl. [T. caroliniana P. Mill]; rare

ULMACEAE
Celtis laevigata Willd.; infrequent
Celtis occidentalis (L.) var. georgiana (Small) Alls.; rare

VERBENACEAE
Callicarpa americana L.; infrequent
Verbena scabra Vahl; rare

VIOLACEAE
Viola sororia Willd.; rare

VITACEAE
Ampelopsis arborea (L.) Koehne; infrequent
Parthenocissus quinquefolia (L.) Planch.; frequent
Vitis aestivalis Michx.; infrequent
Vitis rotundifolia Michx.; infrequent

MAGNOLIOPHYTA - LILIOPSIDA

AGAVACEAE
*Yucca aloifolia L.; infrequent

ARACEAE
Arisaema dracontium (L.) Schott; infrequent
Arisaema triphyllum (L.) Schott; rare

ARECACEAE
Sabal palmetto Lodd. ex. Schultes; infrequent

BROMELIACEAE
 Tillandsia usneoides (L.) L.; infrequent

COMMELINACEAE
Tradescantia obtusiifolia Raf.; infrequent

CYPERACEAE
Cladium jamaicense Crantz [C. mariscus (L.) Polh.]; infrequent
Cyperus glabrous Aublet; infrequent
Cyperus retrorsus Chapm.; infrequent
Eleocharis alticola Torr.; rare
Fimbristylis castanea (Michx.) Vahl; infrequent
Rhynchospora colorata (L.) H. Pfeiffer
[Dichromena colorata (L.) Hitchc.]; rare
Scirpus robustus Pursh; rare
Scleria triglomerata Michx. [S. utica Milh.]; infrequent

DIOECOCEAE
Dioscorea villosa L.; rare

IRIDACEAE
Sisyrinchium rosulatum E. Bickn.; rare

JUNCACEAE
Juncus bufonius L.; infrequent
Juncus roemerianus Scheele; infrequent

LILIACEAE
*Allium vineale L.; infrequent
Trillium sp. Reported by Gregorie (1925)
at Auld site; not recently observed.

ORCHIDACEAE
Corallorhiza wisteriana Conrad; infrequent
Hexastelis spicata (Walt.) Barnh.; infrequent

POACEAE
Andropogon glomeratus (Walter) B.S.P. [A. virginicus L. var. abbreviatus (Hackel) Fern. & Griscom]; infrequent
Andropogon virginicus L.; frequent
Arundinaria gigantea (Walter) Muhl. subsp. tecta (Walter) McClure; infrequent
Arthraxon hispidus Thunb. var. cryphatherus (Hackel) Honda.; infrequent
*Bromus tectorum L.; infrequent
Cenchrus carolinianus Walt. [C. inermis M.A. Curtis]; rare
Chasmanthium laxum (L.) Yates [Uniola laxa (L.) B.S.P.]; infrequent
*Dactylolentium aegyptiun (L.) Willd.; infrequent
Dickanthium acuminatum (Sw.) Gould & Clark [Panicum acuminatum Sw. (sensu lato) incl. P. anhuriae Ashe; P. mirandole Ashe; P. leucothrix Nash]; infrequent
Dickanthium consanguineum (Kunth) Gould & Clark [Panicum consanguineum Kunth]; infrequent
Dickanthium latifolium (L.) Gould & C.A. Clark [Panicum latifolium L.]; infrequent
Dichanthelium laxiflorum (Lam.) Gould  
{Panicum laxiflorum Lam.; P. xalapense  
H.B.K.}  rare  
Dichanthelium malacophyllum (Nash) Gould  
{Panicum malacophyllum Nash}  rare  
Dichanthelium oligosanthes var. scriberianum  
(Nash) Gould  {Panicum scriberianum  
Nash}; rare  
Dichanthelium sabulorum (Lam.) Gould &  
Clark var. patulum (Scribn. & Merr.)  
Gould & Clark.  {Panicum lanceatum  
Trin.}; infrequent  
Dichanthelium scabrunseum (Ell.) Gould &  
Clark.  {Panicum scabrunseum Ell.  
P. aculeatum A. Hitchc. & Chase}; rare  
Distichlis spicata (L.) Greene; infrequent  
Echinochloa walteri (Pursh) Heller; rare  
Elymus virginicus L. var. halophilus (Bickn.)  
Wieg.; infrequent  
Eragrostis birsuta (Michx.) Nees; infrequent  
Eragrostis spectabilis (Pursh) Steud.  
in frequent  
Eustachys petraea (Swartz) Desv.  
{Chloris petraea Sw.}; infrequent  
Muhlenbergia mutica Walt.; infrequent  
Muhlenbergia capillaris (Lam.) Trin.;  
in frequent  
Muhlenbergia schreberi J. F. Gmel.; rare  
Optimenus setarius (Lam.) Roemer & Schultes  
{O. birtellus (L.) Beauv. subsp. setarius  
(Lam.) Mez ex Ekman}; frequent  
Panicum amarum Ell.  
{P. amarum A. Hitchc. & Chase}; rare  
Panicum boscii Poir.  
{P. boscii var. molle (Vasey)  
Hitchc. and Chase}; frequent  
Panicum dichotomiflorum Michx.; infrequent  
Panicum virgatum L.; infrequent  
Paspalum distichum L.; infrequent  
Paspalum setaceum Michx. var. ciliatifolium  
(Michx.) Vasey [P. ciliatifolium Michx.;  
P. longipilum LeConte]; rare  
Phalaris caroliniana Walt.; rare  
Piptochaetium avanaeum (L.) Parodi  
{Stripa avanaeum L.}; infrequent  
*Poa annua L.; infrequent  
*Polypogon monspeliensis (L.) Desf.; frequent  
Setaria geniculata (Lam.) Beauv.; infrequent  
Sphenopholis intermedia (Rydb.) Rydb.; rare  
Sphenopholis obtusa (Michx.) Scribn.; rare  
Spartina alterniflora Loisel.; frequent  
Spartina patens (Ait.) Muhl.; frequent  
Sporobolus indicus (L.) R. Br.  
{S. purpurei (R. & S.) Hitchc.}; frequent  
Sporobolus virginicus (L.) Kunth; infrequent  
Stenotaphrum secundatum (Walt.) Kunze;  
in frequent  
Tridens flavus (L.) A. Hitchc.  
{Triodia flava  
(L.) Smyth}; infrequent  
Tririalis purpurea (Walt.) Chapman;  
frequent  
Vulpia octoflora (Walt.) Rydb.  
{Festuca octoflora  
Walt.}; infrequent  

SMILACACEAE  
Smilax bona-nox L.; infrequent  
Smilax glauca Walt.; rare  
Smilax laurifolia L.; infrequent  
Smilax rotundifolia L.; infrequent  

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BOOKS RECEIVED


Volume 29 of Annual Review of Ecology and Systematics is another excellent mix of articles on ecology and systematics. A total of 20 articles are presented followed by a Subject Index, Cumulative Index of Contributing Authors, and a Cumulative Index of Chapter Titles, Volumes 25–29.

Contents include:

Molecular Trans-Species Polymorphism
Principles of Phylogeography as Illustrated by Freshwater and Terrestrial Turtles in the Southeastern United States
The Functional Significance of the Hyporheic Zone in Streams and Rivers
Endangered Mutualisms: The Conservation of Plant-Pollinator Interactions
The Role of Introduced Species in the Degradation of Island Ecosystems: A Case History of Guam
Evolution of Helping Behavior in Cooperatively Breeding Birds
The Ecological Evolution of Reefs
Roads and Their Major Ecological Effects
Sex Determination, Sex Ratios, and Genetic Conflict
Early Evolution of Land Plants: Phylogeny, Physiology, and Ecology of the Primary Terrestrial Radiation
Possible Largest-Scale Trends in Organismal Evolution: Eight "Live Hypotheses"
Fungal Endophytes: A Continuum of Interactions with Host Plants
Floral Symmetry and Its Role in Plant-Pollinator Systems: Terminology, Distribution, and Hypotheses
Vertebrate Herbivores in Marine and Terrestrial Environments: A Nutritional Ecology Perspective
Carbon and Carbonate Metabolism in Coastal Aquatic Ecosystems
The Scientific Basis of Forestry
Pathways, Mechanisms, and Rates of Polyploid Formation in Flowering Plants
Bacterial Growth Efficiencies in Natural Aquatic Systems
The Chemical Cycle and Bioaccumulation of Mercury
Phylogeny of Vascular Plants
The authors provide a list of 41 additions, reinstatements, and significant range extensions for the flora of Arkansas. *Trautvetteria carolinensis, Dalea gattingeri, Rhynchosia minima*, and *Setaria pumila* are reported as new and persistent elements, while *Magnolia macrophylla, Didiplis diandra, Valerianella locusta*, and *Sisyrinchium exile* are reinstated to the state flora. A number of alien weeds are noticed and documented for the first time, however, their persistence is not known.

The authors provide a list of 41 taxa representing additions and reinstatements to the Arkansas flora as well as noteworthy range extensions within the state. Herbarium abbreviations are taken from Holmgren et al. (1990).
APIACEAE

**Hydrocotyle sibthorpioides** Lam. This invasive Asian pennywort occurs sporadically in the Southeast in wet, disturbed habitats. We add three county records to the two recorded by Smith (1988). **Ashley Co.: Sundell 11,104 (UAM). Calhoun Co.: Thomas & Amason 157.168 (NLU, UAM). Pulaski Co.: E. & M. Sundell 12,048 (UAM).**

ASTERACEAE

**Conyza bonariensis** (L.) Cronq. This common and widespread horseweed has escaped notice, or at least collection, in southern Arkansas for years—the more remarkable because it forms extensive populations along our major highways that are easily recognized even at speeds of over 60 miles per hour. *Conyza bonariensis* was not discovered in the state until 1989, when Thomas and Amason collected plants in a railroad yard in El Dorado in Union County (Thomas et al. 1991). Voucher specimens taken from roadsides and river banks are recorded here for eight additional counties. **Arkansas Co.: Thomas, Sundell, & Amason 145.284 (NLU). Calhoun Co.: Thomas & Amason 157.214 (NLU, UAM). Cleveland Co.: Thomas & Amason 157.108 (NLU, UAM). Desha Co.: Thomas, Sundell, & Amason 145.498 (NLU). Drew Co.: Sundell 12.110 (UAM). Hempstead Co.: Thomas & Amason 155.483 (NLU). Lafayette Co.: Thomas, Sundell, & Amason 150.931, 156.555 (NLU). Miller Co.: Thomas, Sundell, & Amason 151.143 (NLU). The species should be considered an established element of the Arkansas flora.**

**Crepis setosa** Haller f. is known from Missouri (Steyermark 1963) and the northeastern United States (Gleason and Cronquist 1991) as a waif. Although the species is unlikely to persist in Arkansas, its presence is documented by a collection from Russellville in Pope County, where it grew as a weed in pavement cracks, **E. M. & J. Sundell 12,105 (UAM).**

BRASSICACEAE

**Cardamine concatenata** (Michx.) O. Schwartz. Like bloodroot and white trout lily, toothwort is rare enough on Arkansas' West Gulf Coastal Plain to have gone undetected except for a single report for Arkansas County (Smith 1988). We record it here from mesic woodlands in two additional localities. **Drew Co.: Sundell & Pagan 10.149 (UAM). Union Co.: Thomas & Amason 109.031 (NLU).**

**Cardamine debilis** D. Don is an unobtrusive and probably undercollected alien weed, sporadically introduced in greenhouses and warmer areas of North America (Rollins 1993). Plants were collected from a flower bed in Pulaski County, October 1997, marking the species' first occurrence in Arkansas. **Sundell 12,258 (UAM, UARK).** Although Kartesz (1994) places C. debilis
in synonymy with *C. flexuosa* With., the two appear to be distinct and are recognized as such by Rollins.

**Cardamine flexuosa** With. The alien *Cardamine flexuosa* grew in abundance at Daylite Nursery in Drew County, where it had escaped from containers to surrounding work areas. Rollins (1993) records this infrequently collected cress from several eastern states, Mexico, and Costa Rica. Smith’s (1988) report of the species from Baxter County, Arkansas, was based on misidentification of material of *Sibara virginica* (Smith, pers. comm.). Thus we report it here as new to Arkansas. **Sundell 12,259** (NLU, UAM, UARK).

**Lepidium oblongum** Small. Although Rollins (1993) describes the range of this prostrate peppergrass as extending east to Arkansas, Smith (1988) has seen only a single specimen from Lonoke County. We here add Washington County to that short list, where it was growing in pavement cracks on the University of Arkansas campus in Fayetteville. **Sundell 12,264** (UAM, UARK). Collections at NLU document the species’ presence in Mississippi and Louisiana as well.

**Raphanus sativus** L. Radish escapes from cultivation rather frequently in the cooler parts of North America where it is common and abundant in ruderal habitats (Rollins 1993). Although it apparently does not persist as a weed in Arkansas, its occurrence should be noted. In Drew County, a few plants were scattered along a newly seeded road construction site. **Sundell 12,260** (UAM).

**Rorippa sylvestris** (L.) Besser. A collection from inside the Mississippi River levee in Chicot County reconfirms the presence of this weedy crucifer in Arkansas, previously reported for Crittenden County by Wilcox in 1973. **Sundell, Thomas, & Amason 10,952** (UAM).

**COMMELINACEAE**

**Murdannia keisak** (Hassk.) Hand.-Maz. This species has been known in Arkansas only from Tucker’s 1969 report for Conway County. In 1996, Thomas collected specimens on a shaded roadbank in nearby Pulaski County. **Thomas, Hunter, et al. 148,617** (NLU).

**Murdannia nudiflora** (L.) Brenan is an Asian introduction that has become rather common in disturbed sites on the Atlantic and Gulf Coastal Plain (Darwin et al. 1981, Wunderlin 1998). Thomas’s collection from Hempstead County in southern Arkansas, where plants dominated a shaded lawn, represents its first record in the state. **Thomas, Amason, et al. 155,570** (NLU).

**Tradescantia crassula** Link & Otto. Amason has observed this spiderwort thriving out of doors at his home in Union County for several decades. **Thomas, Sundell, Amason, et al. 156,721** (NLU).
CYPERACEAE
Cyperus cuspidatus Kunth. This little flat sedge occurs sporadically on the eastern Gulf Coastal Plain (Godfrey & Wooten 1979) and is recorded here from two Arkansas counties. Chicot Co.: Thomas 142,804 (NLU). Drew Co.: E. & J. Sundell 10,435 (UAM).

EUPHORBIACEAE
Phyllanthus pudens L.C. Wheeler and Phyllanthus tenellus Roxb. Both Phyllanthus pudens (E. & M. Sundell 12,037 [UAM]) and P. tenellus (E. & M. Sundell 12,038 [UAM]) were found thriving at Daylite Nursery in Drew County where they were escaping to gardens and waste areas from plant containers brought in from Louisiana and Texas. Although both of these species reproduce out of doors in Ouachita Parish in north Louisiana, there is no evidence that they will persist in the Arkansas flora. Phyllanthus is largely a tropical and subtropical group with only a single species, P. carolinensis, indigenous to the temperate regions of the southeastern United States. Nevertheless, the recent, successful invasion of southern Arkansas by P. urinaria, first reported by Smith for Union and Arkansas counties (Smith 1978-1980) and again by Sundell (1986) for additional localities, suggests that if transportation is available, other species of Phyllanthus might move north.

FABACEAE
Dalea gattingeri (Heller) Barneby. Known from cedar glades in Tennessee, Georgia, and Alabama (Isely 1990) and, more recently, from Howell County, Missouri, within 10 km of the Arkansas border (Summers et al. 1995), Dalea gattingeri was discovered by Logan in Fulton County, Arkansas, in June, 1997 (Logan 97-20 [UAM, UARK]) and subsequently recorded in the Arkansas Natural Heritage Commission data base from six additional localities in that county, all dolomite glades (Logan 98-34 [UAM]). The species resembles the widespread D. purpurea, differing in characters of the inflorescence and bracts.

Rhynchosia minima (L.) DC. This weedy vine was erroneously attributed to the Arkansas flora by Grear (1978) based on a specimen from Aransas (not “Arkansas”) National Wildlife Refuge in Aransas County, Texas (Smith 1988). Collections from the shores of the Mississippi River in Chicot County here confirm its presence in the state. Thomas, Sundell, & Amason 142,827 (NLU).

Trifolium striatum L. Arkansas is one of a few southeastern states where knotted clover, a European native, has had some success as an escape from cultivation (Isely 1990). We record here four new localities from three counties, nearly doubling its known presence in the state: Pulaski Co.: Thomas &

Vicia hirsuta (L.) S.F. Gray is a European native introduced to ruderal sites over much of the United States (Isely 1990). The species has two seeds per fruit and is often mistaken for the more common V. tetrasperma, with four seeds per fruit, and overlooked. In Arkansas, it has been documented only from Washington County in the northwest. We add two southern counties on the Louisiana border: Lafayette Co.: Thomas, Sundell, & Amason 156,549 (NLU). Union Co.: Thomas & Slaughter 104,337 (NLU, UAM).

GENTIANACEAE
Centaurium texense (Griseb.) Fern. Previous records of Texas centaury in Arkansas were limited to a few counties in the Ozark Mountains, however a recent collection from a blackland prairie site in Hempstead County in southwest Arkansas (Sundell 12,368 [UAM]) represents an important (though not unexpected) range extension within the state. Several species of calcareous soils exhibit a similar pattern in Arkansas, for example, Juniperus ashei Buchholz and Penstemon cobaea Nutt.

IRIDACEAE
Sisyrinchium exile Bickn. Based on Hornberger’s (1987) merging of Sisyrinchium exile with S. roslatum, Smith (1988) excluded the former taxon from the Arkansas flora. Hornberger developed her concepts of Sisyrinchium species in the southeastern United States “mostly from herbarium materials” (pers. comm.). However, differences in stature and flower color between those taxa that are immediately apparent in the field are obscure in dried specimens. We recommend reinstatement of S. exile based on the following voucher specimens: Ashley Co.: Thomas 92,053 (NLU, UAM). Bradley Co.: (where plants of S. exile were mixed with the larger and more common S. roslatum): Sundell & Amason 11,737 (UAM). Union Co.: Thomas 133,595 (NLU).

LAMIACEAE
Clinopodium gracile (Benth.) Kuntze. Thieret reported Clinopodium gracile as new to the United States in 1964 from a Louisiana collection. The species has subsequently spread through much of Louisiana and into southern Arkansas. Union Co.: Thomas & Amason 143,743 (NLU).

Scutellaria racemosa Pers. This recently introduced South American native is known from scattered localities on the Gulf Coastal Plain (Godfrey & Wooten 1981). Originally picked up in Arkansas in 1992 by Marie Locke during her work on the flora of Jefferson County (Smith, pers. comm.), its presence in Arkansas is documented here by three collections, all from gar-
dens, where the plants were likely contaminants in horticultural material imported from further south. **Drew Co.: Sundell 11,601 (UAM). Jefferson Co.: E. & M. Sundell 12,055 (UAM). Union Co.: Thomas & Amason 155,860 (NLU).** Time will tell whether this alien skullcap deserves resident status.

**LILIACEAE**

**Erythronium albidum** Nutt. Like bloodroot and toothwort, white trout lily in Arkansas is a common species of the Ozark and Ouachita highlands, recorded by Smith (1988) for only two counties on the West Gulf Coastal Plain. We here confirm his report for Arkansas County and add three stations from two other counties, all collections from richly wooded creek bottoms. **Arkansas Co.: Butcher s.n. (UAM). Cleveland Co.: Baker 20 (UAM). Drew Co.: McDougald & Lincoln 15, Barbee, Lamb, & Pagan 36 (UAM).**

**LYTHRACEAE**

**Cuphea carthagenensis** (Jacq.) J.F. Macb. was first collected in Arkansas in Ashley County by Thomas in 1985 and recorded by Hooks (1986). Like a number of others native to the Gulf Coastal Plain, the species is not unexpected in Arkansas’ southern counties. However, blooming from mid-summer to fall, when field activities are typically less intense, it is probably underrepresented in herbarium collections. We report it from a wet site in Lafayette County in southwest Arkansas (**Sundell, Thomas, & Amason 11,852 (UAM)**).

**Didiplis diandra** (Nutt. ex DC.) Wood. Water-purslane was collected at Felsenthal National Wildlife Refuge in Ashley County (**Sundell & McDonald 7623, 7630 [UAM]**), where it grew both on mud and submerged in temporarily flooded habitat. It was reported for the state (as **Peplis diandra** Nutt.) by Branner and Coville in 1891 but, to our knowledge, has never been documented.

**MAGNOLIACEAE**

**Magnolia macrophylla** Michx. According to Tucker (1976), big leaf magnolia grew as a native plant in Arkansas only in Clay County on Crowley’s Ridge in the northeast corner of the state, where a single grove had been reduced by natural hazards and local gardeners to a few small trees. Tucker predicted that the species would soon be extirpated at the site; two trees remained in 1981 (Figlar 1981); a survey of the site in 1995 failed to relocate the species (Meyer 1997). In 1994, Stuckey discovered a single tree of **Magnolia macrophylla** growing on a heavily wooded slope above a stream, in the vicinity of Mandeville near Texarkana in Miller County, in the southwest corner of Arkansas (**Stuckey s.n. [UAM, UARK]**). Wild populations of big leaf magnolia in northern Louisiana are the most likely seed source.
MORACEAE

Fatoua villosa (Thunb.) Nakai. Sundell reported this herbaceous Asiatic weed as new to Arkansas in 1986 based on a Drew County specimen. The species has persisted in southern Arkansas (our most recent collection was made in 1996), however, to our knowledge, it remains restricted to gardens and nurseries, growing vigorously to heights of three feet. Pulaski Co.: Sundell 10,440, E. & M. Sundell 12,049 (UAM). Union Co.: Sundell & Amason 7,461 (UAM), Thomas & Amason 107,891, 111,269 (NLU).

PAPAVERACEAE

Sanguinaria canadensis L. Bloodroot is documented from almost every county in the Ozark and Ouachita highlands of Arkansas (Smith 1988) but is unknown from most of the southeastern half of the state. The phenomenon of more northern, highland species pioneering on the Coastal Plain was discussed by Kral (1966), who noted that their random distribution on some but not all richly wooded stream terraces in north Louisiana could best be explained by impediments to dispersal rather than environmental limitations. We record bloodroot from the mesic hardwood terrace of Hunger Run Creek in Drew County where it grew with two other highland associates, Cardamine concatenata (Michx.) Schwartz and Viola pubescens Ait.: Sundell & Pagan 10,152 (UAM).

POACEAE

Eriochloa acuminata (J. Presl) Kunth var. acuminata is known in Arkansas at present from Conway and Mississippi Counties in the north central and northeastern parts of the state (Smith 1988). Recent records from five additional counties suggest that the species is probably undercollected. Desha Co.: Thomas, Sundell, & Amason 145,466 (NLU). Lafayette Co.: Thomas, Sundell, & Amason 150,961 (NLU). Lee Co.: Thomas 134,402 (NLU). Miller Co.: Thomas, Sundell, & Amason 151,107 (NLU). St. Francis Co.: Thomas 131,382 (NLU, UAM).

Rottboellia cochinchinensis (Lour.) Clayton. This noxious Asiatic grass has become naturalized in the West Indies, Florida and Louisiana (Allen 1992). It appeared previously in Arkansas in Ashley County (Smith 1988) and was rediscovered as a weed in a soybean field in 1996 in Arkansas County by Brad Koen of the Arkansas Cooperative Extension Service. Koen s.n. (NLU, UAM, UARK).

Setaria pumila (Poir.) Roem. & Schult. This distinctive, narrow-spiked, European bristle grass was first reported for North America (as S. pallide-fusca [Schum.] Stapf & Hubb.) from a Baton Rouge, Louisiana collection by Thieret and Allen in 1974. It is currently known in that state from twenty

PORTULACACEAE
*Portulaca umbraticola* Kunth. Orzell and Bridges (1987) reported this distinctive purslane from Monroe County in eastern Arkansas, and we here note its occurrence at a second locality, in Miller County, in the southwestern corner of the state. *Thomas, Sundell, & Amason 151.119* (NLU).

PRIMULACEAE

PSILOTACEAE
*Psilotum nudum* (L.) Beauv. Whisk-fern has been reported by Peck and Taylor (1995) for three counties in southwest Arkansas: Clark, Lafayette, and Union. Thomas recently discovered the species at Grassy Lake in Hempstead County (*Thomas, Amason, Stuckey, et al. 155,572* [NLU]), where seventeen plants were counted around the base of a large baldcypress tree. The species is native in north Louisiana; in the older part of North Monroe, for example, plants are common behind shrubbery that has not been replaced for several decades. All such plants are less than six inches tall and do not get bigger: they are the native diploid of Florida and the Gulf Coast, rather than the much larger greenhouse tetraploid. Based on size, Thomas’s Hempstead County plants were diploids and more likely to be natives at the northern edge of their range than waifs.

PTERIDACEAE
*Pteris multifida* Poir. in Lam. et al. Spider brake was first reported for Arkansas in 1941 from Hot Springs National Park in Garland County, where it has persisted to the present (Taylor 1984). We record a second locality for this naturalized fern. Union Co.: *Thomas & Amason 144,850* (NLU).

RANUNCULACEAE
*Trautvetteria caroliniensis* (Walt.) Vail. was discovered in Arkansas (on Brady Mountain in the Ouachita Highlands, Garland County) in the late 1980’s by John Pelton of the Arkansas Native Plant Society. Pelton communicated the discovery to Vernon Bates and Burt Pittman, who were then conducting a floristic inventory of the Ouachita National Forest. Specimens
collected at that time have never been cited in publication as documentation of the population (Bates & Pittman, pers. comm.), however, it is likely that the single Arkansas population of *Trantvetteria* mapped in *Flora of North America* (Parfitt 1997) is the same. The monotypic genus is disjunct in North America and eastern Asia, with North American populations of the eastern and western forests recognized (rather arbitrarily according to Parfitt) at the varietal level. Variety *carolinensis* of the eastern United States was previously known to occur west of the Mississippi River only at several stations in Shannon County, Missouri (Steyermark 1963). Arkansas plants were growing in abundance on a richly wooded seepage slope with *Smilax laurifolia*, *Viburnum nudum*, *Osmunda cinnamomea*, and *O. regalis* under a closed canopy of mixed hardwoods and pine. *Sundell 10,473 (UAM, UARK), 10,585 (UAM).*

**ROSACEAE**

*Pyrus calleryana* Dcne. When Sundell reported callery pear in 1986 as new to Arkansas from Drew and Ashley Counties, the species was already widespread on the state’s Coastal Plain as an escape from cultivation to early successional habitats. The stout, thorny trees have proven to be a nuisance to pine reforestation practices. We here document its status as a wild plant in six additional counties, including two upland sites in the Ouachita Mountains. *Calhoun Co.: Sundell, Amason, & Eiberidge 7,888 (UAM). Cleveland Co.: Lunsford 12 (UAM). Hempstead Co.: Thomas, Sundell, & Amason 139,840 (NLU). Garland Co.: Sundell 10,650 (UAM, UARK). Miller Co.: Thomas, Sundell, & Amason 151,152 (NLU). Montgomery Co.: E. & M. Sundell 12,357 (UAM). In addition, specimens at HSU document callery pear as adventive in Clark County (Dan Marsh, pers. comm.).*

**SOLANACEAE**

*Datura ferox* L. (*D. quercifolia* Kunth). This previously unreported species of thorn-apple appeared in a soybean field in Clay County. It is a southwestern species (Correll & Johnston 1970) probably brought into our area with agricultural seed and not likely to persist. (Thomas and McCoy reported it from East Carroll Parish, Louisiana, in 1982.) Appreciation is expressed to Andy Vangilder and John Boyd of the Arkansas Cooperative Extension Service for sending material (*Vangilder s.n.*) to UAM.

**VALERIANACEAE**

*Valerianella locusta* (L.) Latterade was reported for Arkansas by Demaree (1943) and Johnson (1971) but excluded by Smith (1988), who suggested that Arkansas reports were probably based on cultivated material. It is re-instituted in the Arkansas flora with collections from a roadside in Sharp County, where plants grew in abundance on mounds of soil (*Sundell & Amason 12,074 (UAM, UARK)), and a graveyard in Howard County (*Lawson 1507 [NLU]).*
VIOLACEAE

Hybanthus concolor (T.F. Forst.) Spreng. In Arkansas, green violet is well-documented from the Ouachita and Ozark highlands and from Crowly’s Ridge. Collections from the wooded shores of Grassy Lake in Hempstead County mark its presence on the Gulf Coastal Plain. *Sundell, Amason, & Stuckey* 10,874 (UAM), *Thomas & Amason* 139,733, 155,576 (NLU).

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REFERENCES


BOOK REVIEW


This book is a translation, originally published in Spanish as, Ordenes y decálogos en la Selva Central, in 1995. Many thanks should go to the Smithsonian Tropical Research Institute, and especially Ira Rubinoff, for encouraging its translation.

The book covers the Selva Central region of Peru, also called the “central montaña,” composed of portions from the western portions of: Oxapampa Province, in the Department of Pasco, and Chanchamayo and Satipo Provinces in the Department of Junín. This is one of the two most biologically interesting parts of the country because of its myriad of habitat types, from high altitude “jalca” on sandstone containing Guayana Highland floristic elements, to middle elevation “ceja de selva," largely comprised of cloud and montane forest with many endemic species. The book is largely a socio-economic history of the region, but it also contains extremely valuable information on the ecological characteristics, the effects of agropastoral and logging activities, and other aspects related to land tenure, including the unique “minifundios.”

The book is divided in three parts: genesis of a regional space, the colonist economy, and indigenous integration. While this kind of book may not be a normal acquisition for the everyday monographer or floristian, anyone concerned with long-term conservation of any tropical area is well-served by reading this. I have found that to establish long-term studies, it is critical to understand the evolution of the local populations, (be they indigenous or otherwise) so that our in-country counterparts might better translate our concerns for basic science into information for the applied world of the local residents. The most important part for me was the second one, especially chapters four, five and six, where the land tenure systems, patterns and intensity of land use, and finally, economic articulation and environmental degradation themes are discussed, respectively. Having worked in Peru since 1990, reading of this book gave me a new appreciation for the complexities of managing the biotic resources of the region. While several portions of the “conclusions” chapter are now outdated, and support a particular political point of view, the chapters of the second part certainly make this book a worthwhile investment for any botanist working in the Andes, and especially, in Amazonia. This book is not only appropriate for acquisition by botanical libraries, but also for ethnobotanists, and for anyone assisting in the establishment of Integrated Conservation and Development areas.—JOHN J. PIPOLY III.
NOTEWORTHY RECORDS OF MISSISSIPPI VASCULAR PLANTS

BRUCE A. SORRIE
160 West Rhode Island Ave.
Southern Pines, NC 28378, U.S.A.

STEVE W. LEONARD
CSTS-ENV. Bldg. 6678
Camp Shelby, MS 39407-5500, U.S.A.

ABSTRACT

Herbarium study and field exploration, primarily in the Longleaf Pine and Coastal Pine Meadow regions, have yielded the following new species to Mississippi: Chamaecrista derrigiana, Cladium mariscoides, Dichanthelium fusciforme, Dryopteris ludoviciana, Eleocharis elongata, E. melanocarpa, E. robbinii, Isoetes lanistamenis, Lobelia boykinii, Mitreola angustifolia, Rhynchospora decurrens, R. globularis var. pinetorum, R. harperi, Rhynchospora scirpoide, Sagittaria isetiformis, Scleria reticularis sensu stricto, Spiranthus brevilabiis var. floridanus, Utricularia olivacea. The following are previously known from the state, but are rarely collected, or represent significant range extensions within Mississippi: Agrimonia incisa, Aristida condensata, A. simpliciflora, A. tuberculosa, Barmannia biflora, Calopogon multiflorus, Codorachis cylindrica, Dichanthelium erectifolium, Elyonurus tripacoides, Gordonia lasianthus, Isocetes melanopoda, Juncus gymnocarpus, Marshallia trinervia, Myriophyllum laxum, Parnassia grandifolia, Polygala leptostrachys, Potamogeton epiphyllus, Rhynchospora curtissii, R. fasicularis var. distans, R. nitens, R. tracyi, Ruellia pedunculata ssp. pinetorum, Sorghastrum apalachicolens, Stylosma aquatica, S. pickeringii, Tridens carolinianus.

RESUMEN

Los estudios de herbario y exploraciones de campo en las zonas de pino palustre y de prados costeros con pinos, han dado las siguientes especies nuevas para Mississippi: Chamaecrista derrigiana, Cladium mariscoides, Dichanthelium fusciforme, Dryopteris ludoviciana, Eleocharis elongata, E. melanocarpa, E. robbinii, Isoetes lanistamenis, Lobelia boykinii, Mitreola angustifolia, Rhynchospora decurrens, R. globularis var. pinetorum, R. harperi, Rhynchospora scirpoide, Sagittaria isetiformis, Scleria reticularis sensu stricto, Spiranthus brevilabiis var. floridanus, Utricularia olivacea. Las siguientes se conocen previamente del estado, pero se colectan raramente o representan una ampliación significativa de su area en Mississippi: Agrimonia incisa, Aristida condensata, A. simpliciflora, A. tuberculosa, Barmannia biflora, Calopogon multiflorus, Codorachis cylindrica, Dichanthelium erectifolium, Elyonurus tripacoides, Gordonia lasianthus, Isocetes melanopoda, Juncus gymnocarpus, Marshallia trinervia, Myriophyllum laxum, Parnassia grandifolia, Polygala leptostrachys, Potamogeton epiphyllus, Rhynchospora curtissii, R. fasicularis var. distans, R. nitens, R. tracyi, Ruellia pedunculata ssp. pinetorum, Sorghastrum apalachicolens, Stylosma aquatica, S. pickeringii, Tridens carolinianus.

INTRODUCTION

Field work was conducted during 1995–98, primarily in a ten county area of southeastern Mississippi (Forrest, George, Greene, Hancock, Harrison,
Jackson, Lamar, Pearl River, Perry, and Stone counties). From 1995–96 work was carried out by Bruce A. Sorrie (BAS) under a contract from the United States Fish and Wildlife Service, Endangered Species, to survey seepage bogs and wet savanna habitats of southern Alabama and Mississippi for selected Federal Species of Concern (formerly C2 candidates). In 1997, a rare species inventory was conducted by BAS on the 22,000+ acre University of Mississippi Forest Lands in George, Jackson, and Stone Counties, under a contract from The Nature Conservancy, Mississippi Field Office. From 1997-98 work was carried out by BAS under a contract from The Nature Conservancy, Southeast Region Office, to survey remaining high quality longleaf pine (Pinus palustris P. Miller) communities.

In 1993 the Mississippi Military Department signed a memorandum of agreement with the Mississippi Department of Wildlife, Fisheries, and Parks for a biological inventory of Camp Shelby Training Site (CSTS). Camp Shelby is located principally in Forrest and Perry Counties, and covers 134,000 acres, mostly leased from the DeSoto National Forest. The Mississippi Museum of Natural Science and the state’s Natural Heritage Program hired contractors and coordinated field work at CSTS. From 1995-98 Steve W. Leonard (SWL) was field botanist on the inventory team.

Southeastern Mississippi lies within the Longleaf Pine and Coastal Pine Meadows Physiographic Regions, as defined by Lowe (1921). Although supporting a wide variety of habitat types, varying from xeric maritime dune scrub to salt marshes to mixed mesophytic ravine forests, the area is most notable for its extensive pine forests, pine savannas, and seepage bogs. Southward, and in wet sites northward, slash pine (Pinus elliottii Engelmann) is dominant; while northward, and in mesic to dry sites southward, longleaf pine is dominant. Mesic and moist sites usually support a mixture of the two. Beneath the pines is a fire-adapted, species-rich herbaceous layer dominated by grasses, composites, and legumes. Wet sites usually also support a dense, ericaceous shrub layer. North of the six southernmost counties, loblolly pine (Pinus taeda L.), shortleaf pine (Pinus echinata P. Miller), and to a lesser extent spruce pine (Pinus glabra Walter) become important components as the topography becomes more rolling and dissected.

The dramatic loss of the longleaf pine ecosystem over 97% of its former range has been documented by Ware et al. (1993) and Frost (1993). Although similar losses occurred in Mississippi, much of the southeastern portion of the state remains in a relatively natural condition. This is due to the presence of large public lands and the implementation of recurring fire management. The De Soto National Forest (which includes Camp Shelby within its borders), the Mississippi Sandhill Crane National Wildlife Refuge, and the University of Mississippi Forest Lands together form one of the largest and most ecologically significant blocks of longleaf pine ecosystem remaining (222,000
knowledge of the flora of Mississippi is less well known than most other southeastern states (Bryson & Carter 1994). Published or draft atlases of vascular flora exist for Arkansas, Florida, Georgia, Louisiana, South Carolina, and Tennessee. Major revisions of state floras are well advanced in the Carolinas and Virginia (combined) and Texas. In Mississippi, and also in Alabama, a paucity of historical collecting coupled with a diverse and biogeographically complex flora has hindered the publication of modern floristic manuals. Lowe (1921), Small (1933), and Radford, Ahles, and Bell (1968) remain as basic references for Mississippi plants. The Flora of Mississippi Project was begun in the 1960s (Jones 1974) and has resulted in treatments of a number of families and genera [see references cited by Stevens (1991) and Bryson et al. (1996)]. Numerous county floras have added greatly to our knowledge of plant distribution (see Stevens 1991 for most titles). Currently, the PLANTS database provides a comprehensive list of taxa documented from the state (USDA, NRCS 1995). This database admits species based on vouched specimens, monographic treatments, and literature reports.

In this paper, plants are listed alphabetically by genus and species. Nomenclature follows Karetz (1994) unless noted otherwise. Herbarium abbreviations follow Holmgren et al. (1990), except for bas, ctb, MMNS, and swl (pers. herb. Bruce A. Sorrie, pers. herb. Charles T. Bryson, herbarium of the Mississippi Museum of Natural Science in Jackson, and pers. herb. Steve W. Leonard). Historical specimen data was derived from the Mississippi Natural Heritage Program database (MSNHP) and from rare species files developed by BAS. Specimen label data was transcribed exactly as the collector wrote it, except that lists of associated species have been omitted. For some taxa, where we have documented many current populations, only a few representative collections are cited. The abbreviation FS stands for Forest Service Road.

**Noteeworthy Collections**

*Agrimonia incisa* Torrey & Gray (Rosaceae). Previous Mississippi collections are from Forrest, George, Harrison, and Simpson Counties (MSNHP); to these we add Perry and Stone Counties. Once considered a candidate for listing by the US Fish and Wildlife Service, incised groove-bur has a spotty distribution from South Carolina to central Florida to eastern Texas. Camp Shelby, straddling Forrest and Perry Counties, supports ten discreet occurrences. Habitats vary from mesic longleaf pine woodland to entrances to gopher tortoise burrows in dry pine-oak woodland, pine plantations, and cemeteries; but it is most abundant on roadside embankments. MacRoberts and MacRoberts (1997) cite similar habitats for *Agrimonia incisa* in Texas.
and suggest that fire suppression and subsequent habitat alteration have caused a widespread decline in this species.


\textit{Aristida condensata} Chapman (Poaceae). Lowe (1921) does not include this species of dry to xeric sandhills, but PLANTS does. Mississippi populations mark the western edge the species’ range.


\textit{Aristida simpliciflora} Chapman (Poaceae). This rare but easily overlooked grass is known from less than 25 counties range-wide (central Florida to southern Mississippi). Rogers (1977) collected it from the Ragland Hills in Forrest County; the following are the remaining collections known to us.


\textit{Aristida tuberculosa} Nuttall (Poaceae). Lowe (1921) does not include this species of semi-stable dunes and xeric sandhills, but PLANTS does. \textit{Aristida tuberculosa} has a unique distribution pattern: upper Mississippi River and immediate tributaries; about the head of lake Michigan; coastal New Hampshire to Delmarva Peninsula; fall-line sandhills of the Carolinas and Georgia; plus scattered locations on the coastal plain from South Carolina to Florida and Louisiana. Some of these latter may represent adventive populations in disturbed soils and fallow fields.

Burmannia biflora L. (Burmanniaceae). This endemic to the Atlantic and Gulf Coastal Plains has rarely been collected in Mississippi. Jones (1976) lists four counties, but the specimen that he saw from Jackson County actually is Apteria aphylla [Channell 1661 (MISS)]. Jones also lists Pearl River Co., but we have not yet located a voucher. The primary habitat in Mississippi is seasonally ponded depressions and, occasionally, seepage bogs.


Calopogon multiflorus Lindley (Orchidaceae). Lowe and PLANTS do not list C. multiflorus for Mississippi, but Luer (1972) maps it there. This essentially Floridian orchid has rarely been collected outside of that state.

Voucher specimens: Hancock Co.: three mi south of Necaise, 5 Apr 1967, S.B. Jones, Jr. 11489 (MISS). Jackson Co.: Ocean Springs, 4 Apr 1888, F.S. Earle s.n. (AMES, SIU); Ocean Springs, Apr 1893, J. Skehan 206 (BRIT); two mi W of Alabama state line, 6 May 1966, R.D. Sattkus 66-2-11 (NO); circa 1 mi W of MS/AL line between I-10 and US 90 on Franklin Creek Road, recently burned savanna, rare, 20 Apr 1984, C. Norquist 1774 (IBE); ca. 6.3 mi E of Moss Point, plants scattered in pine savanna, 15 Apr 1988, M.W. Morris 3076 et al (IBE).

Chamaecrista deeringiana (Small & Pennell) Macbride (Fabaceae). Reported herewith new to Mississippi. The following establishes a new western range limit for this essentially Floridian species.

Voucher specimen: Harrison Co.: Deer Island, W end, live oak woods over sand or shell, 29 Aug 1977, M.B. Brooks 432 with S. McDaniel (IBE).

Cladium mariscoides (Muhl.) Torrey (Cyperaceae). Reported herewith new to Mississippi. This species was not included for Mississippi by Bridges et al. (1993). This species occurs primarily within the southern portion of the glaciated region of eastern North America, with scattered occurrences in most southeastern states.

Voucher specimens: Jackson Co.: swamp ponds, Ocean Springs, 19 Aug 1953, D. Denairee 33953 (GH); pine meadows between hwy. and RR, about halfway between Pascagoula and Fontainbleu [sic], 22 Aug 1962, R.M. Harper 4530 (GA, GH); abundant on boggy margin of pond on N side of John Smith Road, just W of Huey Davis Road, 26 Sep 1996, B.A. Sorrie 9066 with R.J. LeBlond (MMNS, NCU); abundant in open wet slash pine flatwoods on E side of Trent Lott Airport, N of Sarracenia Road, 11 Nov 1997, B.A. Sorrie 9633 (IBE, NCU).

Coelorachis cylindrica (Michaux) Nash (Poaceae). Although there are numerous records for Arkansas and Louisiana, this grass seems rare east of the Mississippi River. PLANTS lists this grass for the state, but the following are the only Mississippi specimens we are aware of.
Voucher specimens: Forrest Co.: 1/2 to 1 mi N of Petal, between N Railroad Ss. and hwy. 11, several plants at this site, 23 Jul 1971, K.E. Rogers 6720 (NCU). Monroe Co.: just N of Lowndes County, where US 45 crosses Buttahatchee River, on roadside bank, 30 Jun 1991, J. MacDonald 2771 (IBE).

Dichanthelium ericifolium (Nash) Gould & Clark (Poaceae). Lelong (1986) reports this grass only from Jackson County, the western range limit of the species. It is apparently rare, for we have not yet encountered a Mississippi specimen in searches of over a dozen southeastern herbaria. Once learned, Dichanthelium ericifolium is easy to distinguish from other congeners, and in Mississippi is restricted to seasonally ponded cypress depressions, usually accompanied by D. wrightianum, Polygala cymosa, Sabatia bartramii, Ilex myrtifolia, and Hypericum myrtifolium.


Dichanthelium fusiforme (Hitchcock) Harvill (Poaceae). Reported here with new to Mississippi. This combination was made by Harvill (1977), but is not included in synonymy under D. acicularis by Kartesz (1994). This plant’s taxonomic status has long been in question, and recent authors have treated it as D. acicularis var. ramosum (Grisebach) Davidse (Davidse & Pohl 1992) or Panicum aciculare var. arenicoloides (Ashe) Beetle (Zuloaga et al. 1993). Lelong (1986) synonymized Panicum fusiforme under a related species, P. angustifolium Elliott. However, the very long (3.0 mm) fusiform spikelets are strikingly different from the blunt spikelets of D. acicularis and D. (Panicum) angustifolium, and so we will use Harvill’s combination until a comprehensive revision is undertaken. The following is the only specimen we have seen for Mississippi.

Voucher specimen: Jackson Co.: thickets near the coast, Ocean Springs, 1952, D. Damon 32226 (GH). The specimen was originally determined to be Panicum angustifolium, but spikelets are 3.0 mm long and fusiform.

Dryopteris ludoviciana (Kunze) Small (Dryopteridaceae). Reported here with new to Mississippi. This coastal plain endemic was not included for Mississippi by Evans (1978) or by Montgomery and Wagner (1993).

Voucher specimens: Perry Co.: Camp Shelby, about 100 plants on W side of Denham Creek, 2 air mi southwest of New Augusta, 14 Sep 1995, S.W. Leonard 9082 (MMNS).

Eleocharis elongata Chapman (Cyperaceae). Reported here with new to Mississippi. Although ranging from North Carolina to Florida and Texas (and scattered in the neotropics), this species is not listed by Lowe (1921) or PLANTS. This sedge usually inhabits seasonally to permanently ponded
depressions. The rhizomes are unusually well developed in the Ocean Springs specimen, and the habitat is also unusual, but the specimen appears to be correctly identified, with slender spikes as wide as the culms and with red-margined scales.


Eleocharis melanocarpa Torrey (Cyperaceae). Reported herewith new to Mississippi. This species is not listed by Lowe (1921) or PLANTS. Unlike other Mississippi species, the tips of the culms of E. melanocarpa often arch over and root in the moist or wet sandy substrate, thus forming a dense tangle. This sedge ranges from Massachusetts to Florida and Mississippi, disjunct to eastern Texas, southern Michigan, and northern Indiana.

Voucher specimen: Perry Co.: Camp Shelby, abundant in nearly dry gum pond behind Mars Hill Church, 23 Apr 1995, J. MacDonald 8469 with A. Leidolf (IBE); same place, 9 Oct 1996, S.W. Leonard 9656 with J. Moore and J. MacDonald (FSU, MMNS).

Eleocharis robbinsii Oakes (Cyperaceae). Reported herewith new to Mississippi. Although known from the state for over twenty-five years, this is the first published documentation. Mississippi marks the western range limit for the species. Plants usually form dense beds in shallow gum ponds with fluctuating water levels; two such ponds on Camp Shelby support populations. In contrast to E. elongata, the scales of E. robbinsii are green, often with a translucent scarious margin, and without any red coloring. Statements to the contrary in Godfrey & Wooten (1979) were based on misidentified specimens. In addition, scale length in E. elongata is 3.5-4.5 mm, in E. robbinsii 5.5-7.0 mm.

Voucher specimens: Forrest Co.: Hwy. 49 about 3-5 mi N of Stone Co. line, shallow pond west of highway across fence, 30 Sep 1970, K.E. Rogers 4658-B (NCU); same place but actual distance is 1.2 mi N of county line, 19 Jun 1998, B.A. Sorrie 9780 (GH, IBE, MMNS); vicinity of Maxie, edge of boggy area, 5 Jul 1971, K.E. Rogers 6662-B (NCU). Lamar Co.: about 3 mi W of Purvis, abundant, 29 Aug 1973, K.E. Rogers 9225 (NCU); same place [Mossy Pond], 1 Sep 1998, B.A. Sorrie 9931 with S.W. Leonard (GH, bas). Perry Co.: Camp Shelby, very abundant around edge of gum pond behind Mars Hill Church, 20 Sep 1994, J. MacDonald 7728 with D. Wyrick (IBE); same place, 11 Sep 1995, S.W. Leonard 9059 (FSU, MMNS).

Elyoneurus tripsacooides Humboldt & Bonpland ex Willd. (Poaceae). This primarily neotropical species is not listed by Lowe (1921), but is included in Hitchcock (1950) for Mississippi. That report may be based on a duplicate of the following. In the United States it is also known from Florida and southern Georgia.
Voucher specimens: **Harrison Co.:** Biloxi, 21 Aug 1898, S.A. Tracy 4594 (NCU).

**Gordonia lasianthus** (L.) Ellis (Theaceae). Lowe (1921) cites loblolly bay only from Bay St. Louis in Hancock County. From then until 1994, only 12 sites were documented in George, Perry, and Stone Counties (MSNHP). Extensive searches on Camp Shelby have revealed it to be far more common—25 occurrences have been located there. All of these populations consist of small numbers of plants, primarily in seepage of toe slopes and along streams where organic soils are present. Mississippi marks the species' western range limit.


**Isoetes louisianensis** Thieret (Isoetaceae). Reported herewith new to Mississippi. This quillwort was described from southeastern Louisiana by Landry and Thieret (1973). Prior to 1996, *I. louisianensis* was known from only eight populations in Washington and St. Tammany Parishes and was listed as endangered by the US Fish and Wildlife Service. In 1996 we independently collected unknown quillworts in the De Soto NF and Camp Shelby, which were verified as *I. louisianensis* by W. Carl Taylor and Neil Luebke of the Milwaukee Public Museum. Subsequently, an intensive search was conducted throughout the De Soto NF by Forest Service personnel and SWL, and elsewhere by SWL. To date, over 50 populations have been found in ten Mississippi counties. This species normally inhabits intermittent streams and stream edges, scour channels, and floodplain depressions beneath a canopy of *Quercus laurifolia* Michx., *Nyssa biflora* Walter, *Acer rubrum* L., and *Cyrilla racemiflora* L. Soils are mineral in content. Plants initiate growth during winter months and produce mature megaspores from April to July. Around mid-July, streams dry up and plants senesce and disappear until rains resume in November. In addition to the following, Louisiana quillwort has been vouchedered by SWL from Hancock, Harrison, Pearl River, and Stone Counties.

Isoetes melanopoda Gay & Durieu (Isoetaceae). Taylor et al. (1993) include Mississippi in the range, but Evans (1978) does not and we have seen no earlier collections than those below. This quillwort grows in moist mixed hardwoods and in ephemeral streams, generally north of the range of *I. louisianensis*.


Juncus gymnocarpus Coville (Juncaceae). This rush is not listed by Lowe (1921) nor by Pullen et al. (1968). Rogers (1973) is apparently the first to report this rush from the state. The geographical range consists of three disjunct areas: montane eastern Pennsylvania; montane North Carolina, South Carolina, and Tennessee; and the coastal plain of panhandle Florida, southern Alabama, and southern Mississippi. The long disjunction between the Appalachian Mountains and the Gulf Coastal Plain suggests the possibility of taxonomically different entities, but R. Kral has seen specimens from Camp Shelby and concurs with our identification (pers. comm. to SWL 1996). To date sixteen occurrences have been documented from Camp Shelby, and four from UMISS Forest Lands. In addition to the following, McDaniel (1987) reports it from Lamar County.

Voucher specimens: Forrest Co.: hwy. 98 a few mi SE of junction with hwy. 49, numerous at edge of farm pond, 26 Oct 1972, K.E. Rogers 8841-E (MISSA); large colony in black gum-sweetbay-pine swamp forest along Poplar Creek, Camp Shelby, 26 Sep 1996, S.W. Leonard 9649 (MMNS). Perry Co.: occasional along West Fork of Denham Creek, Camp Shelby, 18 Sep 1995, S.W. Leonard 9088 (MMNS); locally abundant on E side of Sweetwater Creek, N of FS 305-F1, Camp Shelby, 16 Apr 1996, S.W. Leonard 9428 (NCU). Stone Co.: wet seepage in mesic hardwood-loblolly pine ravine by Long Branch, N of Wire Road, Univ. Miss. Forest Lands, 12 Jun 1997, B.A. Sorrie 9278 (GH, MMNS).

Lobelia boykinii Torrey & Gray ex A. DC. (Campanulaceae). Reported herewith new to Mississippi, disjunct from Houston County, Alabama, and Okaloosa County, Florida. This coastal plain endemic is most numerous in Georgia and the Carolinas, with a few populations in New Jersey, Delaware, the Florida panhandle, and Alabama.

Voucher specimens: Jackson Co.: Cottonmouth Savanna, N side of Frank Snell Road, E of route 613, locally numerous in pond cypress depressions in slash pine flatwoods, 5 Jun 1996, 10 Nov 1997, and 19 Jun 1998, B.A. Sorrie 8871 (GH, NCU, MMNS), 9785 (FSU, IBE); uncommon in disturbed pond cypress depression at junction of Nut Bank Road and connector to route 613, about 3.5 mi SSW of Big Point village, 2 Oct 1997, B.A. Sorrie 9587 with R.J. LeBlond (bas).
Marshallia trinervia (Walter) Trelease (Asteraceae). This striking member of the genus was brought to the attention of SWL by Dr. Sam Rosso of the University of Southern Mississippi, who reported a station near the Lamar/ Marion County line. Despite knowledge of its presence in Mississippi for nearly 150 years, M. trinervia has traditionally been considered rare in the state. Lowe (1921) lists it only from Greene and Tishomingo Counties, but Channell (1957) cites collections from Clarke, Forrest, Greene, Perry, and Scott Counties. Watson and Estes (1990) add Covington, Lee, and Pearl River Counties. At the University of North Carolina herbarium (NCU) there are specimens from seven sites in Covington, Forrest, and Pearl River Counties. Thus, it would seem that this species is not as rare in Mississippi as previously thought. Primarily a plant of creek banks, wooded slopes, and limestone cliffs from central Alabama and western Georgia to central Tennessee, recent collections suggest that Marshallia trinervia has exploited moist roadsides in the Gulf Coastal Plain. We here report stations not previously documented.

Voucher specimens: Forrest Co.: Hwy. 11 and 49 cloverleaf, cleared area, 2 Jun 1965, S.B. Jones, Jr. 2933 (NCU); about 1/2 mi S of Hattiesburg, edge of low pine woods, 24 Aug 1969, K.E. Rogers 13500-C (NCU). Lamar Co.: moist roadside, 6.0 mi S of US 98 on W side of MS Hwy. 89 and 0.4 mi S of junction of WPA Road, N of Purvis, 22 Jun 1997, S.W. Leonard 9833 (MMNS). Pearl River Co.: 4.4 mi S of Derby on US 11, roadsides and ditches, 30 May 1976, D.E. Boufford 18652 et al (NCU); wet ditches, Hwy. 11, 1 mi N of McNeill, 2 Jun 1977, C.E. Reed 103625 (NCU); low area on roadside of Hwy. 26, about 15 mi E of Poplarville, 30 May 1976, G. Nesom s.n. (NCU) [this location probably is in Stone Co.]. Perry/Forrest Co.: Camp Shelby, edge of shrubs along small streams on E and W sides of Poplar Creek, at county line, 22 May 1998, S.W. Leonard 99399 (MMNS).


Myriophyllum laxum Shurtleworth ex Chapman (Haloragaceae). Neither Lowe (1921) nor Jones (1975) includes it for Mississippi, but PLANTS does. Mississippi marks the species’ western range limit. This southeastern United States endemic is often misidentified as M. pinnatum (Walter) BSP. or M. heterophyllum Michaux.

Voucher specimens: Jackson Co.: submersed aquatic in pond, about 7 mi NNE of Ocean
Parnassia grandifolia DC. (Saxifragaceae). Large-leaved grass-of-Parnassus is known from the state only from the southeastern quarter, where first collected in the late nineteenth century. Eakes (1989) cited two populations, in Forrest and Stone Counties. The Camp Shelby inventory has verified 17 occurrences, plus an additional station on private property. Populations occur in seepage communities at the base of slopes, in clayey soil.

Voucher specimens: Pearl River Co.: at least 100 plants in boggy drainage on N side of Hillsdale Road, 3.7 mi W of 1-59, or 0.5 mi SE of US 11, between Poplarville and Lumberton, 27 Apr 1996, S.W. Leonard 9447 (MMNS). Perry Co.: several colonies from a few plants to 400 or more, in seepages that drain into Dickey Creek, Camp Shelby, SE of New Augusta, 12 Nov 1996, S.W. Leonard 9691 (MMNS).

Polygala leptostachys Shuttleworth (Polygalaceae). Lowe (1921) only lists one record, from Harrison County. This species ranges from central Florida to southwestern Georgia and southeastern Mississippi. Polygala leptostachys is even more slender than its close relative, P. verticillata L., and the difficulty of detecting it may explain the paucity of herbarium collections range-wide.


Potamogeton ephrydus Raf. (Potamogetonaceae). Jones (1974) omits this species from Mississippi, but PLANTS includes it. Hellquist and Crow (1980) specifically state “northern Mississippi” in their range description. In any event, this pondweed is rarely collected in the state. The junior author found it in dense beds at several road crossings of a gravelly, fast-flowing stream in Lawrence County. In protected pools along the stream, the upper leaves have weakly expanded blades to 5 mm wide, but none floating. This site and those in two nearby Louisiana parishes (Thomas and Allen 1993), mark the southernmost locations for the species.

Voucher specimen: Lawrence Co.: swiftly flowing water of Tilton Creek at SW end of Tilton Road, about 0.4 mi from Sauls Valley Church; plants in clear water from a few cm deep to 0.5 m, 28 Dec 1996, S.W. Leonard 9736 (IBE, MMNS).

Rhynchospora curtissii Britton (Cyperaceae). Kral (1996) maps only Jackson County for Mississippi. This rare sedge is an East Gulf Coastal Plain endemic, known from fifteen counties range-wide.

Voucher specimens: Hancock Co.: 3.5 mi NE of Santa Rosa, just N of Dead Tiger Creek, clearcut adjacent to hardwood hammock, clay soil, 25 May 1981, S. McDonald 25108 (FLAS). This specimen was originally determined as R. phleoida (Kukenthal) Gale. Jackson Co.:
Rhynchospora decurrens Chapman (Cyperaceae). Reported herewith new to Mississippi. This is a seldom collected species, although ranging from southeastern North Carolina to south Florida and Louisiana. Gale (1944) cites no Mississippi collections and PLANTS omits it. *Rhynchospora decurrens* inhabits temporarily flooded depressions in swamps, often with *Taxodium* and *Nyssa*.

Voucher specimen: **Pearl River Co.**: 2 mi W of Picayune, low woods, 9 Jun 1965, F.H. Sargent 8629 (DUKE, VDB).

Rhynchospora fascicularis (Michaux) Vahl var. distans (Chapman) Small (Cyperaceae). Gale (1944) cites one Mississippi collection without specific location. This is still a poorly known and seldom collected taxon, despite distinctive achene morphology. It ranges from southeastern Virginia to south Florida to southeastern Mississippi; disjunct to Bermuda.


Rhynchospora globularis (Chapman) Small var. pinetorum (Small) Gale (Cyperaceae). Reported herewith new to Mississippi. Despite ample differences from other varieties of *R. globularis*, most authors have not recognized var. *pinetorum*. The achene characters noted by Godfrey and Wooten (1979) and Weakley (in prep.) are diagnostic. *Rhynchospora globularis* var. *pinetorum* ranges from North Carolina to southern Florida and eastern Texas; also western Cuba and Jamaica. This sedge often occurs on calcareous substrates.

Voucher specimen: **Jackson Co.**: low wet areas, Fountainbleau Point, P.O. Ocean Springs, 29 Apr 1954, D. Doneeare 35016 (GH).

Rhynchospora harperi Small (Cyperaceae). Reported herewith new to Mississippi. Kral (1996), and LeBlond (1997) do not credit this species to the state. Knowledge of the distribution of this species has increased dramatically during the past several years (LeBlond 1997). This sedge occurs exclusively in seasonally ponded depressions on the Atlantic and Gulf Coastal Plains.

Voucher specimens: **Jackson Co.**: Cottonmouth Savanna, N side of Frank Snell Road, E of route 613, common in pond cypress-slash pine depression in flatwoods, 10 Nov 1997, B.A. Sorré 9623 (GH, MMNS, NCU); same place, 19 Jun 1998, B.A. Sorré 9786 (ISU, IBE, VDB).

Rhynchospora nitens (Vahl) Gray (Cyperaceae). Lowe (1921) and PLANTS
do not list it for Mississippi, but there are specimens at VDB from Forrest and Jackson Counties (Kral pers. comm.). *Rhynchospora nitens* is widespread on the southeastern United States coastal plain, probably overlooked in Mississippi.


*Rhynchospora scirpoides* (Torrey) Gray (Cyperaceae). Reported herewith new to Mississippi. Like *R. nitens*, this species inhabits periodically inundated sites, but is much rarer in the southeastern United States. Lowe (1921) lists *Psilocarya corymbiformis* Bentham, a synonym of *R. scirpoides*, from Horn Island, but the specimen at MISSA is actually *R. nitens*.


*Rhynchospora tracyi* Britton (Cyperaceae). Lowe (1921) reports this sedge on the authority of Small, but gives no localities. The following will serve to document its presence in Mississippi.

Voucher specimens: Jackson Co.: cypress pond between Ocean Springs and Gautier, 28 Jul 1955, R.K. Godfrey 53700 with R.B. Chauvell (FSU, GH); hwy. 90 just W of Ala. line, wet soil at edge of sawgrass marsh, 26 Sep 1970, K.E. Rogers 4612-A (SMU), 4612-B (NCU); same place, in shallow water, no date, K.E. Rogers 4627-A (NCU); edge of *Cladium* marsh along US 90, circa 1 mi N of Orange Lake, 11 Sep 1980, K. Gordon 2255 (ctb, MMNS); common in disturbed cypress depression at junction of Nut Bank Road and connector to route 613, about 3.5 mi SSW of Big Point village, 2 Oct 1997, B.A. Sorrie 9588 with R.J. LeBlond (GH, IBE, NCU).

*Ruellia pedunculata* Torrey ex Gray ssp. *pinetorum* (Fern.) R.W. Long (Acanthaceae). This seldom collected taxon is vouchered from about 25 counties range-wide (South Carolina to panhandle Florida to western Louisiana); half of which are concentrated in a small area from Washington County, Alabama to Tangipahoa Parish, Louisiana. Previously, this plant had been col-
lected in Harrison and Wayne Counties (MSNHP); here we add four more counties. Because it is difficult to detect when not in flower, we suggest that *R. pedunculata* ssp. *pinetorum* is probably not as rare in Mississippi as previously assumed.


**Sagittaria isoeiformis** J.G. Smith (Alismataceae). Reported herewith new to Mississippi. This is one of the more difficult species of *Sagittaria* to find, because plants are often obscured by dense colonies of *Eleocharis robbinsii*, *Leersia hexandra*, or other aquatics. Two locations are known from Camp Shelby, a range extension westward from Covington County, AL.

Voucher specimen: **Perry Co.**: mostly submerged and not abundant in dense vegetation fringing gum pond behind Mars Hill Church, Camp Shelby, 20 Sep 1994, J. MacDonald 77286 with D. Wyrcik (IBE); same place, 8 Sep 1995, S.W. Leonard 9057 with J. MacDonald (MMNS), J. MacDonald 9107 (IBE).

**Scleria reticularis** Michaux (Cyperaceae). Reported herewith new to Mississippi. We here treat *S. reticularis* in the strict sense, without var. *pubescens* Britton (= *S. muehlenbergii* Steudel). The two warrant treatment as full species, based on morphological characters, habitat, and distribution, as treated by Weakley (in prep.). *Scleria reticularis sensu stricto* ranges discontinuously on the coastal plain from southern New Hampshire to the Florida panhandle to Mississippi, disjunct to Michigan and Indiana. It is very rare south of the Carolinas. *Scleria muehlenbergii* ranges continuously from southern New Jersey to south Florida, west to Texas and Oklahoma, with scattered records inland, in the West Indies, and in Central America. It is abundant in the southern Atlantic and Gulf Coastal Plains.

Voucher specimen: **Forrest Co.**: hwy. 19 ca. 3.5 mi N of Stone County line, shallow pond W of hwy. across fence, 1970, K.E. Rogers 4660-B (VDB), 4660-C (NCU). **Lamar Co.**: Mossy Pond, 3 mi W of Purvis, uncommon on sandy-peaty shelf on NW shore, 1 Sep 1998, B.A. Sorrie 9936 with S.W. Leonard (GH, IBE, NCU).

**Sorghastrum apalachicolense** D.W. Hall (Poaceae). Shortly after this species was named and described from Florida (Hall 1982), S. McDaniel found it in Lamar Co., Mississippi (specimens at FSU, IBE) and K. Gordon found it
in Pearl River County (MSNHP database). Until our survey work, *Sorghastrum apalachicolense* was thought to be a rare disjunct in Mississippi, but it now has been documented from nine counties. Moreover, this grass is quite common in suitable habitat: frequently burned, mesic longleaf pine-oak-bluestem communities with diverse herbaceous layers. We observed several thousand plants in 1997 and 1998.

In 1997, SWL spent many hours observing the inflorescence development of *S. apalachicolense*, *S. secundum* (Ell.) Nash, and *S. elliottii* (Mohr) Nash, species often misidentified on specimen labels and annotations. Because of the arching-drooping panicle axis, even soon after breaking the sheath, *S. elliottii* differs markedly from the other two, in which the axis is straight to slightly arching. Furthermore, *S. elliottii* flowers a month later than *S. apalachicolense* (in southern Mississippi) and about two weeks later than *S. secundum* (in southern Alabama).

As the inflorescence emerges from the apical leaf sheath of *S. apalachicolense*, it takes the form of a compact plume with mostly ascendant branches. The branches and branchlets diverge in an irregular pattern as anthers reach maturity; later, as seeds develop and are shed, the branches return to the ascendant position. In *S. secundum*, the branches and branchlets diverge in a very regular manner so as to form a secund inflorescence in which the florets line up uniformly along one side of the axis. Each floret appears equidistant from each other and from the axis. After seed maturation, the branches return to the ascendant position. Thus, specimens taken prior to full anthesis, or toward the end of seed dispersal, are superficially similar in these two species. In addition to the spikelet width character given in Hall (1982), *S. apalachicolense* specimens possess a short collar of bristles at each panicle branch node; these bristles are greatly reduced or absent in *S. secundum*.

Our observations of *Sorghastrum* reveal other important points. First, *S. secundum* is absent from Mississippi; specimens so labeled from Lamar County (S.B. Jones, Jr. 2460 (FSU)) are *S. apalachicolense*. In fact, we are unaware of any verified record of *S. secundum* from west of the Mobile-Tensaw Delta, Alabama. Second, flowering of *S. apalachicolense* occurs about three weeks later in Mississippi (late August to early September) than in the Florida panhandle. We can offer no explanation for this discrepancy. Thus, in Florida, flowering and fruiting of *S. apalachicolense* overlaps no other species, but in Mississippi, it overlaps the onset of *S. nutans* (L.) Nash. Third, the very short life cycle—maximum of four weeks from breaking sheaths to seed set—gives *S. apalachicolense* a short detection window.

Voucher specimens: **Forrest Co.**: longleaf pine woodland, 1.0 mi WSW of Grapevine Road along FS 310-B, Camp Shelby, 6 Sep 1996, S.W. Leonard 9622 (MMNS). **George Co.**: mixed pine-hardwood stand N of Walker Road, Univ. Miss. Forest Lands, 22 Sep 1997,
B.A. Sorrie 9518 (US, bas). **Harrison Co.:** frequent in powerline right-of-way in sandy soil, about 1 mi NE of Lizana along Saucier-Lizana Road, 7 Sep 1997, S.W. Leonard 9883 (swl); rare in mesic longleaf slash pine woods by CC Camp Road Bog, S side of route 43 between Lyman and Lizana, 27 Sep 1996, B.A. Sorrie 9069 with R.J. LeBlond (bas). **Jackson Co.:** uncommon in multi-age longleaf pine-oak uplands N of Larue Road about 0.5 mi NW of Old Biloxi Road, De Soto NF, 1 Oct 1997, B.A. Sorrie s.n. with R.J. LeBlond (bas); cut-over pinelands 0.3 mi S of Wire Road on east side of hwy. 57, 7 Sep 1997, S.W. Leonard 9879 (MMNS). **Lamar Co.:** very large population in thickened longleaf pine-bluestem upland along Dobson Road, 1 Sep 1998, B.A. Sorrie 9938 with S.W. Leonard (FSU, IBE, US); same place, 4 Sep 1998, B.A. Sorrie 9944 (BRIT, GA, GH). Marion Co.: infrequent in pinelands along hwy. 13, 0.6 mi NW of Lamar Co. line, 5 Sep 1998, S.W. Leonard 10082 (MMNS). **Perry Co.:** scattered in longleaf pine woods S of pipeline on both sides of FS 327, 3.2 mi S of FS 309, Camp Shelby, 8 Sep 1996, S.W. Leonard 9052 with J. MacDonald (IBE). **Stone Co.:** frequent in mesic well-burned longleaf pine uplands, Univ. Miss. Forest Lands, shears swelling and inflorescences opening 21-23 Aug 1997, spikelets nearly all dropped by 23 Sep, B.A. Sorrie 9444 (MMNS, bas), 9446 (GH, NCU, bas), 9451 (IBE), 9452 (NCU, US), 9454 (DUKE, FSU, GH), 9533 (US).

**Spiranthes breviflabris** Lindley var. **floridana** (Wherry) Luer (Orchidaceae). Reported herewith new to Mississippi. In a treatment of the *Spiranthes* of the state, Morris (1989) could find no documentation of its occurrence, but suggested that *S. breviflabris* and its var. *floridana* might occur. Although the variety *floridana* supposedly ranges from North Carolina to Florida and Texas, current information on distribution and abundance is virtually nonexistent. Most botanists have never seen this orchid and the Florida Natural Areas Inventory (the state with the most historical records) does not track it. Knowledge of the range and current abundance of the nominate variety is even poorer. Furthermore, confusion with *S. lacera* (Raf.) Raf. var. *gracilis* (Bigelow) Luer has clouded specimen records, literature reports, and range maps, including those of Luer (1972). Observations in 1997 suggest that this orchid appears in the first growing season following a fire, when competition from coarser herbs and shrubs is at a minimum. Plants mature and senesce in only a few weeks, providing a brief window for detection. Mississippi populations all support less than twenty individuals. The Jackson County specimen at AMES was originally determined as *S. gracilis*, and is mounted on a sheet with other specimens of that taxon from Connecticut, Illinois, and Vermont.


**Stylisma aquatica** (Walter) Raf. (Convolvulaceae). PLANTS lists this species for Mississippi, but Myint (1966) does not map it there. This, our only
pink flowered \textit{Stylisma}, inhabits intermittently ponded depressions, often with \textit{Taxodium ascendens} and \textit{Nyssa biflora} in the canopy.


\textbf{Stylopxima pickeringii} (Torrey ex M.A. Curtis) Gray (Convolutulaceae). Lowe (1921) and Myint (1966) do not include this species for Mississippi, but PLANTS does. The subspecific disposition of Mississippi specimens is problematic—characters they possess do not fit the published descriptions or the key provided by Myint (1966). Supposedly, \textit{S. pickeringii} var. \textit{pattersonii} (Fern. & Schub.) Myint can be separated from var. \textit{pickeringii} by style branches 1.0—1.5 mm long vs. 2—3 mm, style branches definitely unequal vs. mostly equal or slightly unequal, stylopodia 1—2 mm long vs. up to 3—4 mm, and sepals mostly acute or acutish vs. mostly obtuse. In Mississippi plants, style branches are all less than 0.7 mm and vary from equal to definitely unequal, stylopodia are all less than 2 mm, and sepals vary from acute to obtuse. The resolution of this problem must await more detailed studies. The nominate variety ranges discontinuously on the coastal plain from New Jersey to central Alabama; var. \textit{pattersonii} ranges from western Louisiana and southern Arkansas to eastern Texas, Kansas, and Iowa. The following document the known extant populations.


\textbf{Tridens carolinianus} (Steudel) Henrard (Poaceae). Lowe (1921) does not include this species (nor under any synonym), but PLANTS does. This striking grass ranges from southeastern North Carolina to northwestern Florida to western Louisiana, apparently nowhere common.


*Utricularia olivacea* C. Wright ex Grisebach (Lentibulariaceae). New to Mississippi. This neotropical species occurs in the United States as scattered populations on the coastal plain from New Jersey to Florida. The plant's extremely small size, even when flowering, makes detection difficult. Moreover, *U. olivacea* is sensitive to changes in water level, so that it may not appear annually at a given site. The Hinds County specimen names three lakes, at least one of which was a natural arm of the Pearl River (R. Wieland, Mississippi Natural Heritage Program, pers. comm.). The 1935 date represents the second oldest collection in the United States and the first outside of Florida.


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REFERENCES


CHROMOSOME NUMBERS AND POLLEN DIAMETER VARIATION
IN THELESPERMA (ASTERACEAE)

LEE F. GREER¹ and A. MICHAEL POWELL

Department of Biology
Sul Ross State University,
Alpine, TX 79832, U.S.A.

ABSTRACT

Diploid and tetraploid chromosome numbers and pollen measurements are reported for 95 collections from five taxa of Thelesperma (Asteraceae). These chromosome counts include the first 17 diploid (2x) reports for T. megaloporicum var. ambiguwm. A correlation between ploidy level (2x, 4x) and pollen diameter (mm) is found in diploid and polyploid plants of T. megaloporicum and T. simplicifolium. In both taxa, multivalent configurations (IV, V, VI, X) are found. A recurring oversized bivalent (II) was observed in up to 23 of the 103 collections from four of the five taxa studied.

RESUMEN

En este estudio se contaron números cromosómicos diploides y tetraploides, y medidas de polen de 95 colecciones, las cuales en total agrupan cinco táxones de Thelesperma (Asteraceae). Los recuentos de cromosomas incluyen 17 de diploides (2x) de T. megaloporicum var. ambiguwm, publicados ahora por primera vez. En plantas diploides y poliploides de T. megaloporicum y T. simplicifolium se encontró una correlación entre el nivel de ploidía (2x, 4x) y el diámetro del polen (mm). Además ambos táxones presentaron configuraciones multivalentes (IV, V, VI, X). Posiblemente en 23 de las 103 colecciones se observó una recurrencia de bivalentes (II) con tamaño incrementado, en cuatro de los cinco táxones.

Melchert (1963) included approximately 169 documented chromosome counts for 10 taxa of Thelesperma. Prior to the Melchert (1963) study, chromosome numbers were known for 10 of the 15 taxa recognized in his treatment, and counts of n = 8, 9, 10, 11, 12 and 22 were already established for Thelesperma. The pre-1963 counts led erroneously to the notion that every taxon of Thelesperma was characterized by a single chromosome number. Melchert discovered 2x dysploid series in four taxa of Thelesperma and dysploid diploid and polyploid plants in three taxa. The documented counts reported by Melchert (1963) were never published. About 27 chromosome counts for Thelesperma published in 15 papers since 1966 (see Goldblatt & Johnston

¹Correspondence should be addressed to L. Greer, Loma Linda University, Dept. of Nat’l. Sci.-Biology Section, Loma Linda, CA 92350, U.S.A., lgreer03g@ns.llu.edu.

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1990, and earlier Indices to Plant Chromosome Numbers) also revealed chromosome number variation in the genus. Certain meiotic irregularities in *Thelesperma*, mostly one to five rings-of-four in diploids and polyploids, were reported by Melchert (1963), Strother (1976), Keil and Pinkava (1976), and others.

We document numerous chromosome counts from five taxa of *Thelesperma*. Most of the counts resulted from a populational study of the diploid-tetraploid *T. megapotanicum-T. ambiguum* complex, which was the focal point of thesis research (Greer 1997). We comment on meiotic irregularities and the correlation between ploidy level and pollen diameter in *Thelesperma*.

**METHODS AND MATERIALS**

Capitula for meiotic analysis were fixed in Modified Carnoy's Solution (4 chloroform: 3 ethanol: 1 glacial acetic acid; v:v:v). Standard squash techniques (Turner & Johnston 1961) and acetocarmine stain were employed in chromosomal observations. The sources of pollen for pollen size comparisons were the same as those for meiotic analyses. Pollen sizes were measured by ocular micrometer calibrated with slide micrometer such that 1 ocular unit equaled 1 μm (Greer 1997). Often up to 10–30 pollen grains were measured for a given collection.

Correlations between pollen diameter and ploidy level were established by a two-step process. A consensus measurement was estimated for the most frequent ranges of pollen diameters found in each voucher collection (inclusive and exclusive of the pollen exine, i.e., mm exinate and intinate). These consensus measurements (in mm exinate and intinate) were then plotted against the inferred ploidy levels of the respective specimens (Fig. 1).

All the voucher specimens are preserved at the Sul Ross State University Herbarium (SRSC) except for the B.L. Turner collections of *T. filifolium* var. *filifolium*, which are housed in the Herbaria of the University of Texas at Austin (TEX and LL).

**RESULTS**

Included are 95 original chromosome number reports for four species (five taxa) of *Thelesperma*. Specimen citations are accompanied by meiotic chromosome numbers, configurations, irregularities, and pollen diameters in Table 1. Certain capitulum characters of *T. megapotamicum* var. *megapotamicum* and *T. megapotamicum* var. *ambiguum* are included, e.g., heads radiate or discoid and disc corolla coloration, because the putative hybrids of these taxa are thought to be distinguishable by variation in these characters (Melchert 1963; Greer 1997). It is important to note that both 2x and 4x chromosome numbers and pollen grains with variable diameter were often observed
in the same populations and even in the same individual plants (Table 1).

The Turner collection of *T. filifolium* var. *filifolium* in Kimbel County yielded the rare euploid cytotype of *n* = 11 (Greer 1997). Most collections of *T. filifolium* var. *filifolium* have the dysploid cytotypes of *n* = 9 and *n* = 8 (Melchert 1963). This chromosome number (Greer 1997) confirms the continued existence of this rare cytotype in Kimbel County which was first reported by Melchert (1963).

**DISCUSSION**

The 17 diploid (2*n* = 22) chromosome counts obtained for *T. megapotamicum* var. *ambiguum* (RESULTS) represent the first diploid (2x) chromosome numbers reported for the taxon. Previous reports (Melchert 1963; Turner & Flyr 1966) suggested that var. *ambiguum* was exclusively tetraploid throughout its range. Melchert (1963) recognized *T. megapotamicum* and *T. ambiguum* as distinct species. He listed 42 counts for the complex, 17 diploid and tetraploid counts for *T. megapotamicum*, 19 tetraploid counts for *T. ambiguum*, and six tetraploid
Table 1. The meiotic chromosome numbers, configurations, irregularities, and pollen diameters with the respective taxon, source specimen collection numbers, and locations. Collections are arranged alphabetically by taxa. Observed multivalent configurations and both exinate and intimate pollen diameters are included. The putative presence of the oversized bivalent is designated by (H). Chromosome counts or pollen measurements from more than one plant are indicated as (populational). Authorities for the taxonomy are noted below.

<table>
<thead>
<tr>
<th>Taxon &amp; capitular characters</th>
<th>Locality &amp; collection no.</th>
<th>Ploidy level (x=11)</th>
<th>Chromosome number(s)</th>
<th>Pollen diameter (μm) (exinate &amp; intimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T. filifolium var. filifolium Red-brown disc, radiate</td>
<td>Tex.: Harper County Turner s.n. (a,b)</td>
<td>2x</td>
<td>2n = 9II (H)</td>
<td>18-20-24 μm exinate, 14-16-18 μm intimate</td>
</tr>
<tr>
<td>T. filifolium var. filifolium Red-brown disc, radiate</td>
<td>Tex.: Kimbel County Turner s.n.</td>
<td>2x</td>
<td>n = 11 (populational)</td>
<td>26-28 μm exinate, 22-23 μm intimate</td>
</tr>
<tr>
<td>T. longipes Yellow discoid</td>
<td>Tex.: Crockett County 5 mi N of Ozona Greer 122a,b</td>
<td>=2x</td>
<td></td>
<td>16-18-24 μm exinate, 26-28 μm intimate</td>
</tr>
<tr>
<td>T. megalopatamicum var. megalopatamicum Yellow disc, radiate. (red-brown 75%, orange &amp; yellow, ca. 12% each)</td>
<td>Tex.: Terrell County 5.5 mi E of Longfellow Powell, 2671l</td>
<td>2x</td>
<td>2n = 11II (populational)</td>
<td>20-23(-25) μm exinate, 16-24(-22-24) μm intimate, 29-30(-45) μm exinate, 26-29(-40) μm intimate</td>
</tr>
<tr>
<td>T. megalopatamicum var. megalopatamicum Yellow discoid</td>
<td>Tex.: Brewster County ~11.6 mi NE of Alpine Greer 111</td>
<td>=2x</td>
<td></td>
<td>20-23 (-25) μm exinate, 16-18(-22-24) μm intimate</td>
</tr>
<tr>
<td>T. megalopatamicum var. megalopatamicum Yellow discoid, reddish disc lobes (red-brown at maturity)</td>
<td>Tex.: Brewster County ~35 mi S of Ft. Stockton Powell 2723</td>
<td>2x</td>
<td>2n = 11II</td>
<td>18-20 μm exinate, 10-15-18 μm intimate, 30 μm exinate few to 40 μm exinate</td>
</tr>
<tr>
<td>T. megalopatamicum var. megalopatamicum Yellow discoid</td>
<td>Tex.: Pecos County 3 mi E of TX 1776/11 Greer 114</td>
<td>=4x, 6x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. megalopatamicum var. megalopatamicum Yellow discoid</td>
<td>NMex.: Socorro County-34 mi E of San Antonio Powell 2528</td>
<td>2x</td>
<td>2n = 11II</td>
<td></td>
</tr>
</tbody>
</table>

1Taxonomy with authorities: Thelypteris Lessing; T. filifolium (Hook.) A. Gray var. filifolium; T. longipes A. Gray; T. megalopatamicum (Spreng.) O. Kuntze var. megalopatamicum; T. megalopatamicum (Spreng.) O. Kuntze var. ambiguus (A. Gray) Shinners; T. simplicifolium A. Gray var. simplicifolium.
<table>
<thead>
<tr>
<th>Taxon &amp; capitate characters</th>
<th>Locality &amp; collection no.</th>
<th>Ploidy level (x=11)</th>
<th>Chromosome number</th>
<th>Pollen diameter (mm) (exinate &amp; intimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em> Yellow discoid</td>
<td>Tex.: Hudspeth County 12.5 mi E of Dell City Powell 2831</td>
<td>4x</td>
<td>2n = 22II</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em> Yellow discoid (≈ 50% red and yellow discs)</td>
<td>Tex.: Presidio County 32 mi S of Marfa Powell 2522</td>
<td>4x</td>
<td>2n = 18II + 2IV</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em> Yellow discoid</td>
<td>Tex.: Brewster County 5 mi W of Marathon Slawn and Powell 2542</td>
<td>4x</td>
<td>2n = 18II + 2IV</td>
<td></td>
</tr>
</tbody>
</table>
| *T. megapotamicum* var. *megapotamicum* Yellow discoid | Tex.: Brewster County W side of Alpine Greer 96 | 4x | 2n = 22II | 25-30(-31) μm exinate
2n = 22II Anaphase I dicentrics
18-28(-28) μm intimate
Inmat.; 10 μm exinate
6 μm intimate
 |
| *T. megapotamicum* var. *megapotamicum* Yellow discoid | Tex.: Brewster County ~10 mi NE of Alpine Greer 110 | 4x | 2n = 22II | |
| *T. megapotamicum* var. *megapotamicum* Yellow discoid | Tex.: Pecos County 2 mi E of Imperial Greer 116a,b,c (populational) | 4x | 2n = 20-21II (?) | 25-35(-49 crushed) μm exinate
20-22 μm exinate
15-18-20 μm intimate
Dimorphic pollen in 1:1 ratio.
26-29(-31) μm intimate
 |
| *T. megapotamicum* var. *megapotamicum* Yellow discoid | Tex.: Pecos County 12.9 mi E of Imperial Greer 119 | 4x | 2n = 20-21II | |
| *T. megapotamicum* var. *megapotamicum* Yellow discoid, radiate | Tex.: Terrell County E side of Lozier Canyon Greer 169 | 4x | 2n = 22II | 23-24 μm exinate
26-29(-31) μm intimate
 |
| *T. megapotamicum* var. *megapotamicum* Yellow discoid, radiate | Tex.: Terrell County W side of Lozier Canyon Greer 171 | 4x | 2n = 22II | 19-22 μm exinate
(≈2x) | |
<table>
<thead>
<tr>
<th>Taxon &amp; capitular characters</th>
<th>Locality &amp; collection no.</th>
<th>Ploidy level (x=11)</th>
<th>Chromosome number</th>
<th>Pollen diameter (mm) (exinate &amp; intimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Ward County, TX 1776/1450</td>
<td>2x</td>
<td>2n = 9H+11V</td>
<td>(?) (H)</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Ward County, TX 2 mi N of Monahans</td>
<td>2x</td>
<td>2n = 11H (H)</td>
<td>2n = 12H? (?)</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Winkler County, TX 14.7 mi N of Monahans</td>
<td>2x</td>
<td>2n = 9H+11V</td>
<td>Avg.: 20 μm exinate</td>
</tr>
<tr>
<td>Young appearing plants (1st year perennials?)</td>
<td>Tex.: Winkler County, TX 4.5 mi NE of Kermit</td>
<td>2x</td>
<td>2n = 11H</td>
<td>Avg.: 29–30 μm exinate</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Winkler County, TX 14.1 mi NE of Kermit</td>
<td>2x</td>
<td>2n = 11H (H)</td>
<td>1st head: Most 18–20 μm exinate (13–14)–15 μm intimate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2n = 9H+11V</td>
<td>few clusters: 27–30 μm exine</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2n = 9H+11V</td>
<td>18–20 μm intimate (=ix?)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2n = 9H+11V</td>
<td>or 6H+3IV (?)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2n = 9H+11V</td>
<td>2nd head clusters:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2n = 9H+11V</td>
<td>3rd head: 35 μm exinate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2n = 9H+11V</td>
<td>25–30 μm intimate</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Winkler County, TX 16.3 mi NE of Kermit</td>
<td>2x</td>
<td>2n = 9H (H)</td>
<td>2n = 11H (H)</td>
</tr>
<tr>
<td>Young plants (1st year perennials?)</td>
<td>Tex.: Andrews County, TX (populational)</td>
<td>2x</td>
<td>2n = 11H (H)</td>
<td>2n = 11H (H)</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Andrews County, TX N of Winkler-Andrews County line</td>
<td>2x</td>
<td>2n = 11H (H)</td>
<td>2n = 11H (H)</td>
</tr>
<tr>
<td>Reddish involucres</td>
<td>Tex.: Andrews County, TX Greer 186a</td>
<td>2x</td>
<td>2n = 9H+11V</td>
<td>2n = 11H (H)</td>
</tr>
<tr>
<td></td>
<td>Tex.: Andrews County, TX Greer 186b</td>
<td>2x</td>
<td>2n = 11H (H)</td>
<td>2n = 10H? (H)</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Andrews County, TX 24.3 mi NE of Kermit Greer 186a</td>
<td>2x</td>
<td>2n = 11H (H)</td>
<td>2n = 10H? (H)</td>
</tr>
<tr>
<td></td>
<td>Tex.: Andrews County, TX 24.3 mi NE of Kermit Greer 186b</td>
<td>2x</td>
<td>2n = 11H (H)</td>
<td>2n = 10H? (H)</td>
</tr>
<tr>
<td>Taxon &amp; capitular characters</td>
<td>Locality &amp; collection no.</td>
<td>Ploidy level (n=x)</td>
<td>Chromosome number</td>
<td>Pollen diameter (mm) (exinate &amp; intimate)</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Brewster County 36.4 mi S of 1-10, US 67</td>
<td>2n = 11H + 2IV</td>
<td>(19–21–22 μm exinate 17–18 μm intimate</td>
<td></td>
</tr>
<tr>
<td>Yellow discoid</td>
<td>31 May 1995 Greer 187</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Brewster County 9.6 mi E of Marathon</td>
<td>2n = 22H (?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow discoid</td>
<td>Greer 195</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Pecos County 40.5 mi E of Marathon</td>
<td>2n = 11H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow disc, radiate</td>
<td>Greer 206</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Terrell County 41.7 mi E of Marathon</td>
<td>2n = 11H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange-yellow disc, radiate, large trilobate ray florets</td>
<td>Greer 216</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Terrell County 42.4 mi E of Marathon</td>
<td>2n = 11H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow disc, reduced radiate</td>
<td>Greer 217</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Terrell County &gt;46 mi E of Marathon</td>
<td>2n = 22H (?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow discoid</td>
<td>Greer 222</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Terrell County 51 mi E of Marathon</td>
<td>2n = 11H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark yellow disc, minute ray florets</td>
<td>Greer 226</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Terrell County 52.4 mi E of Marathon</td>
<td>2n = 22H (?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow, red-tinted discoid</td>
<td>Greer 228</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Terrell County 51.5 mi E of Marathon</td>
<td>2n = 11H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow disc, radiate</td>
<td>Greer 234a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Terrell County 51.5 mi E of Marathon</td>
<td>2n = 11H (II)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow disc, radiate</td>
<td>Greer 234b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Terrell County 29.1 mi W of Llano Canyon</td>
<td>n = 22</td>
<td>25, 28–30, 32–40 μm exinate</td>
<td></td>
</tr>
<tr>
<td>Yellow discoid</td>
<td>Greer 262 (populational)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Greer and Powell, Chromosome numbers in Thelesperma

915
<table>
<thead>
<tr>
<th>Taxon &amp; capitular characters</th>
<th>Locality &amp; collection no.</th>
<th>Ploidy level (x=11)</th>
<th>Chromosome number</th>
<th>Pollen diameter (mm) (exinate &amp; intinate)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Terrell County 3.6 mi W of Lozier Canyon</td>
<td>4x</td>
<td>2n = 22H</td>
<td>22-26, 40 μm exinate</td>
</tr>
<tr>
<td>Golden disc, very reduced radiate</td>
<td></td>
<td></td>
<td>laggng chromos.</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Terrell County 3.6 mi W of Lozier Canyon</td>
<td>4x</td>
<td>2n = 22H (?)</td>
<td>20-25 μm intinate</td>
</tr>
<tr>
<td>Reddish yellow disc, radiate (somewhat reduced), yellow style branches</td>
<td></td>
<td></td>
<td>laggng chromos.</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Terrell County 3.40 mi W of Crozier Canyon</td>
<td>4x</td>
<td>2n = 21 H</td>
<td>25-26-30 μm exinate</td>
</tr>
<tr>
<td>Yellow disc, radiate (dark colored disc florets)</td>
<td></td>
<td></td>
<td>(16-)18-20-22 μm intinate</td>
<td>(up to 35 μm intinate)</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em></td>
<td>Tex.: Val Verde County 5 mi W of Del Rio</td>
<td>4x</td>
<td>2n = 22H</td>
<td>25-26-30 μm exinate</td>
</tr>
<tr>
<td>Yellow discoid</td>
<td>Greer 155</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark yellow discoid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>megapotamicum</em> and var. <em>ambiguum</em></td>
<td>Tex.: Terrell County 52.4 mi E of Marathon</td>
<td>4x</td>
<td>2n = 17H + 2IV</td>
<td>2n = 17H + 2IV</td>
</tr>
<tr>
<td>Yellow discoid; 2 orange discoid (one clump)</td>
<td>Greer 231</td>
<td></td>
<td>Anaphase I: Separated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(mixed populational)</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>2n = 11H + 4IV + 1VI</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2n = 12H + 5IV</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em></td>
<td>Tex.: Brewster County 3 mi W of Marathon</td>
<td>2x</td>
<td>2n = 11H</td>
<td></td>
</tr>
<tr>
<td>Orange disc, radiate</td>
<td>Powell 2683</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em></td>
<td>Tex.: Brewster County near Terlingua</td>
<td>4x</td>
<td>2n = 18H + 2IV</td>
<td></td>
</tr>
<tr>
<td>Reddish-brown disc, radiate (mixed population of radiate &amp; discoid)</td>
<td>Powell 2512</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em></td>
<td>Tex.: Brewster County</td>
<td>4x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red discoid</td>
<td>~17.1 mi NE of Alpine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Greer 113</td>
<td></td>
<td>(26-)30-33(-34) μm exinate</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(20-24)27-29 μm intitate variable</td>
<td></td>
</tr>
<tr>
<td>Taxon &amp; capitular characters</td>
<td>Locality &amp; collection no.</td>
<td>Ploidy level ((x=11))</td>
<td>Chromosome number</td>
<td>Pollen diameter (mm) (exinate &amp; intinate)</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------</td>
<td>------------------------</td>
<td>-------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Red disc, radiate; double layer ray florets</td>
<td>Tex.: Pecos County 40.5 mi E of Marathon</td>
<td>2x</td>
<td>(2n = 11H (II))</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Red discoid</td>
<td>Tex.: Terrell County 41.7 mi E of Marathon</td>
<td>2x</td>
<td>(2n = 11)</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Orange disc, radiate (slender ray florets)</td>
<td>Tex.: Terrell County 32.6 mi W of Lozier Canyon</td>
<td>4x</td>
<td>(2n = 22II (?))</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Red-brown discoid</td>
<td>Tex.: Brewster County Marathon</td>
<td>2x</td>
<td>(2n = 18II + 2IV)</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Orange discoid almost: 2 minute ray florets</td>
<td>Tex.: Terrell County 51.5 mi E of Marathon Greer 235</td>
<td>4x</td>
<td>(2n = 22II) (2 meiocytes)</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Light orange disc, radiate</td>
<td>Tex.: Terrell County 10.2 mi W of Lozier Canyon</td>
<td>4x</td>
<td>(2n = 22II (II))</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Small red disc, radiate</td>
<td>Tex.: Terrell County 0.9 mi W of Sanderson Greer 280</td>
<td>2x</td>
<td>(2n = 11H)</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Red disc, radiate</td>
<td>Tex.: Terrell County 1.1 mi W of Sanderson Greer 283</td>
<td>2x</td>
<td>(2n = 11H (2-4II))</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Reddish-brown disc, radiate</td>
<td>Tex.: Brewster County 70 mi S of Alpine Powell and Powell 2540</td>
<td>4x</td>
<td>(2n = 18II + 2IV)</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Red-brown disc, radiate (red-brown 75%, orange &amp; yellow, ca. 12% each)</td>
<td>Tex.: Terrell County 5.5 mi E of Longfellow Powell, 2671a</td>
<td>2x</td>
<td>(2n = 11)</td>
<td></td>
</tr>
</tbody>
</table>
Table 1 continued

<table>
<thead>
<tr>
<th>Taxon &amp; capitular characters</th>
<th>Locality &amp; collection no.</th>
<th>Ploidy level (x=11)</th>
<th>Chromosome number</th>
<th>Pollen diameter (mm) (exinate &amp; intimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>T. megalopanicum</em> var. ambiguus</td>
<td>Tex.: Terrell County 5.5 mi E of Longfellow, Powell, 2677b</td>
<td>2x</td>
<td>2n = 111</td>
<td></td>
</tr>
<tr>
<td>Orange disc, radiate (red-brown 75%, orange &amp; yellow, ca. 12% each)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megalopanicum</em> var. ambiguus</td>
<td>Tex.: Brewster County 36.4 mi S of I-10, US 67</td>
<td>4x</td>
<td>2n = 20II</td>
<td>20-22 μm exinate</td>
</tr>
<tr>
<td>Red discoid</td>
<td>31 May 1995 Greer 188a</td>
<td></td>
<td></td>
<td>15-18 μm intimate</td>
</tr>
<tr>
<td><em>T. megalopanicum</em> var. ambiguus</td>
<td>Tex.: Brewster County 36.4 mi S of I-10, US 67</td>
<td>4x</td>
<td>2n = 20II</td>
<td>26 μm exinate (1 pollen)</td>
</tr>
<tr>
<td>Reddish-tinged discoid</td>
<td>31 May 1995 Greer 188b</td>
<td></td>
<td></td>
<td>20 μm intimate (1 pollen)</td>
</tr>
<tr>
<td><em>T. megalopanicum</em> var. ambiguus</td>
<td>Tex.: Brewster County 12.9 mi N of Jct.</td>
<td>4x</td>
<td>2n = 18II</td>
<td>20-22, 21-26(-31) μm exinate</td>
</tr>
<tr>
<td>Red discoid, yellow style branches</td>
<td>Greer 194a,b (populational)</td>
<td></td>
<td></td>
<td>16-20-22 μm intimate</td>
</tr>
<tr>
<td><em>T. megalopanicum</em> var. ambiguus</td>
<td>Tex.: Brewster County 3.5 mi E of Marathon</td>
<td>4x</td>
<td>2n = 20II</td>
<td>2n = 22II (2x)</td>
</tr>
<tr>
<td>Red discoid</td>
<td>Greer 192</td>
<td></td>
<td></td>
<td>20μm intimate (1 pollen)</td>
</tr>
<tr>
<td><em>T. megalopanicum</em> var. ambiguus</td>
<td>Tex.: Terrell County 42.4 mi E of Marathon</td>
<td>2x</td>
<td>2n = 111</td>
<td>30 μm exinate (1 shattered pollen)</td>
</tr>
<tr>
<td>Deep orange disc, radiate</td>
<td>Greer 218</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megalopanicum</em> var. ambiguus</td>
<td>Tex.: Terrell County 346 mi E of Marathon</td>
<td>2x</td>
<td>2n = 111 (?)</td>
<td>20-21 μm exinate</td>
</tr>
<tr>
<td>Orange discoid</td>
<td>Greer 220</td>
<td>4x</td>
<td>2n = 22II (?)</td>
<td>15-18 μm intimate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2n = 22II (20μm exinate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>=4x</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megalopanicum</em> var. ambiguus</td>
<td>Tex.: Terrell County 52.4 mi E of Marathon</td>
<td>4x</td>
<td>2n = 21II</td>
<td>20-22, 24-26(-31) μm exinate</td>
</tr>
<tr>
<td>Reddish discoid</td>
<td>Greer 229</td>
<td></td>
<td></td>
<td>(16-)20-22 μm intimate</td>
</tr>
<tr>
<td><em>T. megalopanicum</em> var. ambiguus</td>
<td>Tex.: Terrell County 52.4 mi E of Marathon</td>
<td>2x</td>
<td>2n = 111</td>
<td>2=2x, 4x</td>
</tr>
<tr>
<td>Orange disc, large ray florets</td>
<td>Greer 230</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1 continued

<table>
<thead>
<tr>
<th>Taxon &amp; caputular characters</th>
<th>Locality &amp; collection no.</th>
<th>Ploidy level (x=11)</th>
<th>Chromosome number</th>
<th>Pollen diameter (mm) (exinate &amp; intimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em></td>
<td>Tex.: Pecos County 33.7 mi E of Marathon Greer 206a, b (populational)</td>
<td>4x</td>
<td>2n = 22II (?)</td>
<td>1st Head: 26–31 mm exinate 23–30 μm intimate 28–30 μm exinate 22–30 μm intimate 19–21 μm intimate 15–21 μm intimate 28–31 μm exinate 23–27 μm intimate</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Red disc, radiate</td>
<td>Tex.: Pecos County 38.8 mi E of Marathon Greer 201</td>
<td>2x</td>
<td>2n = 11II</td>
<td>2nd Head: 17–26 μm exinate 15–21 μm intimate 19 μm intimate 28–31 μm exinate 23–27 μm intimate</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Orange disc, radiate (large ray florets some double layered)</td>
<td>Tex.: Pecos County 38.8 mi E of Marathon Greer 202</td>
<td>2x</td>
<td>2n = 11II</td>
<td>2nd Head: 17–26 μm exinate 15–21 μm intimate 19 μm intimate 28–31 μm exinate 23–27 μm intimate</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Reddish-tinted discoid, orange discoid, reduced radiate</td>
<td>Tex.: Terrell County E side of Lozier Canyon Greer 170 (populational)</td>
<td>6x*</td>
<td>6x</td>
<td>2nd Head: 17–26 μm exinate 15–21 μm intimate 19 μm intimate 28–31 μm exinate 23–27 μm intimate</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Reddish discoid</td>
<td>Tex.: Maverick County 4 mi NW of Eagle Pass Greer 144a,b,c,d (populational)</td>
<td>4x</td>
<td>2n = 22II (?)</td>
<td>2nd Head: 17–26 μm exinate 15–21 μm intimate 19 μm intimate 28–31 μm exinate 23–27 μm intimate</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Radiate</td>
<td>Tex.: Maverick County 4.3 mi NNW of Quemado Greer 145</td>
<td>4x</td>
<td>2n = 20II</td>
<td>two Anaphase I dicentrics</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Discoid</td>
<td>Tex.: Maverick County Rio Grande Valley, US 277 Greer 146</td>
<td>4x</td>
<td>4x</td>
<td>25–31 mm exinate (18–19–)23–30 μm intimate 28–30 μm exinate (20–)22–30 μm intimate 36 μm (few)– 39 μm</td>
</tr>
<tr>
<td><em>T. megapotamicum</em> var. <em>ambiguum</em> Discoid, orange style branches</td>
<td>Tex.: Maverick County 8.1 mi NNW of Quemado Greer 149</td>
<td>2x</td>
<td>2n = 15II + 21IV + 1VI</td>
<td>19–22 μm exinate 11–18 μm intimate 20–31 μm exinate 20–22, 25, 28 μm intimate</td>
</tr>
<tr>
<td>Taxon &amp; capitulo characters</td>
<td>Locality &amp; collection no.</td>
<td>Ploidy level (x=11)</td>
<td>Chromosome number</td>
<td>Pollen diameter (mm) (exinate &amp; intinite)</td>
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<tr>
<td>-----------------------------</td>
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</tr>
<tr>
<td><em>T. megapotamicum</em></td>
<td></td>
<td>=4x</td>
<td>2n = 22II (II)</td>
<td>one cluster: 25–30 μm exinate 22–26 μm intinite</td>
</tr>
<tr>
<td>var. <em>ambiguum</em> Red discoid</td>
<td>Tex.: Val Verde County Del Rio, US 90 Greer 151</td>
<td>=6x? (?)</td>
<td>2n = 22II (II)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6x?)</td>
<td>At least 1 IV</td>
<td>28–29(–35) μm exinate 19–20 μm intinite</td>
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<tr>
<td><em>T. megapotamicum</em></td>
<td></td>
<td>=2x</td>
<td>2n = 10–12II (? )</td>
<td>20–21 μm exinate 11–15–18 μm intinite</td>
</tr>
<tr>
<td>var. <em>ambiguum</em> Orange disc., radiate</td>
<td>Tex.: Val Verde County 5 mi W of Del Rio Greer 152</td>
<td></td>
<td>Anaph. I dicentric lagging chromos.</td>
<td>13–15 μm exinate</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>20–25(–32) μm exinate 20–22, 26–29 μm intinite</td>
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<tr>
<td><em>T. megapotamicum</em></td>
<td></td>
<td>=2x?</td>
<td>2n = 11II (?)</td>
<td>21–20 μm exinate 15–18–20 μm intinite</td>
</tr>
<tr>
<td>var. <em>ambiguum</em> Red discoid</td>
<td>Tex.: Val Verde County 5 mi W of Del Rio Greer 153</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>4x</td>
<td>2n = 22II</td>
<td>25–30 μm exinate 20–26 μm intinite</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2n = 20II</td>
<td>–40 μm exinate –&lt;50 μm intinite</td>
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<td></td>
<td></td>
<td></td>
<td>Anaphase I</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>6x?</td>
<td>dicentric</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>8x?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em></td>
<td></td>
<td>=4x</td>
<td>2n = 22II (?)</td>
<td></td>
</tr>
<tr>
<td>var. <em>ambiguum</em> Red disc., radiate</td>
<td>Tex.: Val Verde County 5 mi W of Del Rio Greer 154</td>
<td></td>
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<tr>
<td><em>T. megapotamicum</em></td>
<td></td>
<td>=4x</td>
<td>2n = 22II (I)</td>
<td></td>
</tr>
<tr>
<td>var. <em>ambiguum</em> Red disc., radiate</td>
<td>Tex.: Val Verde County 4x 5 mi W of Del Rio Greer 157a,b,c,d,e (populational)</td>
<td></td>
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</tr>
<tr>
<td><em>T. megapotamicum</em></td>
<td></td>
<td>=4x</td>
<td>2n = 22II</td>
<td></td>
</tr>
<tr>
<td>var. <em>ambiguum</em> Red-orange disc., radiate</td>
<td>Tex.: Val Verde County =4x 2.0 mi W of Comstock Greer 162</td>
<td></td>
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<td></td>
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<tr>
<td><em>T. megapotamicum</em></td>
<td></td>
<td>=4x</td>
<td>2n = 11II</td>
<td></td>
</tr>
<tr>
<td>var. <em>ambiguum</em> Orange discoid</td>
<td>Tex.: Pecos County 2x 40.5 mi E of Marathon Greer 204</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2n = 10II (?)</td>
<td></td>
</tr>
<tr>
<td><em>T. megapotamicum</em></td>
<td></td>
<td>=4x</td>
<td>2n = 18II + 2 IVs</td>
<td></td>
</tr>
<tr>
<td>var. <em>ambiguum</em> Reddish-brown disc lobes, corolla throats yellow, radiate</td>
<td>Tex.: Brewster County 4x Terlingua Creek Putrell 2509</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taxon &amp; capitolar characters</td>
<td>Locality &amp; collection no.</td>
<td>Ploidy level ((x=11))</td>
<td>Chromosome number</td>
<td>Pollen diameter (mm) ((\text{exinate &amp; intinate}))</td>
</tr>
<tr>
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<td>-----------------------------------------------</td>
</tr>
<tr>
<td>T. megapotamicum var. ambiguum Red-brown disc, radiate</td>
<td>Tex.: Brewster County 5 mi W of Marathon Powell 2684</td>
<td>2x</td>
<td>2(n = 11)I</td>
<td></td>
</tr>
<tr>
<td>T. simplicifolium var. simplicifolium</td>
<td>Tex.: Val Verde County 25.7 mi W of Pecos River Greer 166</td>
<td>2x</td>
<td>2(n = 10I) or 11I (28I) (one I may two II overlapping)</td>
<td></td>
</tr>
<tr>
<td>T. simplicifolium var. simplicifolium Yellow disc, radiate</td>
<td>Mexico: Coahuila, Powell, D. Patterson, D. Ittner 1584</td>
<td>4x</td>
<td>2(n = 20I)</td>
<td></td>
</tr>
<tr>
<td>T. simplicifolium var. simplicifolium</td>
<td>Tex.: Crockett County 4.8 mi E of Jct. TX 163/190 Greer 127</td>
<td>2x</td>
<td>2(n = 10I) (II)</td>
<td>(22–24–25 (\mu)m exinate 14–17 (\mu)m intinate 27 (\mu)m exinate 20–21(–23) (\mu)m intinate 42 (\mu)m exinate 37 (\mu)m intinate</td>
</tr>
<tr>
<td>T. simplicifolium var. simplicifolium</td>
<td>Tex.: Val Verde County 23.8 mi W of Del Rio Greer 158</td>
<td>(\approx)2x</td>
<td>2(n = 10I); 2(n = 10I); 13?</td>
<td>Avg.: 20 (\mu)m exinate (10–12)15 (\mu)m intinate</td>
</tr>
<tr>
<td>T. simplicifolium var. simplicifolium</td>
<td>Tex.: Kinney County 21.1 mi NW of Quemado Greer 150</td>
<td>2x</td>
<td>2(n = 10I); 2(n = 10I); 13?</td>
<td>20–22 (\mu)m exinate 15–18 (\mu)m intinate a few cells: 25, 31 (\mu)m exinate, (-23 \mu)m</td>
</tr>
<tr>
<td>T. simplicifolium var. simplicifolium Yellow disc, radiate Curvicarpum achene form</td>
<td>Tex.: Menard County 1 mi E of TX 29/83 Greer 137</td>
<td>2x</td>
<td>2(n = 10I)</td>
<td>Anaphase I lagging chromosomes of one bivalent (II)</td>
</tr>
<tr>
<td>T. simplicifolium var. simplicifolium Yellow disc, radiate Curvicarpum achene form</td>
<td>Tex.: Menard County 1 mi E of TX 29/83 Greer 138</td>
<td>(\approx)2x</td>
<td>2(n = 11I) (II)</td>
<td>18–20 (\mu)m exinate 35–36(–40) (\mu)m exinate base of echinations: 30 (\mu)m</td>
</tr>
<tr>
<td>T. simplicifolium var. simplicifolium</td>
<td>Tex.: Maverick County Rio Grande Valley, US 277 Greer 147</td>
<td>(\approx)4x?</td>
<td>2(n = 11I) (II)</td>
<td>20–23(–29), 30 (\mu)m exinate 15–17 (\mu)m intinate</td>
</tr>
<tr>
<td>T. simplicifolium var. simplicifolium Yellow disc, large overlapping ray florets</td>
<td>Tex.: Terrell County 0.2 mi W of Lozier Canyon Greer 243</td>
<td>4x</td>
<td>2(n = 20I)</td>
<td>20–21–24 (\mu)m exinate (13–)16–20 (\mu)m intinate</td>
</tr>
</tbody>
</table>
counts for putative hybrids between the taxa. Because of their remarkable morphological similarity, identical meiotic cytologies (2n = 22, 44 with multivalents), and the case with which they apparently interbreed where sympatric, *T. megapotamicum* and *T. ambiguum* are best treated as varieties (Greer 1997). The only reliable distinguishing characteristics are range, the slightly reduced habit of var. *ambiguum*, and disc coloration. Disc florets of var. *megapotamicum* are yellow and heads generally are discoid; disc florets of var. *ambiguum* are red-brown and heads are generally yellow-radiate.

The reports (Table 1) for the *T. megapotamicum* complex provide an expanded understanding of how diploid and polyploid distribution in the species is structured, especially in Texas. *Thelesperma megapotamicum* var. *megapotamicum* is almost exclusively diploid (2n = 22) with yellow, discoid heads in most of its range, which extends from Nebraska, Colorado, and Wyoming west to Arizona, south across Trans-Pecos Texas into central Mexico, and east to northwest Texas (Melchert 1963). In the predominant portion of its range which extends from south Texas and near the Rio Grande Valley west into Val Verde County, *T. megapotamicum* var. *ambiguum* is largely tetraploid (2n = 44) with red-brown disc corollas and large, yellow ray florets. However, west of the Pecos River, mixed diploid and tetraploid populations of var. *ambiguum* occur from western Val Verde County through Terrell and Brewster counties (Greer 1997). The floral morphology of these populations of var. *ambiguum* vary from radiate with red-brown discs, discoid orange, radiate orange, to discoid red-brown. Along this same axis, var. *megapotamicum* plants are also often diploid (2n = 22) with yellow discs and ray corollas. Populations of var. *megapotamicum* elsewhere in the Trans-Pecos are mostly tetraploid (2n = 44) with yellow discoid heads, although there are occasional plants with yellow discs and yellow ray florets, often reduced in length.

Melchert (1963) interpreted plants from this area resembling both var. *megapotamicum* and var. *ambiguum* as hybrids or intergrades between the taxa. He found only tetraploids in this area. This region of apparently extensive morphological intergradation seems to mark the sympatric overlap of the

<table>
<thead>
<tr>
<th>Taxon &amp; capitular characters</th>
<th>Locality &amp; collection no.</th>
<th>Ploidy level (x = 11)</th>
<th>Chromosome number</th>
<th>Pollen diameter (mm) (exinate &amp; intimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>T. simplicifolium</em> var. <em>simplicifolium</em></td>
<td>Tex.: Val Verde County 0.7 mi W of Pecos River <em>Greer 163</em></td>
<td>2x</td>
<td>2n = 20(c)</td>
<td>21–22 µm exinate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2n = 10II (SI?)</td>
<td>14–16 µm intimate</td>
</tr>
</tbody>
</table>
|                             |                          | = 4x                  | 26–28–29–30 µm exinate | 22–23–26 µm intimate nickname
ranges of var. megapotamicum and var. ambiguum from western Val Verde County west into Brewster County. The intergradation is so smooth and continuous that morphotypes were difficult to assign taxonomically.

Origins of polyploidy. The origins of polyploidy in *T. megapotamicum* remain uncertain. Variation in floral character combinations in the sympatric region, high fertility, and the absence of univalents or trivalents in meiotic observations, suggest that allopolyploidy is more likely than autoploidy in var. *ambiguum* (Greer 1997). Because of the lack of morphological differentiation between diploids and tetraploids, however, polyploidy in the typical yellow discoid var. *megapotamicum* seems more likely to be autoploid. For similar reasons, autoploidy also seems more likely in other polyploid taxa of *Thelesperma* such as *T. simplicifolium* and *T. longipes* (Greer 1997).

Multivalent configurations have been observed at meiosis in diploid (Keil & Pinkava 1976; Greer 1997; Results) and in tetraploid (Melchert 1963; Strother 1976; Powell & Powell 1977; Greer 1997; Results) cytotypes of both *T. megapotamicum* var. *megapotamicum* and *T. megapotamicum* var. *ambiguum*. Melchert (1963) reported that in tetraploids, two rings-of-four (IV) were most common, and that one and three rings-of-four also were observed. In this study, we report that widely variable numbers of apparent ring and chain quadrivalents (IV), hexavalents (VI), and even decavalents (X) were found in populations of var. *megapotamicum* and var. *ambiguum* (Greer 1997). Anaphase segregation was essentially balanced and fertility remained high in spite of the multivalents (Melchert 1963) and the occasional occurrence of dicentric chromosomes (Table 1; Greer 1997).

Large bivalent. A persistent large bivalent (II) was observed in meiotic preparations in up to 23 of the 103 collections (Table 1; Greer 1997), most noticeably in preparations from diploid plants. Such an oversized bivalent has been observed in *T. megapotamicum* var. *megapotamicum*, *T. megapotamicum* var. *ambiguum*, *T. simplicifolium* var. *simplicifolium*, and *T. filifolium* var. *filifolium* (Greer 1997). An oversized bivalent is also plainly visible in Melchert’s (1963) meiotic camera lucida figures of the above taxa as well as in *T. longipes*, *T. filifolium* var. *intermedium*, and possibly also in *T. burridgeanum* (Greer 1997). Melchert (1963) did not call attention to the large bivalent. In one collection of *T. simplicifolium* var. *simplicifolium* (Greer 137; Table 1), the chromosomes of an oversized bivalent lagged in anaphase I. The lagging and dicentric chromosomes observed (Table 1) may be associated with the large bivalent. A large bivalent would be more frequently expected to lag and to undergo paracentric inversions because of its length. The large bivalent may be a result of a massively unequal reciprocal translocation that occurred early in the evolution of *Thelesperma* (Greer 1997).

Pollen diameter variation. Pollen diameter size variations seem to reflect
the ploidy levels of the plants that produced them (Greer 1997). From diploid plants (2x) of *T. megalopotamicum*, the broad range of pollen diameters for presumed 1x pollen (1x gametophytes) was 17–26 µm exinate and 11–21 µm intinite. From tetraploid plants, the range of pollen diameters for presumed 2x pollen (2x gametophytes) was approximately 20–35 µm exinate and 18–29 µm intinite. Rare pollen found in preparations with even larger diameters, 30–50 µm exinate and 25–42 µm intinite, have been attributed tentatively to 3x pollen (3x gametophytes). (See Fig. 1).

Diploid plants of *T. megalopotamicum* occasionally were found to produce unreduced 2x pollen (ca. 24–30 µm exinate) along with the more abundant 1x pollen (18–24 µm exinate). In Andrews and Winkler counties where var. *megalopotamicum* is known to occur only as a diploid, discrete clusters of larger pollen were seen in meiotic preparations, suggesting that localized tetraploid (4x) microsporangial tissues are producing clusters of unreduced 2x gametophytes. Plants of both var. *megalopotamicum* and var. *ambiguum* from Brewster, Terrell, and Val Verde counties, where populations are typically tetraploid, consistently produce pollen of both sizes (ca. 24–30 µm; ca. 18–22 µm) in a nearly 1:1 ratio of putative 1x and 2x pollen. In tetraploids of *T. megalopotamicum* larger than normal pollen (30–35 µm) were occasionally observed, suggesting that tetraploids also may be producing unreduced gametophytes (3x?, Fig. 1).

The same kind of ploidy level—pollen diameter variation was also observed in *T. simplicifolium* var. *simplicifolium*, which has both diploid and tetraploid cytotypes. The correlation between known chromosome numbers and pollen sizes suggests that in certain species of *Thelesperma* a given ploidy level may predominate in a specific population or plant, while gametophytes of different ploidy levels are being also produced (Greer 1997). Similar production of unreduced gametes has been reported by Beaman (1957) in *Townsendia* (Asteraceae) and Powell and Sikes (1975) in *Perityle* (Asteraceae).

**Acknowledgments**

We thank Sharon Yarborough, Assistant Curator of the Sul Ross State University Herbarium (SRSC), for her help in dealing with specimens of *Thelesperma*. We are grateful to B.L. Turner for contributing capitula of *Thelesperma* and for discussing the essence of his systematic observations concerning *Thelesperma megalopotamicum* and other species of the genus. We appreciate loans of specimens from the University of Texas (TEX, LL) and El Instituto de Botanica Darwinion (SI), San Isidro, Argentina. We also thank Cristian Carvajal and Raul Esperante for their translation of the abstract into Spanish.
REFERENCES


BOOK REVIEW


This book replaces the classic work, “Plant Cell Biology-An Ultrastructural Approach,” published in 1975. It includes photographs made using the following microscopic techniques: conventional light, phase contrast, differential interference contrast, fluorescence (including fluorescence antibody and immuno-fluorescence), confocal laser scanning, transmission electron (TEM) and scanning electron (SEM). Many techniques involving antilonal antibodies, serial optical sections, shadow casting, freeze-fracturing, freeze-etching, ultra-thin, freeze substitution, and a variety of ancillary ones, are explained in detail in the text as well as in the legends.

The book is comprised of 60 plates in an 8.5 x 12” format, on high-gloss paper, with sometimes oversized labels for the sub-plates, and an accompanying text for each. Several black and white drawings scattered throughout the text are original artwork, but are not numbered. There is also one figure of a “generalised plant cell” that places the organelles and ultrastructural features of our beloved tetradodecahedron in perspective. The 60 plates are arranged in groups according to subject, and include the following sections: an introductory survey, nucleus, endoplasmic reticulum, Golgi apparatus and coated vesicles, vacuoles, mitochondria, nucleic acids in mitochondria and plastids, plastids, microbodies, cytoskeleton, cell division, transport between cells, vascular tissue, the plant surface, plant reproduction, the plant as a multicellular organism and the index.

Like its predecessor, this book is an instantaneous classic and a MUST for anyone teaching general biology or plant biology. The clear, concise text and fantastic images would serve the needs of everyone from high school biology advanced placement students to advanced undergraduate biology majors taking a cell biology course. I unhesitatingly recommend this excellent bargain to everyone!—John J. Pipoly III.
SALVINIA MOLESTA (SALVINIACEAE), NEW TO TEXAS AND LOUISIANA

COLETTE C. JACONO
United States Geological Survey
7920 NW 71st St.
Gainesville, FL 32653, U.S.A.

Initially discovered at a schoolyard demonstration pond in southeastern Texas, the Federal noxious weed *Salvinia molesta* Mitchell has recently been found in abundance at Toledo Bend Reservoir. This 75,300 ha impoundment of the Sabine River forms a 145 km border between Texas and Louisiana and is a popular bass fishing lake.

Native to a small region of southeastern Brazil (Forno 1983), *S. molesta* has dominated water bodies over an expansive range including regions of Africa, Asia, Australia and the South Pacific (Mitchell 1972; Forno & Harley 1979). Vegetative reproduction and rapid growth rates contribute to the invasiveness of this plant, typically resulting in dense surface mats that cover open water, degrade aquatic habitat, and constrain the use of reservoirs and waterways (Mitchell & Tur 1975; Thomas & Room 1986). Until now, *S. molesta* has been successfully intercepted at nurseries, botanical gardens, and at a private pond (Myers 1982; Johnson 1995), precluding naturalization in the United States. Likely sources for the introduction are local nurseries found distributing the species as an ornamental water garden plant (Rhandy Helton, Texas Parks and Wildlife Department, personal communication).

This is the second *Salvinia* species introduced to these states. *Salvinia minima* was first reported from Louisiana in 1980 (Landry 1981) and from Texas in 1993 (Hatch 1995). Its distribution has increased extensively since these reports (Montz 1989). The two species are readily distinguished by the multicellular hairs on the upper frond surface. The apex of each hair is divided into four branches. In *S. molesta*, the tips of the branches are joined to form a cage-like structure, while in *S. minima*, branches are spreading and free at the tips. Leaf hair features may be viewed with a 10X lens and can be used by biologists for early field detection.

This report documents an introduction that constitutes a serious threat to aquatic systems throughout the southern United States. *Salvinia molesta* has been found above the high water level at public ramps and roads along Toledo Bend Reservoir, likely dragged there by boat trailers, known vectors for overland spread (Miller and Wilson 1989).

ACKNOWLEDGMENTS

The author gratefully acknowledges assistance in identification from Nancy Coile, Wendy Forno, and David Mitchell.

REFERENCES

ORTHODON VS MOSLA (LAMIACEAE)

NEIL A. HARRIMAN

Biology Department
University of Wisconsin-Oshkosh
Oshkosh, WI 54901, U.S.A.
harriman@uwosh.edu

The generic name Orthodon Bentham & Oliver (Lamiaceae) has never gained widespread acceptance. Mosla (Bentham) Buchanan-Hamilton ex Maximowicz has been used almost universally for this Asian genus of about 22 species, several of them quite weedy. Indeed, Bentham himself (1876) adopted Mosla and cited his own generic name in synonymy, without comment.

The relevant data are these:
Orthodon Bentham & Oliver, J. Linn. Soc., Bot. 9:167. 12 October 1865, Lamiaceae.

Orthodon Bentham & Oliver is an illegitimate homonym of Orthodon R. Brown, easily discoverable from Index Nominum Genericorum (Plantarum). However, before plant taxonomy was blessed with such invaluable compilations, there was no practical and reliable way to discover the existence of duplicated generic names. This was what led Bau and Nayar (1969) to propose conservation of Mosla against Orthodon Bentham & Oliver; McVaugh (1970) replied (as Secretary for the Committee on Spermatophyta) that the existence of Orthodon R. Brown (Musci) made Orthodon Bentham & Oliver (Lamiaceae) a later homonym—the proposal was therefore superfluous, and was withdrawn by its authors.

There the matter rested. Since 1970, no proposal to conserve Orthodon Bentham & Oliver against Orthodon R. Brown has been submitted to Taxon, Dan Nicolson informs me (pers. comm., 4 December 1998). One expects none would arise, because Mosla is so widely used that to return to a conserved Orthodon would be destabilizing to nomenclature.

However, Orthodon Bentham & Oliver has now resurfaced: Gleason, H.A. and A. Cronquist (1991, p. 445) adopt it in place of Mosla. Its "impropriety" is not remarked upon in Hammond (1992). The name cannot be used; I surmise (following the suggestion of Paul Fryxell) that its appearance may stem from the entry in Airy Shaw (1973), wherein.

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Orthodon is accepted in generic status and Mosla is reduced to synonymy, the compiler having been unaware of the existence of the priorable Orthodon R. Brown (Musci).

Mosla is represented in the United States of America only by the weedy annual Mosla dianthera (Roxburgh) Maximowicz, the type species of the genus; its known range is Georgia, Kentucky, New Jersey, North Carolina, and Tennessee (data from www.mip.berkeley.edu/bonap/checklist_intro.html), but it can be expected to spread much more widely. It would be most unfortunate if the illegitimate name Orthodon dianthera were to become weedy in the literature.

REFERENCES


TRIOSTEUM (CAPRIFOLIACEAE) IN TEXAS

WALTER C. HOLMES
Department of Biology
Baylor University
Waco, TX 76798-7388, U.S.A.

KAY M. FLEMING
Texas Parks and Wildlife Department
Athens, TX 75751, U.S.A.

RUTH AND RON LOPER
University of Texas at Tyler
Tyler, TX 75707, U.S.A.

JASON R. SINGHURST
Wildlife Diversity Program
Texas Parks and Wildlife Department
Austin, TX 78704, U.S.A.

Triosteum is a genus of about six species distributed in eastern North America and Asia. These are coarse, perennial, erect herbs with one to many stems arising from a woody crown. Many authors recognize three species from North America, T. angustifolium L., T. perfoliatum L., and T. aurantiacum Bickn. (Small 1933; Fernald 1950; Steyermark 1963; Radford et al. 1968; Strausbaugh & Core 1978). Triosteum angustifolium is characterized by narrowed leaf bases, whereas T. perfoliatum and T. aurantiacum have connate-perfoliate leaf bases. The latter two are segregated primarily on the nature and amount of pubescence and glandular hairs. Although recognizing the two species, Voss (1996) mentions that “pubescence characters are not as consistent as some keys suggest ...” Brooks (1986) treats them as infraspecific taxa, maintaining that “The characters typically used to distinguish the two varieties, especially stem vestiture and leaf shape, intergrade with some degree of frequency in both the GP [Great Plains] and extraregional material examined. This suggests that separation of the two entities is dubious.”

Correll and Johnston (1970), as well as Hatch et al. (1990) and Jones et al. (1997), include only Triosteum angustifolium within the flora of Texas. Therefore, the collection cited below is the first report of T. perfoliatum (T. perfoliatum var. perfoliatum sensu Brooks, 1986) in the state. The species is known from MA and NY, west to MN, eastern NE and KS, northeastern OK, south to northern GA, AL, MS and AR (Fernald 1950; Brooks 1986). There is also

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one record from Natchitoches Parish in northwestern LA (Thieret 1969; Thomas & Allen 1996).

The Anderson County location, located at the western limits of the Pineywoods, is a mature hardwood-pine forest dominated by Pinus taeda L., P. elliottii Mill. (Pinaceae), Quercus stellata Wang., Q. falcata Michx. (Fagaceae), Acer rubrum L. (Aceraceae), and Liquidambar styraciflua L. (Hamamelidaceae). Common understory plants include Rhytmohia latifolia Nutt. ex T.&G. (Leguminosae), Polygala polygama L. (Polygalaceae), Oplismenius hirtellus (L.) Beauv., Chasmanthium sessiliflorum (Poir.) Yates (Gramineae), and Eupatorium caradinianum Raeusch. (Compositae).

The leaves of the specimen are distinctly panduriform and have margins that vary from entire to conspicuously crenate-sinuate. Small (1933), Fernald (1950), Radford et al. (1968), and Brooks (1986) all report strictly entire leaf margins for all species of Triostium in the United States with the exception of the bases. Thieret 26855 (LAF, TEX!), the only Louisiana collection of the species, has similar crenate-undulate margins on some of its leaves.


The following key, based upon Texas material, may be used to distinguish between the two species of the genus now known from the state.

1. Flowers yellow. 1 per axil; bracts subtending flowers two, exceeding the length of flowers or fruits; calyx long hirsute; glandular hairs few; bases of midstem leaves narrowed. ............................................................... T. angustifolium

2. Flowers reddish to orange, (1–)2 or more per axil; bract subtending flowers one, ca. one-half the length of flowers or fruits; calyx densely puberulent; glandular hairs numerous; bases of midstem leaves perfoliate. .............. T. perfoliatum

Triostium angustifolium occurs from central CT, Long Island (NY), and PA, west to MO, southeastern KS, eastern OK, and east TX, south to GA and northern LA. Correll and Johnston (1970) give the distribution as east Texas, specifically Smith and Cass counties, both within the Pineywoods Vegetational Region. Hatch et al. (1990) list the species as occurring only in the Pineywoods. However, T. angustifolium is now known from the northern part of the Pineywoods and also from the northern part of the Post Oak Savannah in Lamar County.

ACKNOWLEDGMENTS

We wish to thank the curators of the following herbarium for the loan of specimens or other information that made this study possible: BRIT/SMU, SHSU, TAMU, and TEX/LL.

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BOOK REVIEWS


It has been a good many years since a genuine, bonafide complete hard-copy flora has appeared for Texas or any substantial part of Texas. Thus it is with some excitement that we received this new book. The reviewer of this new FLORA was daunted by the heft (at almost 10 pounds it builds up the deltoids etc.) and 1600 pages crammed with information. Obviously one cannot read every word and examine every illustration in a few hours of perusal. My notes are pretty effusive—with a lot of overused adjectives they'll rate a goose-egg in any journalism class—but who cares, so here goes: INCREDIBLE, FANTASTIC, WONDERFUL, BEAUTIFUL, ETC. WOW! To be more specific: COMPREHENSIVE, ENCYCLOPEDIC, INNOVATIVE. With every species illustrated—it's a new departure in Texas floras, a breath of fresh air. More than any other flora of the region, it approaches the oft-stated goals of floristic workers to combine professional soundness and completeness with usefulness and accessibility for people of all levels of botanical expertise, and for all sorts of consumers of botanical information. In short, this is a super-fine product of a dedicated, skilled, industrious and deeply knowledgeable team of experts, who are to be praised and congratulated along with their contributors and sponsoring institutions and publishers.

Now among the gushing words a little rain must fall. Perfection has been closely approached, not fully attained. In some hours of review, about 20 misspellings have been detected, all falling into the category of minor inconveniences, none resulting in serious misunderstanding. One literature citation was repeated under two different authorships. But even a nit-picker like me can find very little to carp about.

Naturally one can differ with the authors on some of their taxonomic judgments. (Whenever 10 taxonomists are present, 30 opinions exist on any given issue.) But no need to belabor that here. The authors' judgments are all defensible, even those that differ from mine.

The beauty of the volume itself, including the section on superb color photographs, bespeaks much loving attention to the details of lay-out, typography, binding, etc., and will add to its appeal to the general public, those elusive intelligent lay persons who may spot the book in Barnes and Nobles and be captivated for the first time by a meaty type of wild-plant botany, as opposed to the palladium in the "wildflower" books.

Praise belongs not only to the team that produced the work, but to those nameless technoids who have given us electronic sending and processing of data, words and illustrations, and electronic layout and setting of type and illustrations. This reviewer thinks back to the almost totally unillustrated Texas flora that came out in 1970. Every word was written longhand, typed manually, edited, re-typed, edited, re-typed, edited and retyped. Finally, the huge typescript was taken personally (by Donovan Correll, on the train) to a vast print shop in Wisconsin where it was set (clackety-clack, clackety-clack) in hot lead on old Linotype machines. Then the galley proofs were mailed to this reviewer in Munich, corrected by him and by Correll, then sent back to Wisconsin for re-setting. Then the work was printed...
in an initial run of 3,000 copies. The signatures were assembled by hand and sewn together and the books bound (about one in three was defective on the first go-round). How blessed we are to have a brand-new publishing industry in the last few decades in which a lot of the processes are streamlined and quality is so much better controlled.

So let us praise and congratulate everybody involved in this effort, and publicize this great work vigorously so that it can become a part of the collections of every institutional library and many thousands of private individuals. And let us encourage these authors and others to produce equally useful floristic accounts for the rest of Texas and surrounding regions (as they say they already plan to do), and to produce not only hard-copy but CD-ROM versions and cyberversions subject to constant up-dating. And let us encourage even more foundations to support this type of work so that it may accelerate and flourish as a background informational field on which conservation efforts may proceed and so that public awareness and enjoyment of our wild treasures may accelerate. And all the people said: AMEN.—Marshall Johnston.


An informative, easy-to-use plant identification field guide to 44 of the more common woody plants and cacti of South Texas. This handy field guide for landowners, land managers, conservationists and sportsmen provides a comprehensive reference on the most common species of woody vegetation found in the South Texas Plains, and includes information on their value to livestock, wildlife and humans.

The South Texas Plains area is a triangular region, roughly south and east of the line from Del Rio to San Antonio to Rockport. Also called the Rio Grande Plains or south Texas “brush country”, it encompasses about 20.5 million acres, covering fifteen counties and portions of fourteen others. Over 281 species of woody plants and 32 species of cacti are recognized in the south Texas ecological region. The vast majority of these plants are found in the lower Rio Grande Valley. The 44 described in this book represent an estimated 75% of the overall brush and cacti biomass of the south Texas ecological region, including the Rio Grande Valley.

In the 1400s and 1500s, this area was dominated by grasslands, but woody plants were often present in thickets, upland areas, major drainage’s and river bottoms. Natural fires helped maintain the region as a grassland or savannah, reducing woody plant densities. With the migration of early settlers and their livestock in the 1800s, brush densities increased due to overgrazing, along with other factors such as lack of natural fires, soil compaction and periodic droughts. This increase of brush density was eventually considered detrimental by ranchers. Brush control and range reseeding began in the late 1930s and early 1940s, however, by the 1960s, research by wildlife biologists indicated extensive brush control was detrimental to wildlife. White-tailed Deer hunting was on the increase by the 1950s giving landowners an economic incentive into providing quality habitats. Since then,
brush removal has been reduced or applied in a manner that is not detrimental to wildlife, thus improving the habitat for deer and other wildlife species such as birds, reptiles, rabbits, ground squirrels, bobwhite quail and wild turkey.

Identification of these key food plants and knowing their nutritional value becomes an important aspect of evaluating habitat, range condition and ecosystem health of the South Texas Plains area.

Grouped into thorned and thornless categories, the plants are alphabetized by family with common and scientific names given. Each plant is laid out in a two page spread with often three color photos showing habit, flowers and fruit. Text includes the description and values of the plant to wildlife, cattle, goats, as well as humans and a nutritional Crude Protein Value chart for each plant. A summary chart is provided showing the percentage of nutritional values of crude protein (CP), digestible protein (DP), and digestible dry matter (DMD) for each season of the year. In addition, a bibliography, illustrated glossary and index are provided.

With the ever increasing need to conserve our resources, it would seem to me that many of these plants could be incorporated into the South Texas homeowner's landscape. Native plants not only provide beauty and ease of care, they can provide a welcomed food source to some of the most coveted visitors into our gardens ... butterflies and hummingbirds. — Linny Heagy.


This book represents the first attempt to synthesize the classical approach to land plant evolution with the modern approaches offered by morphogenetic and molecular evidence presented in a phylogenetic context. The book is divided into 7 chapters, followed by 5 appendices, an exhaustive bibliography, taxonomic and subject indices.

The first two chapters give a historical background, a primer on phylogenetic systematics, and the applications of paleobotanical data to modern systematic studies. It is followed by a cogent summary of our current understanding of the kingdoms of organisms and the higher ranks containing "plants". The subsequent three chapters cover the Embryobionta, Polysporangiophytes, Zosterophyllopsida and Lycophytes, and Lycopsida. Each section deals with the origins of the group's concept, systematics, phylogenetic questions and aims of analysis, choice of taxa, character descriptions and coding, analysis, results and discussion. This organization of data is the first of its kind, and clearly points out the depth or dearth of our current knowledge for each character, its origin, morphogenesis, evidence from the fossil record, and systematic utility. For each analysis and result, step-by-step explanations are clearly given, limits of available data are thoroughly discussed, and suggestions for future work outlined. The purpose of the series, "...to publish innovative studies in the fields of comparative evolutionary biology, especially by authors willing to introduce new ideas or challenge or expand views now accepted." is truly fulfilled in these chapters. I can think of
no more cogent summary of what we know, what questions remain, and how we might proceed to answer them.

The last chapter, “Perspectives on the early evolution of land plants” is the most illuminating of all. In addition to the proposed classification of the Chlorobiota to the level of infraclass, it offers a clear explanation of such concepts as the annotated Linnaean conventions recommended by Wiley, with several additions that logically permit the systematic positioning of fossil groups. Comparison of the phylogenetic classification presented for the land plants, together with the historical and modern processes underlying character analyses, give all students of plant evolutionary biology a fundamental understanding of the strengths or weaknesses of competing concepts. I found the discussion of microphyll evolution in lycopsids particularly complete, in which the three competing hypotheses: reduction, retention and sterilization, are explained in detail, first in ontogenetic, then in taxic homologous terms.

The appendices are detailed and give us a picture of how reliable fossil evidence is for key groups, followed by complete character and character state coding tables. The bibliography is extensive, as are the taxonomic and subject indices. This book is a must as a foundation for any major graduate course in plant comparative morphology or systematic and evolutionary biology. I wish it had existed when I was preparing for my doctoral comprehensive exam!—John J. Pipoly III.


This textbook, CD-ROM, instructor’s manual, and enhanced web site (http://www.jbpub.com/botanylinks) provides the most comprehensive set of modern, multimedia course materials this reviewer has ever seen. It is truly impressive!

The textbook is constructed in one of the most logical, easiest-to-use ways imaginable. The preface clearly states that “three topics are so important, so fundamental, that they must permeate every aspect of an introductory botany textbook and should be mentioned or alluded to on every page: they are evolution by natural selection, analysis of botanical phenomena, and diversity of organisms and all their components.”

The book is divided in four parts: plant structure, plant physiology and development, genetics and evolution, and ecology. The “part openers” section that introduces each part summarizes the chapters belonging to each part, and how those themes relate to the other respective parts. Within each of the 27 chapters, a “concepts” section comprises several
pages and provides an annotated outline of the subjects that will follow. There are "plants and people" boxes in each chapter, that serve to explain the way in which the information in the chapter relates to our everyday lives. These boxes are surely an "autapomorphic character state." In addition to the plants and people boxes, there are 27 boxed readings scattered throughout the text that represent ancillary reading related to the subject treated in the chapter. The accompanying interactive CD-ROM is referenced in the preference and each sector of the CD-ROM is associated with a chapter or part of the book. The text is richly illustrated with high-quality, full color photographs; SEM, TEM or light photomicrographs; and finally, color or black-and-white original artwork, illustrating significant structures and concepts. Other features, including the marginal notes, summary, important terms section, review questions and BotanyLinks.net questions combine to provide a formidable set of learning tools.

What immediately set this text apart from any other I have seen is the nesting of the information. Depending on the level of the students taking the course, selected parts of the introduction can be used or skipped, and the supplementary materials provided on the CD-ROM can be required or used as a supplement. The coverage of topics, coordination among the text, CD-ROM and net resources (including movie shorts), tables, charts, boxes, artwork and photographs sum to immerse the student in a truly multimedia experience. The text is written in an extremely clear and concise style that painlessly introduces complicated material in a step-by-step fashion. The book has obviously been tested and re-tested for ease-of-use, clarity of presentation, and thoroughness, based not only on feedback given to Mauseth in the years he has used this ever-evolving text, but through the comments of the thirty reviewers he thanks in the preface. Each subject area is absolutely current and is meshed with those that preceded it and those that follow. The book is printed on high-quality glossy paper with a sturdy cover and attractive binding.

Ancillary materials for the instructor include the Instructor's Resource Manual, the Test Bank and Bio-Art, a set of 150 full-color overhead transparencies, the Plant Biology Tutor CD-ROM, the Instructor's CD-ROM, and a Video Resource Library.

The Instructor's Resource Manual contains 27 chapters, corresponding to the text, with detailed instructions for setting up a lab to correspond with the chapter treated in the text. In addition, the Resource Manual contains two appendices, "Tree Keys" and "Field Trips." The keys are for common trees of either the northeastern or southeastern U. S., while the field trips cover areas including the Pacific Northwest, the Desert Southwest, the Southeastern Forests, and the Northeastern Forests. Each of the field trip sections includes specific directions to major parks that show selected habitats, a material, equipment and preparation section, and a reference section. The Plant Biology Tutor CD-ROM is menu-driven, easy to install, and a treasure chest of information closely linked to the principal text. I have not seen the overhead transparencies or the Instructor's CD-ROM, but I assume that they are of the same excellent quality as the other components of this fantastic set of teaching tools.

In summary, I can unhesitatingly recommend adoption of this book by any department offering introductory plant biology. It covers the subject in an exhaustive manner, has its information uniquely nested, uniquely presented among written text, fantastic photographs and artwork, an interactive CD-ROM and web site, and materials that require very little if any modification for use in any geographical area.—John J. Pipoly III.
58083-0, pbk) The University of Chicago Press, 11030 South Lan-
gley Avenue, Chicago, IL 60628. $24.00. 449 Pp.

As stated by the author in Chapter 2, "The concept that individuals can be grouped into populations and that populations can be grouped into discrete biological units called species is a central tenet in biology." Niklas is to be commended for a treatment of both micro- and macro- evolutionary theory that combines basic elements covered in the classic works on biological and evolutionary species, (Carlquist, Cronquist, Dobzhansky, Erhlich, Gould, Grant, Stebbins, et al.) with those of the phylogenetic school, (Eldredge, Cracraft, Wiley, Mishler, et al.), in a refreshingly new, synthetic way. The book is divided into four parts, including a comprehensive review of "evolutionary basics", "life's chronicles: the fossil record," adaptive walks: a hypothesis," and "long-term trends." The book is the first I have seen that has a strong botanical morphogenetic and paleobotanical emphasis, as well as a presentation of the adaptive walk concept.

The first part, dominated by a discourse on population genetics, is aimed at the advanced undergraduate or beginning graduate student, and is written in a clear, concise manner. I found relatively few omissions, with the exception of a discussion of character displacement vs. the Wallace Effect. However, the early introduction of phylogenetics is to be applauded, as is the historical review of Sewall Wright's and others' work with fitness. His introduction to species and speciation, with emphasis on heterochrony are rare in textbooks of this kind. While I would have liked to see more detail regarding morphogenetic abbreviations and additions (sensu Takhtajan and later, Funk and Brooks), the relationship of those concepts to that of the punctuated equilibrium hypothesis offer a balanced review. The concepts of hybridization, polyploidy and introgression are dealt with in a particularly straightforward manner.

The second part deals with the origins and early events in plant evolution, concomitant with the invasion of land and air. Using molecular evidence, paleobotanical evidence, and morphogenetic evidence, Niklas strings together a picture of early land plant evolution that brings the student through the basics of molecular, cellular, histological, vascular and reproductive evolution, first in their historical, then in their modern contexts. It presupposes that the student possesses a firm grasp of the comparative morphology of land plants, but it is, nonetheless, a synthesis that does not exist elsewhere.

The third part of the book, dealing with adaptive aquatic and terrestrial "walks" is the most unique because of its physiological aspects. It is far from light reading, because it contains some of the most complicated of subjects, including physical, physiological and morphogenetic principles rarely discussed in an introductory text. However, it is written so that one logically progresses from the unicellular to multicellular, then the aquatic to the terrestrial habitat, with extensive discussion of the physiological, ontogenetic and anatomical changes necessary to make those transitions. The only oversight I detected is a consequence of my preference to present discussions of genetic spirals and contact parasitich sets simultaneously when teaching phyllotaxy.

The final portion of the book covers long-term trends, including divergence vs. convergence, and tempos vs. events. In the section on divergence and convergence, homology and analogy are clearly differentiated, with examples ranging from the classic paleobotanical and modern morphogenetic. While most texts in this area are dull and boring, the many illustrative examples, and the quotations from Ernst Mayr and Yogi Berra certainly make it entertaining as well as instructive. While the discussion contains more inductive than
deductive reasoning than the chapters that preceded it, the synthesis of evidence from paleobotanical to modern examples informs the student of the historical bases for modern opinions. The final chapter, including explanations of cpDNA, mtDNA and nDNA, rates of genomic evolution, molecular clocks, species orogeny and demise, followed by the fossil record of speciation and extinction, offers another unique synthesis of information normally scattered between micro- and macro-evolutionary course texts.

In summary, this book is an excellent choice for any one-semester course in plant evolution. It is a bargain that should not be missed. With supplementary reprints from pertinent works in population genetics, morphogenesis, and phylogenetic theory, it could easily serve as the backbone of a two-semester graduate course in plant phylogeny. I heartily recommend it to any university biology instructor or student of evolutionary biology.

—John J. Pipoly III.
Index to new names and new combinations in this issue

*Abildaardia papillosa* Kral & M. Strong, sp. nov. 812

*Amaranthus crassipes* Schuhl. var. *warnockii* (L.M. Johnston) Henrickson, comb. nov. 788

*Amaranthus tamaulipensis* Henrickson, sp. nov. 800

*Amaranthus texensis* Henrickson, nomen. nov. 791

*Amaranthus × tucsonensis* Henrickson, nomen. nov. 804

*Barnebydendron* J.H. Kirk., nom. nov. 817

*Barnebydendron riedellii* (Tul.) J.H. Kirk., comb. nov. 817

*Bulbostylis carajana* Kral & M. Strong, sp. nov. 844

*Bulbostylis cleocharoides* Kral & M. Strong, sp. nov. 846

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Barney L. Lipscomb
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Fort Worth, Texas 76102-4060, USA
817 332-4441 / 817 332-4112 FAX
Electronic mail: sida@brit.org
Home page at the URL: http://www.brit.org/sida/

John W. Thieret
Associate Editor
Biological Sciences Dept.
Northern Kentucky University
Highland Heights, Kentucky 41076, USA

Prof. Dr. Félix Llamas
Contributing Spanish Editor
Dpto. de Botánica, Facultad de Biología
Universidad de León
E-24071 León, SPAIN

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NEW PLANTS FROM CRATER MT., PAPUA NEW GUINEA, AND AN ANNOTATED CHECKLIST OF THE SPECIES

W. TAKEUCHI

Botanical Research Institute of Texas
c/o Lae National Herbarium and
Papua New Guinea Forest Research Institute
P.O. Box 314, Lae. PAPUA NEW GUINEA

ABSTRACT

An exploratory survey of the Crater Mt. Wildlife Management Area (CMWMA) has revealed the presence of at least 1,200 vascular plant taxa within the 2,700 sq. km reserve. Included among the findings are several new species and a significant number of distributional records. Three novelties are formally described and illustrated. The new species are Glochidion beebleri, Jasminum pipolyi, and Psychotria matamblii. An annotated checklist of the collections is also provided.

The botanical documentation for the CMWMA is one of the most substantial for any locality in Papuasia. The preservation status and floristic richness of surveyed communities are very high, comparing favorably with the best sites in Papua New Guinea. Continued application of the ICAD (Integrated Conservation and Development) strategy is recommended for the subject area.

INTRODUCTION

Papua New Guinea’s (PNG) biotic environments are a focal point for numerous specialist studies, in large part due to the extraordinary diversification and endemism of its flora. In an effort to preserve this biota, conservation initiatives in PNG have been recently defined and prioritized by a number of
multiagency evaluations, of which the most consequential are the Conservation Needs Assessment Report (Beehler 1993), and the Papua New Guinea Country Study on Biological Diversity (Sekhran & Miller 1995). The Crater Mt. Wildlife Management Area (CMWMA) is listed by these appraisals in their site portfolio of localities with critical floristic or biodiversity significance (Johns 1993: 26; Sekhran & Miller 1995: 121). Despite its pristine condition and high-value biotic estimates, little information on the CMWMA's botanical resources had previously been available. A floristically-oriented census was thus initiated in 1997 to acquire data for determining the diversity and population status of CMWMA plants.

SITE SUMMARY

The 2,700 sq. km territory of the CMWMA (Fig. 1) encompasses a mosaic of floristic environments ranging from alluvial communities at 150 meters elevation to montane cloud forest at 2,100 meters. Except for scattered and localized seres resulting from subsistence agriculture, the forest formations are primary. Life zones from the lowland, premontane, and montane contours are fully represented within the project boundaries. Surveys conducted to date have examined alluvial swamp forest, lowland everwet forest, premontane foothill forest, and stunted montane forest. Within the premontane and montane zones, there are various topographic-edaphic subunits with distinctive floristic assemblages and taxonomically characteristic seral sequences. The CMWMA also includes aquatic habitats represented by lakes, oxbows, springs, permanent streams, and waterfalls. The various elements collectively comprise an unusually comprehensive habitat suite, all located within an administratively cohesive conservation unit accessible only by air.

GENERAL DISCUSSION

The following account of plant resources in the CMWMA is based on intensive collections from a two-year period of exploration. Forests near the villages of Haia and Maimafu served as principal venues for the botanical survey.

In Appendix 1, plant taxa are referenced by the specimen voucher or other source for the occurrence claim. Nearly all registers are supported by fertile collections made in multiple sets for international and local distribution. The Lae National Herbarium (LAE) is the repository for unicates, first sets, and holotypes. Recipients of duplicate sets have been designated in accordance with LAE's exchange protocols, on which Kew (K), Rijksherbarium (L), and Harvard (A), are the primary receiving institutions. Residual sets will be allocated by LAE under their auspices, in compliance with previous agreements made with our PNG host organization.
Fig. 1. Island of New Guinea. Arrow: Crater Mt. Wildlife Management Area.
Collections were field-preserved with 70–75% isopropyl alcohol and transported in plastic wrap to facilities of the PNG Forest Research Institute (PNGFRI) for subsequent processing. Taxa encountered only in sterile condition or otherwise not obtainable, were enumerated as a sight record if the plant was unequivocally known to the writer (viz. 'SR' in Appendix 1). Whenever possible, such sightings are referenced against LAE collections made by other botanists within the Purari drainage; primarily by the former Department of Forests or by CSIRO botanists L.A. Craven and/or R. Schodde. Other collector citations are provided in Appendix 1.

The survey's original intention of developing a baseline census along the CMWMA's full elevational gradient remains out of reach. In view of the 2,700 sq. km area of the reserve, this objective is an ambitious one under any scenario. Although the total species content of the CMWMA remains conjectural, establishing an estimate is still attainable with respect to checklisting the plants likely to be encountered by researchers working in the area. No empirical measure has yet been developed for the total number of plant species enclosed by Papuasian habitat gradients, whether or not assessed on vertical or horizontal lines, though Johns (1993: 26) estimates 2,000+ taxa for the Crater Mt. area. The Johns' estimate appears reasonable and is probably conservative. But if accurate, this should mean that the present itinerary has yielded up to 60% coverage of the CMWMA's total taxonomic content.

Of the floristic environments examined thus far, the forests around Maimafu have received the most complete attention. As the CMWMA's high-elevation antipode, the Maimafu area was expected a priori to have the lowest richness and to be the easiest to achieve collections saturation. Mid-montane stations like Herowana are not included in this summary, but since such sites are ecologically interposed between Haia and Maimafu, many of its plants are probably already checklisted by existing collections. The conspicuous lacuna is the alluvial formation represented by Wabo and comparable sites at the CMWMA's low elevations, where floristic documentation is still generally inadequate. The largest potential advances toward a comprehensive understanding of the CMWMA's flora will be made through critical examination of the lowland alluvial zone, notwithstanding the earlier work done by LAE and CSIRO in the Purari drainage.

A salient aspect of general appraisals of the Papuasian flora is the recognition of a remarkably diverse orchid component with more than 2,000 species (Schlechter 1911–1914, Johns 1993) and the existence of a comparably rich complement of ferns (Parris 1974). Orchidaceous and pteridophytic elements should normally peak in montane forests like Maimafu, but this has not been demonstrated by the survey because of the unfortunate circumstances imposed by the el Niño disturbance. The CMWMA was severely impacted by the recent drought, with considerable losses noted among epiphytic plants.
Enumeration of orchids, ferns, and other herbs was severely preempted. Because these assemblages are typically among the richest groups in the Papuasian montane zone, it is certain that the survey coverage was less comprehensive than if a comparable evaluation had been conducted under the conditions usually prevailing. In comparison, fruticose and phanerophytic plants were less affected by drought and responded to the resumption of rainfall with mass flowering and fruit production. The woody plants are thus better represented in the expedition gatherings.

The checklist in Appendix 1 incorporates results from earlier surveys in the Purari basin, conducted during the 1970's by CSIRO and LAE botanists. The LAE gatherings were made primarily in the Wabo area by what was then the Department of Forests, and were part of the LAE institutional number series. The CSIRO sets originate mainly from the lower part of the drainage bordering the CMWMA proper, from areas subject to the same habitat and forest conditions as are present at Pio-Wabo. These latter collections were more extensive than the LAE survey and are numbered under L.A. Craven and R. Schodde's personal number sequences. The cumulative CMWMA checklist presently includes 167 vascular plant families, 592 genera, and ca. 1,200 morphospecies, but it is obvious that an undetermined number of taxa remain unrecorded.

On a comparative percentage basis, the low elevation ecosystem at Crater Mt. is still unexplored and likely to reward future investigators with a disproportionate number of discoveries. It can be noted in this connection that the Maimafu collections consist largely of taxa already well-documented from the Highlands region. The montane affinity of the CMWMA is clearly with the general Highlands flora. However from the status of the Central Ranges as a floristic barrier, it can be surmised that lowland forests of the CMWMA should contain peculiarized and endemic elements, as has been shown by the novelty value of the CSIRO collections from low elevations.

DESCRIPTIONS OF NEW SPECIES

EUPHORBIACEAE

Glochidion beechleri Takeuchi, sp. nov. (Fig. 2). TYPUS: PAPUA NEW GUINEA.

CHIMBU (SIMBU) PROVINCE: Crater Mt. Wildlife Management Area, E of Haia village, hill forest with some anthropogenic disturbance, 6° 43' S, 145° 00' E, 775 m, 15 Mar 1997 (fr), W. Takeuchi 11,796 (HOLOTYPE: LAE; ISOTYPES: A, K, L).

Arbor mediocris, circiter 15 m alta, habitu caulifloro, ramulis teretibus. Folia (matura) ferre ovata vel elliptica, usque 17.5 cm longa, 8 cm lata. Capsula breviter obovato-pyriformis, 10–15 mm longa, 14–18 mm lata.

Subcanopy tree, 15 m height. Stem unbuttressed, outer bark pale brown, not furrowed, slash pinkish-red, wood dense, straw. Branchlets slender, weak, terete, distally fractiflex, indumentum hirtellous, brunneous, harsh. Stipules
Fig. 2. Gluchidion keblerii Takeuchi, sp. nov. A. Branchlet. B. Fruit cluster on main stem. Drawn from holotype by N.H.S. Howcroft.
linear-acuminate to subulate, caducous or persisting through several nodes, typically 3.5–4.0 mm × 0.3–1.0 mm, hirtellous. Leaves alternate, distichous, decrescent on the branch, the lower ones orbicular-subcordate, 3.5–5.0 cm wide, acroscopically with the leaves ovate and ultimately elliptic, to 10.5–17.5 cm × 5–8 cm; blades thin-coriaceous or papery, sub-bullate, bichromatic, adaxially dark green and glabrescent, abaxial surfaces strikingly blue-green glaucous and with densely hirtellous nervation, larger blades gradually acuminate, margin entire, base equal and obtuse; venation pinnate, laterals 4–7 antorsely directed pairs, arcuate, closing with commissural loops or not, crossing nerves subscalariform, major veins prominulous above, more raised beneath, reticulum ventrally obscure or invisible, dorsally manifest, areoles pulverulent; petiole 3–4 mm long, slightly swollen, articulated at base. Inflorescence not seen. Infructescence cauline from base of trunk, arranged in congested hemispherical clusters on moundlike eruptions of the wood. Schizocarp obovoid, pyriform, or depressedly globose, solitary or several together on a short ramification, mature fruits 10–15 mm × 14–18 mm, 8–9 ribbed, 1–2 mm stipitate or not, exterior surfaces subappressly puberulous, rather hyaline, soft pink in vivo, summit broadly recessed and centrally pitted, style column deciduous, not seen; fruiting pedicel concolorous with exocarp, 2–12 mm long, puberulent; calyx persistent, 6-partite, sepals lanceolate, 2–3 mm × 0.5–1.25 mm, laxly hirtellous. Seeds 2 per cell, enveloped with a smooth orange arilloid.

Distribution and ecology.—Glochidion beehleri is apparently a mid- or late-seral species in forest regrowth. It is locally common at the type locality but has thus far not been collected elsewhere. The ripe fruits are said to be eaten by cassowaries.

Etymology.—The new binomial recognizes Dr. Bruce Beehler, a noted ornithologist and frequent contributor to our knowledge of Papuan natural history. Dr. Beehler was formerly a senior ecologist for Conservation International and is currently the Director for Environmental Conservation at Counterpart International.

Paratype: PAPUA NEW GUINEA. CHIMBU (SIMBU) PROVINCE: Crater Mt. Wildlife Management Area, vicinity of Haia, near the Waro-oo streamcourse (first river E of Mt. Widau), alluvial forest, 6° 43' S, 145° 00' E, 640 m, 30 Sep 1996 (fr), W. Takeuchi 11,303 (BRIT, LAE).

Glochidion beehleri will not enter Airy Shaw's (1980: 92–96) key because of the cauliflory, a condition previously unknown for Papuan representatives of the genus. There are two cauliflorous species from western Malesia (G. oxygonum Airy Shaw from the Moluccas, and G. cauliflorum Merr. of the Philippines, cf. Airy Shaw 1969: 12), but the present taxon is incompatible with either one.

The new Glochidion produces large clusters of pyriform fruits at the base of the trunk. Except for the fructification, it is superficially similar to G. caloneurum in overall appearance.
OLEACEAE

Jasminum pipolyi Takeuchi, sp. nov. (Fig. 3). TYPE: PAPUA NEW GUINEA.


Intercrassus Jarnino Papuasian differ fructus maximus, coccus usque 35 mm diemtro.

Foliis trifoliolatis et glabris, inflorescentiis lepidotis.

Sprawling suffrutescent, or scandent vines. Stems terete, glabrous, glossy green, inermous, virgate, without exudate. Leaves opposite, exstipulate, pinnate, entirely glabrous, pinnately trifoliolate, very rarely unifoliolate but then with an articulated petiole; rachis and petiolules green, adaxially sulcate; leaflets induplicate, coriaceous, adaxial surfaces dark green nitid, abaxially medium green, apex gradually acuminate, margin closely reflexed, base cuneate or rounded, lateral blades generally lanceolate, 6.5–9.0 cm × 1.75–3.0 cm, terminal blades elliptic, 8–12 cm × 2.5–5.0 cm; venation pinnatiform, midrib channelled above, prominent beneath, laterals 5–8, thin, plane or prominulous, undersides with domatia-bearing axils, the domatia distinctly immersed, crateriform, beaded, reticulum lax and irregular, dried leaves typically developing characteristic indentations along nerves; petioles 12–23 mm long, concolorous with stems, not grooved. Inflorescence terminal or from subapical axils, cy- mose, monochasial or more often dichasial, obliquely ascending, the larger ones paniculiform and leafy, to 17 cm length, all axes peltately squamulate, bracts linear, to 6.5 mm long, persistent, granular, pedicels 4–7 mm long, gradually thickened distally, weakly constricted at the calyx. Flowers (rehydrated measurements) bisexual, brevistyloous, heterostyly not seen; calyx funnelform, 2.0–3.0 mm long (exclusive of teeth) to 2.5 mm wide, slightly accrescent, light green, tube glabrous, limb 5–6 denticulate, obscurely fimbriate, denticulations linear-subulate, 0.2–1.0 mm long; corolla salverform, im- brieate, white, entirely glabrous, obtuse in bud, tube 10 mm × 2.0 mm, costate, laxly tuberculate at first, lobes 5 sometimes 4, elliptic-oblong, 6–8 mm × 3–5 mm, mucronulate; androecium included, stamens 2–3, ad- nate to tube 2.5 mm from its base, filaments 0.5 mm long, anthers oblongoid, 3.5 mm long, connective inconspicuously apiculate; gynoecium glabrous, superior, 1 mm height, ovary undulate at the summit, style 0.5 mm long, weakly compressed and tapered, stigma punctiform, presented below the filaments. Berry geminate (aberrantly with cocci 3 or 1), lobes rounded, monospermous, 31–35 mm diameter, connate for ca. 20 mm, exocarp very smooth, nitid, glabrous, hyaline, pearly white with suffused green mottling, pericarp pulpy, greenish within. Seed white, hollowed.

Distribution and ecology.—Diffusely spread and locally frequent at the type locality. Conspicuous in edge situations along streambanks and forest mar- gins but also seen in otherwise closed forest environments.
Fig. 3. Jasminum pipolyi Takeuchi, sp. nov. A. Habit of flowering plant. B. Dichasium. C. Flower from side. D. Flower, distal view of limb. E. Inflorescence habit, with typical bilobed fruit. F. Berry, aberrant trilocular form. G. Fruit in cross-section. Drawn from holotype by N.H.S. Howcroft.
**Etymology.**—The new binomial recognizes John J. Pipoly III, a specialist in Myrsinaceae and Clusiaceae. John Pipoly is a colleague and Head of Floras at the Botanical Research Institute of Texas.

Malesian *Jasminum* have been checklisted by Kiew (1994) with 9 species accepted for Papuasia. Lingelsheim’s outdated key (1928: 18) is still the only one extant.

Fruiting specimens of *Jasminum pipolyi* are immediately distinguished by the exceptionally large fruits, which are strikingly translucent mottled. Also characteristic is the combination of squamulate inflorescence and glabrous, trifoliolate leaves which are crinkled along nerves when dried.

**RUBIACEAE**

*Psychotria matambuai* Takeuchi, sp. nov. (Fig. 4). **Typus:** PAPUA NEW GUINEA. **Eastern Highlands Province:** Crater Mt. Wildlife Management Area, ridge complex above Abegarema village on the crestline to Mt. Mopahveh, short-stature montane forest, near GPS coordinates 92802843 N, 28240 E, elev. 1,768 m, 02 Aug 1998 (fI, fr), W. Takeuchi 12.920 (holotype: LAE; isotype: BRIT).

*Psychotria beaufortii* Takeuchi affinis, sed ramulis ad nodis furfuracea, inflorescentia subcondensata, non glabra, cum pedunculo breviori (non trichotoma ex basi).

Shrub or subarborescent in mature forest understories. **Branchlets** green, fleshy, pithy, cylindrical and robust, collapsed in sicco, furfuraceous with pale brown innovations at nodes, otherwise glabrescent. **Stipules** valvate, hyaline or opaque, fugacious or semipersistent at subapical nodes, deltate, to 16 mm × 13 mm, entire, weakly carinate, laxly provided with setuliform hairs on dorsal and ventral surfaces. **Leaves** decussate, glabrous, spreading, whether or not conferred; blades fleshy-coriaceous, lacking domatia, elliptic to oblanceolate, more often broadest above the middle, 11.0–23.5 cm × 4.25–9.0 cm, ±concolorous, adaxially very dark green, abaxially medium green, bifacially somewhat fuscous with drying, apex acuminate from an obtuse or tapered summit, the acumen generally 1–2 cm long, base gradually narrowing to a petiole 3–4 cm long; venation pinnatiform, major veins elevated, laterals equispaced, 15–19 pairs, divergent, arcuate, abruptly turned near the margin but generally not closing, reticulum irregular, obscure or hardly raised above, prominent below. **Inflorescence** contracted, strictly terminal, paniculiform, 2–4 cm long, ramifications verticillate or not from a peduncle at most 1.5 cm long, ultimately cymose, caducously bracteate, rachises greenish, provided with scalelike ±crisped hairs, commissures furfuraceous. **Flowers** (rehydrated measurements) seen in advanced bud only, cymes crowded, glabrous without on all parts, pedicels proximally articulate; calyx turbinate, 7–8 mm × 6 mm, margin truncate or tearing irregularly, tube smooth, base passing insensibly to the pedicel; corolla white, gamopetalous, obtuse in bud, valvate, penta- or hexamericous, petals ligulate, 9–10 mm × 3.0–3.5
Fig. 4. *Psychotria matambuai* Takeuchi, sp. nov. A. Habit. B. Furfuraceous nodes on branchlet. C. Stipule. D. Drupe, exterior aspect. E. Drupe in cross-section, with pyrenes and rumina-
tions. Drawn from holotype by N.H.S. Howcroft.
mm, tube cylindrical, 4–5 mm × 4–5 mm, throat marked with a 3 mm ring of uniseriate-septate hairs, otherwise glabrous; stamens alternipetalous, inserted in the sinuses, glabrous, filaments 2.5 mm long, anthers introrse, basifixed, exerted, oblongoid, 3.0–3.5 mm x 1 mm; style 8 mm long, but?heterostylos, stigma 2-fid, 3 mm long, papillate, presented at the level of the anthers; disk glabrous, shallowly excavated in the center. Drupes obovoid, 19–21 mm × 14–16 mm (exclusive of calyx), orange-brown, pericarp at first entire, angulate and blackened after drying, apex crowned by the erect calyx remnant, the calycine residue 4–5 mm long, tubular, cylindrical to infundibular. *Pyrenes* 2, equal, triquetrous, crested, endosperm filling the entire cavity, ruminations transversal.

*Distribution and ecology.*—*Psychotria matambuai* is a montane umbrophile restricted to understories of mature forest stands. It is known thus far from Mt. Bosavi and the Crater Mt. area, being especially plentiful at the latter locality.

*Etymology.*—The new binomial recognizes Karol Matambuai Kisokau, a former Secretary of the PNG Department of Environment and Conservation. Karol Kisokau had also served as the first General Manager of the Crater Mt. WMA and is currently Director of Conservation and Research of the Lae-based Village Development Trust.


The new species is allied to the recently described *Psychotria bowcroftii* Takeuchi of the Bismarck–Ramu foothills of northern PNG. The large drupes with cyathiform calycine residue are characteristic of both taxa. Since *P. matambuai* is apparently confined to the southern (Papuan) side of PNG, the species pair provides yet another example of the evolutionary floristic separations imposed by the Central Ranges.

Although similar to *P. bowcroftii* in foliar, stipular, and fruit characters, *P. matambuai* is distinguishable by the furfuraceous nodes and a congested inflorescence with an indumentum of setiform hairs. On Sohmer's (1988) revision of non-climbing *Psychotria*, the new species should key to couplet 60 (ibid: 19). It can then be incorporated into the decision train by introducing a third line into the otherwise dichotomous sequence:

60. Fruit 4–5 mm in length ........................................................................................................ 61
60. Fruit 10–12 mm in length ........................................................................................................ 62
Fruit ≥20 mm in length \textemdash Psychotria matambuai
\textemdash P. howcroftii

The sister species \textit{P. howcroftii} was erroneously reported in the type description as keying to Sohmer's couplet 36 (Takeuchi 1999). The proper result should have been to fork 60 together with \textit{P. matambuai}. The two species can be differentiated with the following couplet:

\textit{Branchlets furfuraceous at nodes; inflorescence to 4 cm overall length, monopedunculate, rachises hairy, cymes congested} \textemdash P. matambuai
\textit{Branchlets glabrous; inflorescence to 10 cm overall length, trichotomous, rachises glabrous, cymes loose} \textemdash P. howcroftii

There is a minor complication at fork 57, since the leaves of \textit{P. matambuai} and \textit{P. howcroftii} can have more than 18 lateral veins, being typically 15–19 pinninerved. However the suggested outcome is more plausible than the alternative branch on the Sohmer key.

\textbf{DISTRIBUTIONAL RECORDS AND OTHER NOTEWORTHY COLLECTIONS}

\textbf{ADIANTACEAE}
\textbf{Coniogramme} sp. nov., aff. \textit{macrophylla} (Bl.) Hieron.; coll. 12,197. Differs from Papuasian populations of \textit{Coniogramme macrophylla} by the longer, narrower pinnae and lax venation. The collection needs to be checked against \textit{C. macrophylla} populations from western Malesia, to ensure that the character states are outside the range of variation for the species as a whole. The CMWMA plants are potentially new if the differences can be maintained against extra-Papuasian material.

\textbf{ANACARDIACEAE}
\textbf{Rhus lenticellosa} Laut.; coll. 11.301, det. P.F. Stevens & WT. An undetermined \textit{Haia} collection was placed to genus by P.F. Stevens (pers. comm. 6/98) and was subsequently keyed to the given result.

\textit{Rhus lenticellosa} is apparently a rare vining species, formerly known only from the Sepik and Southern Highlands Provinces (Ding Hou 1978). The conspicuously cuspidate leaves are defining. Lae Herbarium previously had no specimens determined to this binomial.

\textbf{BEGONIACEAE}
\textbf{Symbegonia parvifolia} Gibbs; coll. 11.701. Apparently endemic to western New Guinea, with the few LAE sheets of this taxon all originating in Irian Jaya. Barkley (1972) had listed the species' range simply as 'New Guinea.' Possibly a record for the eastern side.

\textbf{BURSERACEAE}
\textbf{Canarium} sp. ?nov.; coll. 11.886. What appears to be a new species of \textit{Canarium} was encountered during the recent survey. The suspected novelty has a de-
ciduous phenology, 2.5 cm acuminate stipules, and large leaflets up to 43 cm long and 14 cm wide: unusual features which should ordinarily have resulted in identification. However the plant cannot be made to key out on the Flora Malesiana and does not conform to the description of any known Papuasian Canarium.

CLUSIACEAE/GUTTIFERAE

Mammea papuana (Laut.) Kosterm.; coll. 11,905, det. P.F. Stevens. Two collections of this species were previously known, both from E. Sepik Province (Stevens 1974).

CONVOLVULACEAE

Erycibe carrii Hoogl.; coll. 12,619. Keys to this result on van Ooststroom (1955). Apparently rare. Lae Herbarium has a single sheet of this distinctive species.

Erycibe hollrungii Hoogl.; coll. 11,762. Twigs with longitudinal cork lines and the densely strigose sepals readily distinguish E. hollrungii from close congeners like E. bellwiegii.

Hoogland (1953a) described the species on the basis of a collection from NE New Guinea. In the van Ooststroom revision (1953), the taxon was characterized as being known only from the type, though Hoogland himself later found the species along the Puria River in Madang (Hoogland 1953b). Since then there has been nothing reported on this apparently rare plant. Lae Herbarium has a single sheet, consisting of the Hoogland number from Madang.

Erycibe hollrungii is relatively common around Hata and many duplicates were secured during the recent expedition. The CMWMA collections are a first record for Papua.

ELAEOCARPACEAE

Elaeocarpus lingualis Knuth, 'sepikanus group;' coll. 11,672. A member of a complex including E. elatus, E. sarcantbus, and E. sepikanus sensu stricto. Coode (1981) shows how to separate the species with flowering material, but acknowledges the taxonomy of this group is still problematic.

The species is known from only a small number of localities and had not been definitely reported from the Papuan districts.

EUPHORBIACEAE

Aporosa lamellata Airy Shaw; coll. 11,826. Large oblongish leaves and persisting auriculiform stipules indicate a relationship to A. petiolaris but the conspicuously ridged capsules are unique in the genus (Airy Shaw 1978). The fruiting collection keys unequivocally to the given species and matches the type description in Airy Shaw (ibid).

Aporosa lamellata was formerly regarded as endemic to West Irapa (ibid) although a recent determination (by A. Schor, 1996) on NGF 42,544 places
the taxon in the West Sepik as well. The species is now recorded for the Papuan side.

**Baccaurea papuana** F.M. Bailey; colls. 12,563, 12,948. (Fig. 5). The Maimafu collection from 1,768 m is the highest elevation of record for the species, which is ordinarily characteristic of lowland and coastal environments. CMWMA montane populations have a number of nonconformist features, including leaves smaller than the low elevation form and much larger fruits 35–40 mm long and 27–42 mm wide. The collections were initially prepared as sp. nov., but Airy Shaw (1980) adopts a broad circumscription of *B. papuana* and his conservative view is followed.

**Macaranga reiteriana** Pax & Hoffm.; colls. 12,262, 12,274, 12,507. (Fig. 6). A subarborescent from Whitmore's (1980) 'Longistipulata group,' *Macaranga reiteriana* is distinguished by a dense sericeous indumentum and by solitary sessile fruits inserted on bare peduncles.

The species is known only from Morobe Province, Gulf Province, and the Idenburg River in West Irian (ibid). Collections 12,262 and 12,274 key directly to this binomial and agree with cited material. The species was also recently reported from the Bismarck Mts., Western Highlands (Takeuchi 1999), and is probably much more widespread than the number of collection localities would suggest.

**FABACEAE/LEGUMINOSAE**

**Inocarpus** sp. nov. ('rubidus' morphospecies fide Verdcourt); colls. 11,139, 12,054. This cryptic species has been discussed by Verdcourt (1979) and keys out to the given result. We have several collections from various expeditions to the Papuan districts, so the taxon is apparently not particularly rare.

An unusual feature is the red sap. Leaves are distichous and with conspicuous raised areolations on the underside. The rather small stipules are another identification aid, being subpersistent and often conflated at the apical bud.

Our several sheets of the undescribed taxon all dried to a distinctive orange-brown color.

**FLACOURTIACEAE**

**Ryparosa calotricha** Mildbr.; coll. 12,008. The species is recognizable in sterile condition, due to its distinctive foliar characteristics. Not previously recorded from Papua (Sleumer 1954), and although other Papuan collections may have been obtained since Sleumer's revision, the tree is probably uncommon in the southern provinces.

**MONIMIACEAE**

**Palmeria gracilis** Perkins var. ?nov.; coll. 12,431. The collection is atypically strigose on leaves and infructescence. Possibly a new variety.
Fig. 5. *Bassiana japonica* F.M. Bailey. A. Branchlet, habit. B. Infructescence on old wood. Drawn from *Takeuchi 12,948* by N.H.S. Howcroft.
Steganthera sp. ?nov., aff. 'myrmecophilous group;' coll. 12,742. Branchlets are nodose and ant-inhabited but the surfaces are manifestly muricate, immediately distinguishing the plant from the related S. hospitans. The large leaves are also distantly toothed rather than entire. Female receptacles are distinctively 3-lobed and crenate. Possibly a new species.

MYRSINACEAE

Loheria reiniana (Jacobs) Sleum.; coll. 11,921. There are two endemic species of Loberia, both of which are rare and little-represented in herbaria.

Sleumer (1988) cites a total of 5 collections of this species. Most of the
existing specimens have originated from the Papuan districts, but the species is apparently nowhere very common. Lae Herbarium has nearly all the exsiccateae known to Sleumer, including an isotype. There is no published information on the ecology of the Papuasian taxa.

*Loberia reiniana* is locally common near Haia, where it was seen growing as a terrestrial monocaul with leaves crowded in a terminal coma. The species is always found only in sciophytic situations sequestered within mature stands and is never in seral environments. Blossoms fall quickly after opening, generally on the same day that the perianth deploys.

Population-based studies have never been made of Papuasian *Loberia* and the CMWMA occurrences afford that opportunity.

**MYRTACEAE**

*Syzygium* sp. ?nov.; colls. 11,235, 11,719. The collections are from a very distinctive species which does not key on Hartley and Perry (1973) on any couplet permutation. The suspected novelty is a subcanopy monocaul with flowers in condensed cauline cymes.

**OLEACEAE**

*Chionanthus* sp. ?nov.; aff. *salicifolius* (Lingelsh.) Kiew; coll. 12,965. The herbaceous leaves with closely set venation are unusual for this genus. Similar to Carr 14,121, annotated by Kiew as *Chionanthus* aff. *salicifolius*.

**ORCHIDACEAE**

*Vanilla wariensis* Schltr.; coll. 11,842, det. N.H.S. Howcroft. *Vanilla* is the basis for a local commercial industry which has thus far relied entirely on alien species. Endemic *Vanilla* have potential value as breeding stock for introducing genetic improvements into the current horticultural base (Howcroft, pers. comm.)

*Vanilla wariensis* is a rare orchid with exceptionally large blades and was not previously represented at Lae Herbarium by any specimens. There are no extant populations known of this species except for the Haia colonies (ibid).

**RUBIACEAE**

*Psychotria dieniensis* Merr. & Perry; coll. 12,343. Previously known only from the Fly and Sepik drainages (Sohmer 1988).

*Psychotria polita* Valeton, or aff.; coll. 12,397. *Psychotria polita* is known from the single surviving collection cited by Valeton (1927). Sohmer (1988) does not include the species in his key since the plant is not sufficiently understood. However there is a plate of the only extant sheet and a brief description of its salient characters (ibid).

The Maimafu voucher agrees with the available information on this binomial, including the particulars of its leaves and the extremely delicate
axes of the inflorescence. It is either the elusive P. polita, or a new taxon allied to it.

**Psychotria sphaerothyrsa** Valeton; coll. 12,979. A rare species. Known previously only from the lectotype and islectotype from West Sepik Province and from a citation by Merrill & Perry (1946) from Central Province (Sohmer 1988).

**Psychotria womersleyi** Sohmer; colls. 12,028, 12,056. Previously known from only two specimens originating in Eastern Highlands Province, above 1500 m (Sohmer 1988).

**RUTACEAE**

**Wenzelia tenuifolia** Swingle; coll. 12.958. The entire genus is rare; all 5 species being known from very few specimens. Stone (1985) had discussed the difficulty of evaluating Wenzelia due to the scarcity of collections available for study. He also commented on the elevational range of the genus, noting that Swingle (1967) had not thought it possible for the aurantioid taxa to ascend above 1,220 m.

The present collection from 1,770 m is the highest elevation of record for Wenzelia and is the fifth specimen known.

**SAPINDACEAE**

**Alectryon myrmecophilus** Leenh.; coll. 12,746. Previously known only from Morobe Province (Leenhouts 1994).


**Solanaceae**

**Solanum dendropilosum** Symon; coll. 11.854, det. D.E. Symon. The Crater Mt. number was originally distributed as 'sp. ?nov. aff. dendropilosum' but has been more recently determined to the species by Symon (pers. comm. 7/98).

*Solanum dendropilosum* is represented by few collections and the atypical features of the survey voucher probably represent juvenile characters. However the indumentum is unusual and possibly cannot be accommodated under the present name (ibid).

**Solanum peranomalum** Wernham; coll. 11,204, conf. D.E. Symon. Collection 11,204 was keyed to this species, formerly known only by the type specimen from Mt. Carstensz in West Iryan. The determination has been confirmed by Symon (pers. comm. 7/98).

A new record for Papua New Guinea.

**Sterculiaceae**

**Sterculia monticola** Mildbr. var laxiflora Tantra; colls. (fr) 12,148, 12,647.
The collections key to the given result on available characters. Since the fruits from this species were previously unknown (Tantra 1976), an accessory description is provided from the present material:

Fructescence racemiform, axillary, pendulous, ebracteate, fruiting stalk to 11 cm long and 4.5 mm thick, tomentulose, the hairs densely and appressedly stellate, mostly 4–8 armed; pedicels 20 mm long, articulated above the middle, indumentum like the rachis; follicles 1–4, free, shortly stipitate, divergent, coriaceous, mucilaginous, oblong-acuminate, to 9.0 cm long and 2.0 cm wide, arcuate along the dorsal suture, ventrally somewhat plane; valves 3–5 mm thick, exterior surfaces at first brown, later orange, striate with drying, scabridulous, covered by minute stellate hairs, these with arms +erectopatent and setiform, interior surfaces glabrous; seeds 8–11, black.

APPENDIX 1. LIST OF PLANT TAXA FROM CRATER MOUNTAIN

Voucher source for occurrence record: AM = Andy Mack, C&S = L.A. Craven & R. Schodde, GW = George Weiblen, Ha = village collectors ex Haia, He = village collectors ex Herowana, LAE = staff collections from the Lae Herbarium number series, S&C = R. Schodde & L.A. Craven, WT = W. Takeuchi; sn = sin numéro (without number); SR = sight record of taxon known to the project botanist. Other collectors indicated by name. Determinations by WT unless otherwise noted.

FERNS AND FERN ALLIES

ADIANTACEAE

Conogramme sp. nov., aff. macrophylla (Bl.) Hieron., WT 12197
Syngoramme schlechteri Brause, WT 11168
Taenitis blechnoides (Willd.) Swartz, SR, Maimafu

ASPLENIACEAE

Asplenium acrobracteum Christ, WT 11852, 12181, 12554
Asplenium bipinnatifidum Baker, WT 11816, 12487, 12552
Asplenium cuneatum Lam., SR, Haia; possibly A. affine Sw.
Asplenium decorum Kunze, WT 11962, 12741
Asplenium keyserianum Rosenst., WT 12910
Asplenium morinellum Copel., WT 12114
Asplenium nidus L. var. nidus, WT 11798
Asplenium pellucidum Lam., WT 11742
Asplenium phyllitisus Don subsp. malescens Holz., WT 11115
Asplenium cf. sancti-christoforii Christ, WT 11723; possibly A. keyserianum Ros.

Asplenium scenden J. Smith ex Mett., WT 11861, 12157, 12167, 12534
Asplenium steerei Harrington, WT 12104, 12227; ‘cromwelliense’
Asplenium (close to) steerei Harrington, WT 12250, 12433, 12491, 12493
Asplenium subhemispherium Rosenst., WT’s n.
Asplenium tenerum Forst., WT 12483
Asplenium unilaterale Lam., WT 12166
Dicksonella trinitata (Swartz) J. Smith, WT 12170, 12972-A
Diplora sp., C&S 794, Purari, det. Croft, = Phyllitis sp., aff. ‘longifolia’

ATHYRIACEAE

Callipteris prolifera (Lam.) Bory, SR, Haia
Diplazium acrocarpum Rosenst., or aff., WT 11159
Diplazium aff. ‘lantamense group’, WT 11726, 11825
Diplazium cordifolium Bl., SR, Haia
Diplaziaon schlechteri Hieron., WT 11794

AZOLLACEAE
Azolla pinnata R. Br., SR, Maimafu

BLECHNACEAE
Blechnum acutисculum (v.A.v.R.) C. Chr., WT 12354, 12806
Blechnum dentatum (Kuhn) Diels, WT 11734
Blechnum cf. deorso-lomatium Brause, WT 12323
Blechnum orientale L., SR, Haia; cf. LAE 61165, above Purari R.
Stenochlaena arroliaris (Harr.) Copel., SR, Haia
Stenochlaena vilnea Underwood, SR, equiv. to WT 11523
Stenochlaena palustris (Burm. f.) Beddome, SR, Haia; cf. LAE 61111, Purari R.

CYATHEACEAE
Cyathia contornianans (Wall.) Copel., SR, Maimafu
Cyathea sorbifolium (Sm.) J. Smith, WT s.n.
Dicksonia sp., SR, upper Maimafu

DAVALLIACEAE
Davallia solidia (Forster) Swartz, SR, cf. C&S 783, Purari, det. Croft
Davallia trichomanoides Bl., WT 12703
Davallia novoguineensis (Rosenst.) Copel., WT 12526, 12989
Humata dimorpha Copel., WT 11777
Humata pacifica (Sm.) Desv., SR, O-Pio
Humata tenuis Copel., WT 11780, 12223, 12614
Seychularia cf. dorsalis Copel., WT 11949; 'dorsalis - sinnura group'
Seychularia pentaphylla (Bl.) Fée, LAE 61153, Purari R.

DENNSTAETTIACEAE
Denstaedtia novoguineensis (Rosenst.) Copel., WT 11822
Denstaedtia scandens (Bl.) Moore, WT 11744
Histiopteris incisa (Thunb.) J. Smith, WT 11685
Pteridium aquilinum (L.) Kuhn, WT 12799, approaching P. esculentum

DIPTERIDACEAE
Diptheris conuqjgata Reinwardt, WT 12232
Diptheris novo-guineensis Posthumus, SR, Maimafu; less common than congener

DRYOPTERIDACEAE
Arachniodes aristata (Forst. f.) Tindale, WT 12696
Dryopolystichum phaeostigma (Ces.) Copel., LAE 61158, Purari River; det. Grimes
Polystichum aculeatum (L.) Schott, s. lat., WT 11757

EQUISETACEAE
Equisetum ramoxissinum Desf. subsp. debile (Vauch.) Hauke, WT s.n.; O-Pio

GLEICHENIACEAE
Dranogonopteris linearis (Burm. f.) Underwood var. linearis, WT 12215
Gleichenia dicarpa R. Br., SR, upper Maimafu
Gleichenia hirta Bl. var. candida (Rosenst.) Holtrum, WT 12320
Gleichenia cf. sordida Copel., WT 12225, subg. Diplopterigium

GRAMMITIDACEAE
Calymnodon clarifer (Hooker) Moore, SR, Maimafu
Ctenopteris multicaudata (Copel.) Copel., WT 12849
Ctenopteris repanda Kunze, WT 11817
Ctenopteris subsecundodissecta (Zoll.) Copel., WT 12053, 12368
Ctenopteris sp. A, 'taxodioides-yoderi group', SR, upper Maimafu
Ctenopteris sp. B, WT 12907
Grammitis sumatrana (Baker) Copel., WT 11278
Grammitis spp., WT 12833, 129096
Loxogramme scolopendrioides (Gaud.) Morton, WT 11964
Prosaptia alata (Bl.) Christ, WT 12224; prob. syn. with Ctenopteris

HYMENOPHYLLACEAE
Crepidomanes bipunctatum (Poiret) Copel., WT 11935
Trichomanes ablesbioides Chr., LAE 61147, Purari River, det. Croft
Trichomanes atriores (Presl) Kunze, LAE 66281, Wabo dam site
Trichomanes intermedium v.d.B., LAE 66314, near Wabo

LINDSEAA GROUP
Lindsaea cf. lobata Poiret, WT 12115, possibly L. obtusa complex
Lindsaea lucida Bl., SR, Pio
Lindsaea microstegia Copel., WT 11737, 11788
Lindsaea obtusa J. Smith, WT 11722, 12194, 12701
Lindsaea pauciflora (J. Smith) Mettenius ex Kuhn var. blanda (Mettenius ex Kuhn) Kramer, WT 12889
Lindsaea pauciflora (Brackenridge) Carruthers ex Seemann, WT 12896
Lindsaea tenatifolia Bl., LAE 66296, Wabo dam site
Sphenomeris chinensis (L.) Maxon, SR, Maimatu airstrip
Sphenomeris retusa (Cav.) Maxon, WT 12612
Tapeinidium longifimulium (Cesati) C. Chr., SR, Haia
Tapeinidium novoguineense Kramer, WT 11824, 12344
Tapeinidium cf. novoguineense Kramer, WT 12317
LOMARIOPSIDACEAE
Bolbitis heteroclita (Presl) Ching, WT 11819, 12409
Bolbitis quoyana (Gaud.) Ching, WT 11554; miniature form
Bolbitis ranularis (Brackenridge) Ching, WT 12659
Elaphoglossum novoguineense Rosenst., WT 1246
Lonagrynum sinuata C. Chr., WT 11755; cf. LAE 61095, Purari
Lomariopsis kingii (Copel.) Holttum, SR, Haia; cf. C&S 4644
LYCOPODIACEAE
Huperzia aff. carinata (Poirier) Trevisan, WT 11120
Huperzia nummulariifolia (Bl.) Jermy, SR, Haia
Huperzia phlegmaria (L.) Rothm., WT 12442; C&S 878, Purari
Huperzia cf. phlegmaria (L.) Rothm., WT 12139
Huperzia squarrosa (Forst. f.) Trevisan, WT 12055
Huperzia (near) squarrosa (Forst. f.) Trevisan, LAE 66309, Wabo dam site
Lycopodium volubile Forst. f., WT 12811, 12851
Palhinhaea cernea (L.) Vasc. & Franco, SR, Haia & Maimatu
MARATTIACEAE
Angiopteris erecta (Forst.) Hoffman, WT 12230
Marattia brassii Copel., LAE 61162, Purari River, det. Leiden list
Marattia cf. novoguineensis Rosenst., WT 11832
OLEANDRACEAE
Nephropsis acuminata (Houtt.) Kuhn, WT 11790, 12435, 12496, 12602, 12610, 12624, 12626, 12638
Nephropsis biserrata (Swartz) Schott, WT 11753
Nephropsis cf. falcata (Cav.) C. Chr., WT 11118; indumentum close to falcata
Nephropsis lanterbacii Christ, WT 12067, 12540
Oleandra capudata Baker, WT 11714, 12970
Oleandra werneri Rosenst., WT 11116
PHIIOGLOSSACEAE
Ophioglossum pendulae L., SR; cf. C&S 796, Purari
OSMUNDACEAE
Lepidozrea alpina (Baker) C. Chr., WT 12363, 'typical form' sensu Johns
POLYPODIACEAE
Aglonorpha drymarioides (Hook.) Roos, WT 11147
Aglonorpha beraeae (Kunze) Copel., SR, Maimatu
Aglonorpha bierwyeni (Brause) Copel., WT 12527, 12641
Aglonorpha cf. novoguineensis (Brause) C. Chr., WT 12213, 12292, 12513, 12535
Bertiella nanomata (Fée) Copel. var. nanomata, WT 11845, 12467, 12783
Drynaria sparsa (Desvaux) T. Moore, SR, Haia
Goniophlebus persicifolius (Desvaux) Beddome, WT 11119
Goniophlebus subauriculatum (Bl.) Presl, WT 11117, 12313, 12501, 12512
Lecanopteris mirabilis (C. Chr.) Copel., WT 12758
Lemmaphyllum acetosum (Bl.) Donk, AM 403; WT 11725
Leptochilus decurrens Bl., WT 11963
Microsorum glassophyllum (Copel.) Copel., WT 12521
Microsorum linguiforme (Mettenius) Copel., LAE 61161, Purari, det. Grimes
Microsorum papayum (Baker) Parris, WT 12457, 12568, 12631, 12805, = Phymatosorus sp.
Microsorum punctatum (L.) Copel., WT 11953
Microsorum rampans (Baker) Parris, WT 11775
Microsorum subgeniculatum (Christ) Copel., WT 11743, = Phymatosorus sp.
Phymatosorus communeus (Bl.) Pichi Sermolli, WT 11735, 11881, 12025, 12426
Phymatosorus nigricans (Bl.) Pichi Sermolli, WT 12726
Phymatosorus cf. nigricans (Bl.) Pichi Sermolli, WT 12736
Pyrozia foveolata (Alston) Morton var. foveolata, WT 11946
Pyrozia foveolata (Alston) Morton var. lanterbacchi (Chir.) Hovenkamp, LAE 66321, det. Leiden list
Pyrozia princeps (Mettenius) Morton, WT 11931
Selliguea albidosquamata (Bl.) Parris, WT 11792, 12613, 12727
Selliguea enervis (Cav.) Ching; sensu Hovenkamp, WT 12151, 12832, gramineous form
Selliguea enervis (Cav.) Ching; sensu Hovenkamp, WT 12315, ‘typical’ form
Selliguea ferra (Brause) Hovenkamp, or aff., WT 11781

PSILOTACEAE
Psilotum complanatum Swartz, SR, Haia
Psilotum nudum (L.) Beav., SR, Haia

PTERIDIACEAE
Acrostichum species Willd., S&C 4481, det. Leiden
Pteris exceda Gaud., WT 12377, 13002
Pteris gardneri (Fée) Hooker, WT 12438
Pteris moluccana Blume, SR, Haia
Pteris orientalis v.A.v.R., WT 12608, 12730, 13001
Pteris pacifica Hieron., WT 11910
Pteris schlechleri Brause, WT 12161
Pteris trispicata Swartz, WT 11778
Pteris wallichiana Agardh, WT 13003
Pteris werneri (Rosenst.) Holttum, WT 12876

SCHIZAECACEAE
Lygodium cirrhotum (Burm. f.) Swartz, SR; cf. C&S 736, det. Croft
Lygodium salicifolium Presl, WT 11155
Schizaea dichotoma (L.) Sm., SR; cf. S&C 4229, det. S&C
Schizaea digitata (L.) Swartz, LAE 66355, det Leiden list

SELAGINELLACEAE
Selaginella ‘relation-wallichii group’, WT 11774; interspecific distinction not clear

TECTARIA GROUP
Tectaria baumanniana (Cesati) C. Chr., SR, Haia
Tectaria pleiozona (Alderw.) C. Chr., WT s.n.
Tectaria repanda (Willd.) Holttum, WT 12437
Tectaria cf. repanda (Willd.) Holttum, WT 12415, ‘crenata-repanda group’

THELYPTERIDACEAE
Anaphineuron aff. immerum (Bl.) Holttum, WT 11911
Chingia impoens (Ces.) Holttum, WT 11687
Pleioneuron marattiioides (Alston) Holttum, WT 12400
Pneumatopteris cf. sogerensis (Gepp) Holttum, WT 11686, but keys to P. radigasiana
Sphaerostephanos atasciphius (Rosenst.) Holttum, WT 11932
Sphaerostephanos heterocarpus (Bl.) Holttum, WT 11793
Sphaerostephanos invasus (Forst. f.) Holttum, LAE 61122, Purari, R., det. Leiden list
Sphaerostephanos multicaudatulatus (Copel.) Holttum, WT 11918
Sphaerostephanos novograneensis (Brause) Holttum, WT 10909
Sphaerostephanos pilosiquamatus (v.A.v.R.) Holttum, WT 11823
Sphaerostephanos unitus (L.) Holttum, SR, Haia

THYSOPTERIDACEAE
Calcita sp.; straminia or villosa, SR, upper Maimafu

VITTARIACEAE
Antrophyum alatum Brackenridge, WT 11933; LAE 61094, Purari, det. Croft
**GYMNOSPERMS**

**ARAUCARIACEAE**  
*Anuicaricia buntei* Sm., SR, Mainalu

**CUPRESSACEAE**  
*Lepidobothriodendron* F. M., var. *papuanus*, WT 12203

**CYCADACEAE**  
*Cycas scrubbyana* Ex.M., LAE 61174, Purari River, det. K.D. Hill, also C&S 750

**GNETACEAE**  
*Gnetum gynom.* L. or *G. castaneum* K. Schum., WT s.n.  
*Gnetum latifolium* Bl., WT 12079

**PODOCARPACEAE**  
*Dacrydium imbricatun* (Bl.) de Laubenfels, WT s.n.  
*Podocarpus neriifolius* D. Don, SR, Pio; cf. C&S 4237, det. de Laubenfels

**DICOTS**

**ACANTHACEAE**  
*Calophanoides angustata* (Warb.) Brem., WT 12265-A  
*Dichiptera papuana* Warb., WT 12510  
*Graphiphyllum* cf. *pictum* (L.) Griff., WT 11126  
*Hemigraphis reptans* T. Anders., or aff., SR of common herb, Haia  
*Lepidocarpos* sp., WT 12033  
*Peristrophe* sp., WT 11260  
*Pyxigaltisia pustulata* (Lindau) B. Hansen, WT 11269  
*Rangia klossii* S. Moore, WT 12072, 12890

**ACTINIDIACEAE**  
*Saurauia* aff. *takaharai* Laut., WT 12918  
*Saurauia congestiflora* A.C. Smith, WT 12017  
*Saurauia nanumnnii* Diels, or aff., WT 11124, 11689, 12200, 12475, 11124, 11689. distr. as aff. *conferta*  
*Saurauia schumanniana* Diels, s.l., GW 716B; WT 11811, 12022  
*Saurauia stichophlebia* Diels or aff., WT 11166, 11184  
*Saurauia* sp., series *Obtectae*, WT 12217, 12302 (form 1); 12690, 12769 (form 2)  
*Saurauia* sp., series *Obvallatae*, aff. *conferta*  
Warb., WT 12042, 12078, not the sp.  
*Saurauia* sp., series *Ramiflorae*, WT 12476  
*Saurauia* sp., series *Setosae*, WT 11810  
*Saurauia* sp. A, unplaced aff., WT 12013, 12169  
*Saurauia* sp. B, unplaced aff., WT 12097, 12916  
*Saurauia* sp. C, unplaced aff., *Sands et al.* 1482, Purari R.

**AMARANTHACEAE**  
*Achyranthes aspera* L., SR, O-Pio  
*Achyranthes bidentata* Bl., WT 12576  
*Celosia argentea* L., WT 11967  
*Iresine herbstii* Hook. f., WT 12801

**ANACARDIACEAE**  
*Buchanania arborescens* (Bl.) Bl., AM 336, 589; WT 12091  
*Campnosperma brevipetiolata* Volkens, SR, Haia  
*Dractonelon dao* (Blanco) Merr. & Rolfe, AM 252  
*Gluta papuana* Ding Hou, C&S 4492, E. Purari, det. Ding Hou  
*Pleionium timorensis* (DC.) Leenh., WT 12092  
*Rhus lentisclosa* Laut., WT 11301, det. Stevens & WT, distr. as indet.  
*Rhus taitensis* Guillemin, WT 12404  
*Semecarpus auranti* Engl., WT 11243  
*Semecarpus bracteatus* Laut., WT 12543, 12841  
*Semecarpus magnificus* K. Schum., WT 12678  
*Semecarpus papuanus* Laut., WT 12048, 12063, 12065, 12693 (fr), 12749 (fr)  
*Semecarpus rostratus* Valerio, LAE 61120, Purari R., det. Ding Hou  
*Semecarpus schlechteri* Laut., WT 11828

**ANNONACEAE**  
*Cananga odorata* Hook. f. & Thoms., SR; cf. C&S 4499, E. Purari, det. C&S
Cyathocalyx papuanus Diels, SR; cf. S&C 4230, 4385, det. Leiden
Goniothalamus arnensis Scheffer, WT 11234
Goniothalamus imbricatus Scheffer, WT 11206, 11800
Haplostichanthus longirostris (Scheffer) van Heusden, WT 11272
Polyalthia 'glanca-discolor group', WT 12094
Polyalthia aff. 'oblongifolia group', WT 11160, 11215, 11913, distinctive; laterals acrosopic, leaves areolate
Polyalthia cf. pisocarpa (Bl.) Endl., WT 11248
Polyalthia aff. 'pisocarpa group', WT 11901
Pseudovaria cf. grandifolia (Warb.) J. Sinclair, WT 12024
Xylopia malayana (Hook. f.) & Thomos., or papuan Diels, WT 11994

APOCYNACEAE
Alstonia macrophylla Wall., ex G. Don, WT 12063
Alstonia scholadiensis (L.) R. Br., WT 12071
Alyxia markgrafii Tsang, WT 11740
Alyxia sp.; cf. series Floribundae, WT 12300
Cerbera floribunda K. Schum., AM 1; WT 12006, 12695
Finlaysonia obovata Wallich, C&S 813, E. Purari, det. Forster
Ichnocalyx frutescens (L.) W.T. Aiton, WT 11756
Lepidoptoris tennateis Valeton, C&S 825, Purari
Melodinus acutus (Markgraf) Markgraf, WT 12468 (fr), 12978
Melodinus forbesii Fawc., WT 11710; LAE 61102, Purari R.
Neisoperma ficifolium (S. Moore) Fosb. & Sach., WT 11237, 11997
Papaechites ambe (Warb.) Markgraf, SR, Pio; cf. LAE 66354, det. Middleton
Parsonsia latifolia Markgraf, WT 12309 (fr), 12511
Parsonsia oligantha (K. Schum.) D.J. Middleton, SR, O-Pio
Parsonsia sanguinea (Wernham) Markgraf var. brassii (Markgraf) D.J. Middleton, WT 12387, 12880
Parsonsia (closest to) sanguinea var. brassii, WT 11760
Parsonsia warrenensis Kanchira & Harusima, WT 12731-A

AQUIFOLIACEAE
cf. Ilex, WT 12634

ARALIACEAE
Gastonia spectabilis (Harms) Philipson, SR, Haia
Harmiospanax harmsii K. Schum., WT 12205
Mackinlaya celibica (Harms) Philipson, WT 11164
Mackinlaya schlechteri (Harms) Philipson, WT 11298, 11772
Osmoxylon boerlagei (Warb.) Philipson, WT 12700
Osmoxylon micranthum (Harms) Philipson, WT 12171
Osmoxylon novoguineense (Scheffer) Becc., SR; cf. S&C 789, Purari, det. Philipson
Polyscias cf. ledermannii Harms, WT 11982
Schefflera schumanniana Harms ssp. schumanniana, WT 11130

ARISTOLOCHIACEAE
Pararistolochia manandulae (K. Schum.) M.J. Parsons, GW 743, 813; based on GW det.

ASCLEPIADACEAE
Asclepias physocarpa Schltr., WT 12796
Dischidia ovata Benth., S&C 4480, E. Purari, det. Liddle
Dischidia torricellensis (Schltr.) P.I. Forster, WT 11736; det. P.I. Forster
Heterostemma acuminatum Decne., WT s.n.; S&C 4705, det. P.I. Forster
Hoya australis R. Br. subsp. tennipit (K.D. Hill) P.I. Forster & Liddle, WT 11867, 11947; det. P.I. Forster
Hoya lanterchabii K. Schum., WT 11185, 11205; det. P.I. Forster
Hoya litoralis Schltr., S&C 4482, Purari, det. Green, (not seen)
Hoya piestolepis Schltr., WT 11945; det. P.I. Forster
Marsdenia velutina R. Br., WT 11748; det. P.I. Forster
Sarocolus globatus Wallich subsp. peregrinus (Blanco) Rintz, S&G 4461, E. Purari, det. P. Forster
Sarocolus kauense (Schltr.) P.I. Forster, WT 11843; det. P.I. Forster
Sarocolus oblongus Rintz, cited by Rintz (1980) from Purari R.
Tylophora flexuosa R. Br., S&G 4490, E. Purari, det. P.I. Forster

ASTERACEAE (COMPOSITAE)
Adenostemma lavinia (L.) Kunze, SR, Haia; also S&G 4500
Adenostemma macrophyllum (Bl.) DC., WT 12024, 12062
Agaratum conyzoides L., WT 12797
Bidens pilosa L. var. minor (Bl.) Sherff, WT 12606
Blumea arfakiana Martelli, WT 11223
Blumeana anchialophora Mattfeld, SR, Maimafu
Blumea riparia (Bl.) DC., WT 11743, 12245
Blumea sylvatica (Bl.) DC., WT 12271, 12848, 12981
Cosmos candatus HBK, WT s.n.
Crassocophelum crispoides (Benth.) S. Moore, WT 12605, 12640
Emilia souchifolia (L.) DC. var. javanica (Burm.) Mattfeld, WT 12795-A
Erabotto velutinifolia (Wolf) DC., SR, Haia
Erigeron sumatrensis Retz., WT 12604
Etholia conyzoides L.f. ex L., WT 12878
Gynura procumbens (Lour.) Merr., WT 12931
Microglossa pyrifolia (Lamk.) O. Ktze, WT 12089
Mikania cordata (Burm. f.) B.L. Rob., WT 12630
Senecio sp. @ nov., WT 12322; vining, fulvous lanate underleaf
Tagetes minuta L., SR, Hauneababo track
Tithonia diversifolia (Hemsl.) A. Gray, SR, Haia & Maimafu

BALANOPHORACEAE
Balanophora papuana Schltr., WT 12755

BALSAMINACEAE
Impatiens baackei Bull, WT 12518
Impatiens linearifolia Warb., WT 12256; or as Grey-Wilson’s ‘group 10’

BARRINGTONIACEAE
Barringtonia calyptera (Miers) R. Br. ex Bailey, cited in Payers (1967)

BEGONIACEAE
Begonia aff. ‘augustae’ Irmscher, WT 11195, 12628
Begonia pinnatifida Merr. & Perry, WT 11290
Begonia aff. pseudolateralis Warb., WT 11125, ‘brachybrotys-pseudolateralis’
Begonia serratifolia Irmscher, WT 11171
Begonia sp. ‘kanoeis group’, WT 12082, 12458, det. Gideon
Begonia sp., ‘tafaesiis group’, WT 12080, 12852
Begonia sp. A, unknown aff., LAE 61187, above Purari R.
Begonia sp. B, unknown aff., WT 12030, 12142-A
Synkegontia fulvo-villosa (Warb.) Warb., WT 12029, 12086, 12154, 12915
Synkegontia gerranifolia Ridl., WT 12178, 12321, 12382, 12395
Sykegontia papuana Merr. & Perry, WT 12176
Synkegontia parvifolia Gibbs, WT 11701

BIGNONIACEAE
Dolichandra spathacea (L.f.) K. Schum., C&S 871, Purari, det. van Steenis
Pandorea pandorana (Andr.) Steenis ssp. pandorana, WT 12460
Tecontania decipriphila (Bl.) K. Schum., WT 11137, 12429, 12687, 12821, 12853

BIXACEAE
Bixa orellana L., SR, Haia

BOMBACACEAE
Camptospermum schultzii Mast., C&S 799, Purari

BORAGINACEAE
Cordia subcordata Lam., C&S 872, Purari, det. collectors
Cynoglossum belluligii Brand, WT 12255
Tournefortia minutiflora Ridl., cited in Riedl (1996)
Tournefortia sarmentosa Lamk., SR, Haia
Trigoniopsis nobilita Ev. M. var. inobilita, WT 12032, 12087, 12834

BURSERACEAE
Canarium acutifolium (DC.) Merr. var. acutifolium, LAE 61090, Purari, det. Leiden
Canarium cf. asperum Benthi, SR, O-Pio
Canarium malnose Laut. ssp. malnose, SR; cf. C&S 699, S&G 4393, det. Leiden
Canarium viticinse A. Gray, WT 11250, 11894, 12294, 12078
Canarium sp. nov., WT 11886

Cannabinaceae
Cannabis sativa L., SR, cultivated

Capparaceae
Capparis lanceolariis Lesch. ex Steud., GW 814, det. GW

Caprifoliaceae
Sambucus canadensis L., WT 12074

Cardiopoteridaceae
Cardiopoteris moluccana Bl., SR; cf. C&S 845, Purari, det. Leiden

Caricaceae
Carica papaya L., SR; ?naturalized Maimafu area, also cult.

Caryophyllaceae
Drymaria cordata (L.) Willdenow ex Roemer & Schult., WT 12001, 12566
Stellaria media L., WT 12763

Casuarinaceae
Casuarina cf. oligodon L.A.S. Johnson, WT 12243
Gynuraona papuana (S. Moore) L.A.S. Johnson, WT s.n.

Cecropiaceae
Poikilospermum inaequale Chew, AM 542: WT 12100, 12365, 12729
Poikilospermum pachyanum (Winkler) Merr., AM 215; WT 11158

Celastraceae
Celastrus monoperoideus Loes., WT 12351, 12356
Celastrus noroguinensis Merr. & Perry, WT 12238, 12524, 12616
Lophophetala sp., WT 12046
Pterospermum alpestre (Bl.) Loes. ssp. moluccana (Bl.) Ding Hou, WT 12775
Salacia sororia Miq., WT 12037
Siphonodon celastrinus Griff., SR, Pio; cf. S&C 4393, Gulf

Chloranthaceae
Ascarina philippinensis C.B. Robinson, WT s.n.
Ascarina soboliflora Verdcourt, SR, Maimafu; ID from sessile leaves
Chloranthus erectus (Buch.-Ham.) Verdcourt, WT 12004

Chrysobalanaceae
Marantba syrornoba Bl., SR, Pio
Paratetramorium versteegii Merr. & Perry, SR, Pio
Parinari papiiana C.T. White, WT 11890

Clusiaceae (Guttiferae)
Calophyllum 'goniacarpum complex' sensu Stevens, WT 11836, 12874
Calophyllum papuanum Laut., AM 254
Calophyllum sil Laut., WT 12874
Calophyllum suberosum Stevens, C&S 832, Purari, det. Stevens
Garcinia archboldiana A.C. Smith, WT 10494, 12407
Garcinia celebica L., WT 11906; S&C 4218, det. Stevens
Garcinia aff. celebica L., WT 12561, 12866, 12941
Garcinia dulcis (Roxb.) Kurz, WT 11981, 12084
Garcinia fusiformis Stevens, AM 296
Garcinia holovirgii Laut., WT 11973, 12041
Garcinia aff. kunstheini Laut., WT 11797
Garcinia aff. ?jawaeri Laut., WT 12047
Garcinia cf. klinkii Laut., WT 12792
Garcinia latisima Miq., AM 40; S&C 4454, E. Purari; WT 12311
Garcinia ladermauwi Laut., WT 11980
Garcinia malnensis Laut., WT 11255, 11716, 11887
Garcinia manmoeoides Kosterm., WT 11247
Garcinia warreii Ev.M., WT 12618
Garcinia sp. A, unplaced aff., WT 12282, 12964
Garcinia sp. B, unplaced aff., WT 12651, 12943
Mannea papuana (Laut.) Kosterm., WT 11905, der. Stevens

Combretaceae
Quisqualis indica L., WT 11996
Terminalia complanata K. Schum., AM 240
Terminalia impediens Coode, SR; cf. S&C 4310, det. Coode
Terminalia kaernbachii Warb., WT 11983, 12016
Terminalia cf. macadamii Exell, WT 12037
Terminalia microcarpa Decne subsp. microcarpa, S&C 4509, E. Purari, det. Coode

Convolvulaceae
Erycibe carrui Hoogl., WT 12619
Sumcaborijera
Cunoniaceae
Corynocarpus ciliatus (F.M. Bailey) L.S. Smith, SR, Pio; cf. S&C 4452, Purari, det. Molloy

Cucurbitaceae
Calendula officinalis (L.) Roemer, C&S 843, Purari, det. Frodin
Zea mays var. mays (L.) Miq., WT 11813

Cunoniaceae
Acmena sp., SR, upper Maimau
Calliclava celebica (Bl.) Hoogl., WT 12214
Calliclava wymanii (K. Schum.) Hoogl., WT 12772
Pulla glabra Schltr. var. glabra, WT 12257; typical form
Pulla glabra Schltr. var. glabra, WT 12770; abberant form, cf. 'perryana'
Schizomeria ilicifolia (K.R. Schum.) Schltr., WT 12813
Schizomeria (probably) pareivolia Perry, SR, upper Maimau, sterile
Weinmannia sp., SR, Maimau, sterile

Datiscaceae
Octomeles sumatranus Miq., SR, Pio

Dichapetalaceae
Dichapetalum papuanum (Becc.) Boerl., WT 11878
Dichapetalum sessiliflorum Leenh., WT 11849
Dichapetalum (probably) timoriense (DC.) Boerl., cf. S&C 4427, det. Leiden

Dilleniaceae
Dillenia castaneifolia (Miq.) Diels, SR; cf. S&C 4370, det. Hoogland
Dillenia schlecteri Diels, WT 12310, 12867

Dipterocarpaceae
Vatica papuan Dyer, SR, Pio

Ebenaceae
Diospyros cf. elliptica (J.R. & G. Forst.) P.S. Green, WT 11850, 12014, 12663, 12839

Diospyros forrea (Wildenow) Bakh., s.l., WT 11986
Diospyros kecarya A. Cunn. ex Benth., WT 12764

Elaeagnaceae
Elaeagnus triflora Roxb. var. triflora, WT 12581

Elaeocarpaceae
Aceratium loderiannii Schltr., WT 11840, 12939
Aceratium muellerianum Schltr., WT 12079
Aceratium oppositifolium DC., WT 12099
Elaeocarpus cimicinoides Warb., WT 12098
Elaeocarpus dolichodactyli Schltr., SR, Pio; cf. S&C 4326, 4001, det. Coode
Elaeocarpus loderiannii Schltr., SR, Pio; cf. Pullen 6453 near Purari R.
Elaeocarpus tinguardi Knuth, WT 11672, 'sepikanus complex'
Elaeocarpus multisetus Schltr., S&C 4446, E. Purari R.; also NGF 41158, Purari R., det. Coode
Elaeocarpus nobilis Koorders, S&C 4463, E. Purari R., det. Coode
Elaeocarpus polydactyli Schltr., WT 12622 (fr), Coode's 'group 4'
Elaeocarpus (close to) schlechteranus A.C. Smith, WT 12538, possible sp. nov.
Elaeocarpus sepikanus Schltr., s.l., AM 311
Elaeocarpus sericophides A.C. Smith, GW 809, det. GW
Elaeocarpus sphaericus (Gaertn.) K. Schum., WT 11942
Elaeocarpus sp., 'sepikanus complex', WT 12842 (fr), can't separate sp. with fruits
Elaeocarpus sp., 'sphaericus-altisectus group', WT 12942 (fr), can't separate without flowers
Seriolea micans Schltr., WT 12574
Sloanea cf. wymanii K. Schum., WT 12766, but leaf size atypical
Sloanea aff. pulleniana Coode, AM 669
Sloanea forbesii F.v.M., GW 732, det. GW

Ericaceae
Dimorphanthera aff. hippoceras J.J. Sm., WT 12822
Dimorphanthera brevipes Schltr., WT 11721; det. P.F. Stevens
**EUPHORBIACEAE**

*Dimorphanthera* dekockii J.J. Sm. var. *chlorocarpa* (Sleumer) Sleumer, WT 12184, 12403

*Dimorphanthera* cf. *elegantissima* K. Schum. var. *splendens* (Sleumer) Stevens, WT 12041, 12305, 12406

*Dimorphanthera kempteriana* Schltr., WT 12147, 12937, 11783; det. Stevens

*Dimorphanthera* viviflora Stevens, pers. com. P.F. Stevens

Gaultherieae indet., *Gaultheria*, WT 12451, could be new

*Rhododendron* dielsianum Schltr. var. *dielsianum*, WT 12522, 12450, 12845

*Rhododendron* macgregoriae F.v. M. var. *macgregoriae*, WT 12420, 12514, 12555, 12623-A/B, 12800

*Rhododendron multisetuinum* Sleumer, WT 12026

*Rhododendron* phaochtium F.v. M., WT 12278

*Rhododendron* scabridibracteum Sleumer, WT 12314

*Rhododendron* zoelleri Warb., WT 11239

*Vaccinium* acrobracteatum K. Schum., WT 12318

*Vaccinium* carneolum Sleumer, WT 12316

*Vaccinium* cyclopense J.J. Sm. f. *cyclopense*, WT 12381

*Vaccinium finisterreum* Schltr., WT 12378

**EUPHORBIACEAE**

*Acalypha* grandis Bench., AM 211

*Acalypha helenium* Warb., WT 11197, 12629, 12672, 12675

*Antidesma* olivaceum K. Schum., WT 12074

*Antidesma* aff. *rhynchophyllum* K. Schum., WT 11287, 11715; no result on Airy Shaw

*Antidesma* cf. *sarcocarpum* Airy Shaw, WT 11257, ‘*jucundum-concinnum* group’

*Aporosa* lamellata Airy Shaw, WT 11826

*Aporosa* petidiaris Airy Shaw, WT 12001

*Breynia* papuanana F.M. Bailey, WT 12563, 12948; also LAE 61083, Purari River, det. Dockrill

*Breynia* javanica (Bl.) Kurz, WT 13009

*Breynia cernua* (Poir.) Muell.-Arg., WT 11691, 12506

*Breynia vestita* Warb., WT 12798

*Claroxyylon latexen* Pax & Hoffm., WT 12258, 12574-A, 12992

*Claroxyylon* cf. *microcarpum* Airy Shaw, WT 11844; ‘*ledermannii-microcarpum* group’

*Claroxylon* sp., ‘*Parparascentia* group’, AM 598

*Codiaeum variegatum* (L.) Bl. var. *moluccanum* (Decne.) Muell.-Arg., WT 11191, 12702

*Drypetes* aff. *lasioclinodes* Pax & Hoffm., WT 12082, 12083

*Endospermum labium* Schodde, WT 11803

*Euphorbia* planterioides Teijsm. ex Hask. var. *acuminata* J.J. Sm., WT 12702

*Exocarca* indica (Wildenow) Muell.-Arg., WT s.n.; NGF 41139, Purari R.

*Galearia* celebica Koorders var. *celebica*, SR; cf. S&C 4240, det. Leiden

*Glochidion* chlamydogyne Airy Shaw, or aff., WT 11211

*Glochidion* delticola Airy Shaw, S&C 4504, E. Purari R., det. Leiden list

*Glochidion* fulvismum Miq., or aff., WT 12632, 12778

*Glochidion* mirrastylum Airy Shaw, AM 650

*Glochidion* novo-guineense K. Schum., AM 590; WT 12231, 12635

*Glochidion* perakens Hook. f. var. *supraxonilare* (Benth.) Airy Shaw, AAI 619

*Glochidion* sp. nov.; aff. *caloneurum* Airy Shaw, WT 11503, 11796

*Macaranga* aleritoides F.v. M., GW 755, 756, det. GW

*Macaranga* angustifolia Laut. & K. Schum., WT 11238

*Macaranga* chrysoleicha Laut. & K. Schum., WT 12044, 12264

*Macaranga* ducis Whitmore, WT 12087

*Macaranga* cf. *ducis* Whitmore, WT 12088

*Macaranga* fallacina Pax & Hoffm., WT 11934

*Macaranga* papuan (J.J. Sm.) Pax & Hoffm. var. *glabrisiptala* Whitmore, AM 609

*Macaranga* pleiostemon Pax & Hoffm., WT 12208, 12962

*Macaranga* quadriglandulosa Warb., WT 11752

*Macaranga* reticulata Pax & Hoffm., WT 12262, 12274, 12507
Macaranga tanarius (L.) Muell.-Arg., GW 722, det. GW
Macaranga sp.; aff. ?boffmannii Perry, WT 12558. 12515; sp. dubiae Whitmire
Mallotus dichymobryeous Airy Shaw, LAE 61115, Purari R., det. Airy Shaw
Mallotus paniculatus (Lam) Muell.-Arg., WT 11771. 12266
Mallotus sp. nov.; § Mallotus, WT 12159, 12454
Manihot esculenta Crantz, WT 12795-B
Octosperminum pleiogyrum (Pax & Hoffm.) Airy Shaw, SR, Haia
Omalanthus nova-guineensis (Warb.) K. Schum., WT 11713, 12259
Phyllanthus cicoidea Muell.-Arg., WT 12247. 12281, 12809
Phyllanthus cf. cicoidea Muell.-Arg., WT 12263
Phyllanthus chamoides (F.v.M.) Diels, WT 11448
Phyllanthus florivorus (Laut. & K. Schum.) Airy Shaw, WT 12210. 12572. 12707
Phyllanthus rhophilus Airy Shaw, SR, Haia
Phyllanthus (closest to) rubriflorus J.J. Sm., WT 11259
Phyllanthus urinaria L., WT 12676
Pimeleidendron ao-biognomon Hassk., WT 11995
Ricinus communis L., SR, naturalized Maimanu area

EUPOMATIACEAE
Eupomata lanirina R. Br., WT 11698, 12043

FAGACEAE
Castanopsis australianis (Bl.) A. DC., SR, Maimau
Lithocarpus edelius (Miq.) Rehder, WT s.n., cariological coll.
Lithocarpus lanetberhachii (von Seemen) Markgraf, WT 13010
Lithocarpus rufurillosus (Markgraf) Rehder, WT 11944, 12219, 12472, 12777
Lithocarpus schlechtleri Markgraf, WT 12306
Lithocarpus cf. schlechteri Markgraf, WT 11718

FLACOURTIACEAE
Casarca clusiafolia Bl., WT 12125
Casarca cf. clusiafolia Bl., WT 12042
Casarca gweinifolia Vent., or aff., WT 12835

Gesneriaceae
Aechymanthus spp., WT 11112, 11113, 11266, 11961
Cyrtandra bracteata Warb., WT 11162, 11299
Cyrtandra cf. decurrens de Vries, WT 11151
Cyrtandra aff. ?elata Schltr., WT 11270
Cyrtandra juno-rellia K. Schum., WT 11181, 11196, 11273, 11703
Cyrtandra biglisissima Schltr., WT 11157
Cyrtandra cf. jatowskii Schltr., WT s.n.
Cyrtandra sp. a, § Centrosiphon, WT 11176, 11230, 12163
Cyrtandra sp. b, § Centrosiphon, WT 11275, 11294, 12914
Cyrtandra sp. c, § Centrosiphon, WT 11267, 11276, 11292, 12996
Cyrtandra sp. D, § Centrosiphon or Loxanthae, WT 11289, 12711
Cyrtandra sp.E, § Diplodichon, WT 12149
Cyrtandra sp.F, cf. § Diplodichon, WT 11209, 11245, 11274, 12358
Cyrtandra sp. G, § Geodesmes, WT 12776
Cyrtandra sp. H, § Geodesmes, WT 12027, 12141, 12492
Cyrtandra sp. I, § Leucocyrtandra, WT 12052, 12138, 12346
Cyrtandra sp. J, (Cyrtandropsis), § Leucocyrtandra, WT 11282, 11960, 12854
Cyrtandra sp. K, (Cyrtandropsis), cf. § Leucocyrtandra, WT 11265
Cyrtandra sp. L, § Loxophylhum/ Phacotrichium, WT 11170, 11183
Cyrtandra sp. M, § Macrocyrta, WT 11293

Casarca cf. papauna Sleumer, WT 11803, 12699; possibly C. clusiafolia
Casarca ripicola Sleumer, or aff., WT 12162
Flacourtia rakam Zoll. & Mor., WT 13011
Homalium foetidum (Roxb.) Benth., WT s.n.
Osmelia philippinensis (Turecz.) Bentb., SR, Pio; cf. S&C 4214, 4282, det. Leiden
Panguia edulis Reinw., AAI 356, 629; WT 12002. 12744
Ryparosa cabotica Mildbr., WT 12008
Trichadenia philippinensis Merr., WT s.n.
Xylosma papauna Gilg., WT 12685, det. Damas

GESNERIACEAE
Aechymanthus spp., WT 11112. 11113, 11266, 11961
Cyrtandra bracteata Warb., WT 11162, 11299
Cyrtandra cf. decurrens de Vries, WT 11151
Cyrtandra aff. ?elata Schltr., WT 11270
Cyrtandra juno-rellia K. Schum., WT 11181, 11196, 11273, 11703
Cyrtandra biglisissima Schltr., WT 11157
Cyrtandra cf. jatowskii Schltr., WT s.n.
Cyrtandra sp. a, § Centrosiphon, WT 11176, 11230, 12163
Cyrtandra sp. b, § Centrosiphon, WT 11275, 11294, 12914
Cyrtandra sp. c, § Centrosiphon, WT 11267, 11276, 11292, 12996
Cyrtandra sp. D, § Centrosiphon or Loxanthae, WT 11289, 12711
Cyrtandra sp.E, § Diplodichon, WT 12149
Cyrtandra sp.F, cf. § Diplodichon, WT 11209, 11245, 11274, 12358
Cyrtandra sp. G, § Geodesmes, WT 12776
Cyrtandra sp. H, § Geodesmes, WT 12027, 12141, 12492
Cyrtandra sp. I, § Leucocyrtandra, WT 12052, 12138, 12346
Cyrtandra sp. J, (Cyrtandropsis), § Leucocyrtandra, WT 11282, 11960, 12854
Cyrtandra sp. K, (Cyrtandropsis), cf. § Leucocyrtandra, WT 11265
Cyrtandra sp. L, § Loxophylhum/ Phacotrichium, WT 11170, 11183
Cyrtandra sp. M, § Macrocyrta, WT 11293
**ICACINACEAE**

*Cyrtoidea* sp. N, § Prosthecisiphon, WT 12708

*Cyrtonandra* sp. O, § Rhabdocyrtonandra, WT 11174, 11291, 11769

*Cyrtonandra* sp. P, unplaced, WT 12091, 12477

*Cyrtonandra* sp. Q, unplaced, WT 11172 (filibracteata facies)

*Cyrtonandra* sp. R, unplaced, WT 12092

*Dicroryrichum* spp., or as Agalyma, WT 11128, 11226, 11708, 11807

*Rhynchoschium discolor* (Maxim.) B.L. Burtt, WT 12671, 12735

**GOODENIACEAE**

*Senecea oppositifolia* R. Br., WT 11138, 12593, 12983

**GROSSULARIACEAE**

*Carpodetus arbores* (Laut. & K. Schum.) Schltr., AM 616

*Polyosma aff. angulirrhizoides* Reeder, WT 12073, 12386, keys to *P. steinophum* but not that sp.

*Polyosma 'estrirhizoides-induta group',* SR, Maipau

*Polyosma forbesii* Valeton, or aff., WT 11249, 11841

**HALORAGACEAE**

*Gomacarpus balansensis* (Merr.) Orchard, SR, upper Maipau

*Guiniera macrophylla* Bl., WT 12183

**HERNANDIACEAE**

*Hernanda ovigera* L., SR, PI; cf. C&S 758, det. Croft

**HYDRANGEACEAE**

*Diasma ebriflora* Lour., WT 12559, 'syllecta complex'

**ICACINACEAE**

*Citrinella stauvoleus* (Bl.) Howard, WT 11739, 12036

*Gomphandra montana* (Schellenb.) Sleumer, AM 431; WT 11280, 11937

*Gomphandra* sp., 'australiana-montana group', WT 12692; flowers required to differentiate

*Gomocarytum litoreale* (Bl.) Sleumer, WT 12652

*Platea excelsa* Bl. var. borneensis (Heine) Sleumer, WT 11815, 12132

*Pseudobrytys cadijiflora* (Pulle) Sleumer, or

*P. dorae* Moeser, WT 12771; flowers required to differentiate

*Rhytiaeryum longifolium* K. Schum. & Laut., WT 11670, 12113, 12222, 12419, 12575, 12731-B

*Stemonurus monticola* (Schellenb.) Sleumer, WT 13012

**LAMIACEAE**

*Pelletiaurus scutellaris*oides* L.*) R. Br., LAE 66358, det. Henry

**LAURACEAE**

*Aboeaphne umbelliflora* (Bl.) Hooker f., WT 12012

*Beilschmiedia cf. scholdei* Kosterm., WT 11998, 11814

*Cryptocarya aff. anruoserica* Kosterm., WT 11799

*Cryptocarya cf. depressa* Warb., WT 11922

*Cryptocarya aff. depressa* Warb., WT 11872

*Cryptocarya aff. multipliculatea* Teschner., WT 11202

*Endiandra forbesii* Gamble, WT 13013

*Endiandra magniloba* Kosterm., WT 11920, 12007

*Endiandra cf. papuan* Laut.; 'papuan-glanca group', WT 11251, 12040

*Litsa calophyllantha* K. Schum., WT 11699

*Persia americana* Mill., SR, Maipau, cultivated

**LEEEACEAE**

*Leea coryphantha* Laut., WT 11731

*Leea* (close to) *heterodoxa* K. Schum. & Laut., WT 12949; *coryphantha-heterodoxa group*

*Leea heterodoxa* K. Schum. & Laut., LAE 66334, Purari River, det. Leiden

*Leea indica* (Burman f.) Merr., AM 486; WT 11738, 12633

**LEGUMINOSAE/CAESALPINIACEAE**

*Caesalpinia crista* L., C&S 808, Purari, det. Leiden

*Cassia alata* L., SR, Haia-Pio

*Cruda papuan* Kosterm., C&S 804, Purari, det. Verdcourt

*Intisia bijuga* (Celebr.) O. Kuntze, SR, Haia-Pio; cf. C&S 4545, det. collectors

*Kingia condran* sp., SR, Pio

LEGUMINOSAE/FABACEAE
Arachis hypogaea L., SR, cultivated
Crotalaria lanata Beddome, WT 12018
Crotalaria sp., (possibly) pallida Aiton, cf. C&S 811, Purari, det. Verdcourt
Dolichos altissimus Prain, C&S 830, Putari, det. Verdcourt
Dolichos bacarum Prain, C&S 4491, E. Purari, det. Verdcourt
Derris cf. cuneifolia Grah. ex Benth. (sensu Verdcourt), WT 11939
Derris trifoliatula Lour., C&S 815, E. Purari, det. Verdcourt
Desmodium laxum DC., WT 11773
Desmodium repandum (Vahl) DC., WT 12244, 12803
Desmodium seguax Wall., WT 12573, 12607
Desmodium umbellatum (L.) DC., SR; cf. C&S 724, C&S 4556, det. Leiden
Desmodium sp., (possibly) D. heterocarpum (L.) DC., cf. var. strigosum in C&S 740, C&S 4512
Gliciridia sepium (Jacq.) Walp., SR, cultivated
Inocarpus fagifer (Parkinson) Fosb., C&S 795, Purari, det. Leiden
Inocarpus sp. nov., 'rubidus morphospecies' sensu Verdcourt, WT 11139, 12054
Macropsychanthus lauterbachii Harms, WT 11839
Macuna aff. ?lamii Verdcourt, WT 11837 (fl.), key uncertain without fruit
Macuna nov-guineensis Scheffer, SR; cf. LAE 61103, Purari; C&S 4400
Phaseolus vulgaris L., SR, cultivated
Pongamia pinnata (L.) Pierre 838, 867, Purari, det. collectors
Pterocarpus indicus Willdenow, SR; cf. C&S 4249; C&S 869, det. collectors
Strongylachos decipiens Verdcourt, WT 11131
Tephrosia vogelii Hook. f., WT 12016
Tephrosia sp., (possibly) vestita Vog., SR; cf. the sp. in C&S 903, det. Verdcourt

LEGUMINOSAE/MIMOSACEAE
Entada phaseoloides (L.) Merr., WT s.n., carpological
Mimosa pudica L., SR, Haia & Maimafu
Paraserianthes falcataria (L.) Nielsen, SR; cf. C&S 4242, det. Nielsen

LINACEAE
Hugonia jenkinsii F.v.M., WT s.n.

LOGANIACEAE
Fagraea amabilis S. Moore, WT 11695
Fagraea berteriana A. Gray ex Benth., WT 12790
Fagraea celedonica Thunb., AM 662
Fagraea elliptica Roxb., SR, O-Pio
Fagraea racemosoides Jack ex Wall., SR, O-Pio
Fagraea varoniana F.v.M., SR, Wara Navarah
Genistoma rapiestre J.R. & G. Forst., WT 11907
Genistoma uninodium K. Schum., WT 12012, 12071, 12416
Neuburga celebica (Koord.) Leenh., C&S 4451, 4507, Purari R., det. Conn
Neuburga corvuscarpa (A. Gray) Leenh., AM 507; WT 12830
Neuburga kubii (Valet.) Leenh., WT 11225, 11706
Strychnos minor Bl., GW 799, det. GW; cf. also C&S 4394

LORANTHACEAE
Amyema fribesiana (K. Schum.) Danser, WT 12295
Amyema rigidiflora (K. Krause) Danser, WT 11869
Amyema squarrosa (K. Krause) Danser, WT 12578, 12883
Dactylisphora verticillata (Scheffer) Tiegh., WT 11954
Decaisnea bullangii (K. Schum.) Barlow, WT 12236, 12541
Dendrophthoe curvata (Bl.) Miq., SR, Haia
Macrosolea geminata (Merr.) Danser, WT 12828

MAGNOLIACEAE
Elmerrillia tsampaca (L.) Dandy ssp. tsampaca var. tsampaca, AM 237, 392; WT 11976, 12691
Magnolia candollii (Bl.) H. Keng var. candollii, WT 12585, 12650

MALPIGHIACEAE
Ryosopterys timorensis (DC.) Jussieu var. discolor (Gand.) Jacobs, WT 12564
MALVACEAE

Hibiscus archboldianus Botss., WT 11194, 12086
Hibiscus tiliaceus L., SR; cf. C&S 730; S&C 4522, det. collectors
Thepesia populnea (L.) Sol. ex Corr., WT 11771
Urena lobata L., WT 12459

MELIACEAE

Catanthea hyipetala Fv.M., WT 11302
Creobrotus novoguineensis (Baker f.) Veldk. & Nayar, WT 12038
Dissochaeta angiensis Ohwi, WT 11200, 11220
Heteroblemma sp., WT 11242
Medinilla aff. albida Merr. & Perry, WT 12530
Medinilla aff. compacta Bakh. f., WT 11169
Medinilla crassinervis Bl., AM 622; WT 11675, 12044, 13000
Medinilla dentata Veldk., WT 12068
Medinilla ramiflora group, WT 12373; keys to Mansfels's spp. 14-16
Medinilla rubriflora Ohwi, AM 665; WT 11241
Medinilla sogrensis Bak. f., or aff., WT 12375
Medinilla tenispalidaeata Bakh. f., WT 11782, 12057, 12083
Medinilla teysmannii Miq., WT 12077, 12098
Medinilla aff. zuversteegii Mansf., WT 11114
Meneychion 'hepaticum' sensu Mansf., WT 12189, 12557; keys to hepatitis
Meneychion cf. schraderbergense Mansf., WT 11219, 11895, 12957
Meneychion torricellense Mansf., WT 12045
Ochthocharis halmensis Bl., SR, Pio; cf. S&C 4200, det. Hansen
Osborna brahmati Korth., WT 12102
Osborna cyanoides Triana, WT 11129, 12007, 12609
Poikilogyne multiflora Maxw., WT 12140, 12644
Poikilogyne cf. robusta Mansf., WT 12034, 12391-A, 'robusta-macrophylla'
Poikilogyne villosa Maxw., WT 11692

AGLAIA

Aglai a (nearest) agglomerata Merr. & Perry, AM 700
Aglai a agglomerata Merr. & Perry, WT 11879, 11902, 12062
Aglai a argenta Bl., WT 11956, 12025
Aglai a lepidophetala Harms, WT 11851
Aglai a rimoso (Banco) Merr., WT 12782
Aglai a sapindina (Ev.M.) Harms, WT 11817, 11700
Aglai a subminutiiflora C. DC., WT 11809, 11919
Aglai a cf. subminutiiflora C. DC., WT 12882, 12956; atypical indumentum
Aglai a tomentosa Teijsm. & Binn., WT 11991, 12049
Aglai a aff. tomentosa Teijsm. & Binn., WT 11776
Aglai a sp. ?nov., aff. 'grandis-ranostriae group', AM 695
Aglai a sp., (possibly) A. silvestris (Roemer) Merr., cf. C&S 798, Purari
Aphormis nitidula (Benth.) T.D. Penn. ex Mabb., WT 11952, 12058
 Aphromixis polystachya (Wall.) R.N. Parker, SR; cf. S&C 4297
 Chisocheton cericosta (Miq.) C. DC., WT 11916, 12060
 Chisocheton lasiocarpus (Miq.) Valeton, WT 11966, 11998; entity 'wenlandii'
 Chisocheton lasiocarpus (Miq.) Valeton, WT 11938; entity 'caroli'; = C. caroli Harms
 Chisocheton sayeri (C. DC.) Stevens, LAE 61176, Purari R., det. Stevens
 Chisocheton stellatus Stevens, WT 11975
 Dyssoxylum arborescens (Bl.) Miq., SR; cf. C&S 788, Purari, det. Maberley
 Dyssoxylum excelsae Bl., or aff. 'alliacenum group', WT 11891, 11897, 12013
 Dyssoxylum gandhimodhamanum (A. Juss.) Miq., LAE 61125, Purari R., det. Leiden
 Dyssoxylum hippeastrum (Harms) Mabb., WT 11912
 Dyssoxylum cf. kaniense Harms, WT 11732, 12946
 Dyssoxylum mollissimum Bl. ssp. volle (Miq.) Mabb., WT 12046
 Dyssoxylum papuanum (Merr. & Perry) Mabb., WT 11993
 Dyssoxylum parasiticum (Osb.) Koster., WT 11733, 12174, 12954
 Dyssoxylum pettigruianum F.M. Bailey, WT 11923; LAE 66295
**Diospyros radiciflora** Merr. & Perry, or aff., WT 12562

**Diospyros setosa** (Span.) Miq., WT 12126, 12394

**Diospyros cf. spiniflora** Mabb., WT 11829

**Diospyros variabilis** Harms, WT 11694, 12021, 12291, 12739, 12982

**Diospyros aff. variabilis** Harms, WT 12101

*Veracra americana* Benth., WT 12103

*Xylocarpus granatum* Koern., S&G 1484, E. Purari, det. Leiden

*Xylocarpus nodiflorus* (Lam.) M. Roem., S&G 4483, E. Purari, as *X. antaralavias*

### Menispermaceae

*Arundinaria tymphampolea* (Laut. & K. Schum.) Diels, WT s.n., carpological coll.

*Cheirodendron ovatum* Miq., LAE 61110, Purari R., det. Forman

*Legnophora minitiflora* (K. Schum.) Diels, WT 11948

*Stephania japonica* (Thunb.) Miens var. *japonica*, WT 12887

*Stephania japonica* (Thunb.) Miens var. *timoriana* (DC.) Forman, WT 12680

*Stephania altaica* Miq., WT 11212, 12464

*Timonocarpus petiolatus* Hook. f., WT 12096

*Timopora distilflora* (Laut. & K. Schum.) Diels, WT 11853

### Monimiaceae

*Kibara arbolediana* A.C. Smith, LAE 66299,

Wabo dam site, det. Philipson

*Kibara cf. papuana* A.C. Smith, WT 12722, 12728, *corkiaca-papuana* group

*Levreria* (closest to) *acuminata* (E. v. M.) Perkins, WT 12350

*Levreria montana* Becc., WT 12417

*Levreria nitens* Perkins, WT 12494

*Palmeria brasiili* Philipson, WT 12595

*Palmeria gracilis* Perkins, AAM 376

*Palmeria gracilis* Perkins var. *trowi*, WT 12431; nonconformist indumentum

*Stegantbea hirsuta* (Warb.) Perkins, WT 12164, 12923

*Stegantbea hoptiana* (Becc.) Kanehira & Harasima, WT 11795

*Stegantbea* sp. nov., aff. *myrmecophilous group*, WT 12742

### Moraceae

*Ficus adoniformis* Miq., AM 209, GW 808, det. GW

*Ficus amblyaeve* Corner, AM 408, det. GW

*Ficus amplexiflora* Burm. f., GW 713, det. GW

*Ficus arbuscula* Laut. & K. Schum., WT 12093

*Ficus arbolediana* Summerh., GW 764, det. GW

*Ficus arifolium* King, GW 780, det. GW

*Ficus angusta* Corner, GW 791, det. GW

*Ficus atrata* Bl., GW 714, det. GW

*Ficus bernalis* King, GW 712, 728, 784, det. GW

*Ficus butyrascarpa* Miq., GW 753, det. GW

*Ficus caesarea* King, Dodson s.n., det. GW

*Ficus comitata* King, GW pers. comm.

*Ficus congesta* Roxb., GW 770, 818, det. GW

*Ficus congesta* Roxb. var. *chalmersii* (King) Corner, GW 711, det. GW

*Ficus copiosa* Steud., AM 501, det. GW

*Ficus crassifolia* Miq., GW 805B, det. GW

*Ficus dunnii* Diels, AM 273, 313, det. GW; WT s.n.

*Ficus distichoides* Diels, GW pers. comm.

*Ficus edelweissii* King, GW pers. comm.

*Ficus erythropappa* Miq., GW 736, det. GW

*Ficus glaberrima* Bl., WT 12051

*Ficus gil* Laut. & K. Schum., WT 13014

*Ficus hamburghana* Diels, GW pers. comm.

*Ficus hombroniana* Corner, GW pers. comm.

*Ficus hombroniana* Corner, WT 1184

*Ficus inophylla* Diels, GW pers. comm.

*Ficus irretian Summerh., GW pers. comm.

*Ficus ituna* Diels, WT 11121

*Ficus macrophylla* Laut. & K. Schum., GW pers. comm.

*Ficus megaphylla* Diels, GW 776, det. GW

*Ficus microcarpa* L. f., GW pers. comm.

*Ficus mollior* Fv.M. ex Benth., WT 11679; also GW pers. comm.

*Ficus mollior* Fv.M. ex Benth. var. *sessilis* Corner, LAE 66331, Purari River; det. Corner

*Ficus nova* Summerh. var. *glabrata* Corner, GW 792, det. GW

*Ficus velosa* Teysm. & Binn., WT 11987; LAE 61098, Purari, det. Corner
Takifuchi, Plants from Crater Mt., Papua New Guinea

Ficus subhirsuta Dill., GW 735, 752, det. GW
Ficus odorata King, GW 718, 782, 793, det. GW; WT 11864
Ficus aff. oswettiana Corner, WT 11834, sp. nov., not yet
Ficus pachyrhachis Laur. & K. Schum., GW pers. comm.
Ficus pachyphyca Diels ex Corner, GW pers. comm.
Ficus phaeoscye Laut. & K. Schum., pers. comm. GW based on JE 18 & 30 at A
Ficus phaliophylla Diels, GW pers. comm.
Ficus polyantha Warb., GW pers. comm.
Ficus pseudofacca Corner, GW pers. comm.
Ficus pungens Reinw. ex Bl., GW 717, 750, det. GW
Ficus robusta Corner, GW pers. comm.
Ficus scratchleyana King, GW 800, det. GW
Ficus scratchleyana King var. rhapalosyca
(Diels) Corner, GW pers. comm. based on JE 27 at A
Ficus seminivestita Corner, GW pers. comm.
Ficus segetica Burm. f., LAE 61123, Purari R., det. Corner
Ficus sternocarpa Diels, GW 709, 715, det. GW
Ficus sternocarpa Diels var. pubigena Diels, GW 734, det. GW
Ficus sternocarpa Diels var. sternocarpa, GW 715, det. GW
Ficus subhirtata Miq., AM 207, det. GW
Ficus sublimbata Corner, WT 11123
Ficus subulata Bl., GW 779, 805A, det. GW
Ficus subulata Bl. var. gracillima (Diels) Corner, GW 801, det. GW
Ficus tenella Corner, GW pers. comm.
Ficus ternatana Miq., GW pers. comm.
Ficus trachyphora K. Schum., AM 536, GW 721, det. GW
Ficus trichocerasa Diels, GW pers. comm.
Ficus virgata Reinw. ex Bl., GW pers. comm.
Ficus wassia Roxb., GW 796, det. GW
Ficus xylocydia Diels var. cylindrocarpa (Diels) Corner, WT 11189
Ficus sp., sect. Conosycce, GW pers. comm.
Ficus sp., sect. Rhizocladus, GW pers. comm.

MYRSINACEAE

Gymnacanthera forquhariana (Hook. f. & Th.) Warb. var. zippeliana (Miq.) R. Schouten, WT 11908, 12050
Horsfeldia bellwigi (Warb.) Warb., WT 13015A
Horsfeldia laevisata (Bl.) Warb., WT 13015B
Horsfeldia palmeri Warb., WT 11957
Horsfeldia subtilis (Miq.) Warb. var. subtilis, AM 661: WT 11883
Horsfeldia subtilis (Miq.) Warb. var. aucta de Wilde, WT 11674
Horsfeldia sylvestris (Houtt.) Warb., WT s.n., sterile
Horsfeldia cf. tabularata (K. Schum.) Warb.,
WT 11892, 11940; possibly H. bellwigi Myristica cornutiflora J. Sinclair, WT 11261, 12060
Myristica cf. caeudata Markgraf, WT 13016
Myristica globosa Miq., WT 11254
Myristica aff. globosa Miq., WT 11144, 11929
Myristica ingeas (Foreman) W.J. de Wilde, WT 10251
Myristica cf. inutilis Rich. ex A. Gray subsp. papuanus (Markgraf) W.J. de Wilde, WT 11865, 12067
Myristica subalalata Miq., WT 11262

MYRTACEAE

Ardisia aff. squarrosa Mez, WT 11281, 11904, 12076, det. Pipoly
Loberia reiniana (Jacobs) Sleumer, WT 11921
Melia baphoformis Fv. M., WT 11855
Melia protracta Fv. M., LAE 66530, Purari River
Myrtine aff. acentra (Mez) Pipoly, WT 11612, possible sp. nov., det. Pipoly
Myrtine leucantha (K. Schum.) Pipoly, WT 11693, det. Pipoly

Elaeocarpus macrocarpa (Miq.) de Wilde subsp. prunii (King) de Wilde, WT 11958, 12003, 12057
Elaeocarpus macrocarpa (Miq.) de Wilde subsp. prunii (King) de Wilde, WT 11958, 12003, 12057

MYRTACEAE

Acmena acuminatissima (Bl.) Merr. & Perry, WT 12100
Decaspernium bracteatum (Roxb.) A.J. Scott, SR, Haia & Pió; cf. S&C 4373
Decaspernium exiguum Merr. & Perry, WT 12582
Decaspernium neuropbllum Laut. & K. Schum., AM 625; WT 11216
Metrodieros ramiflora Laut., SR, Maimafu, also cult. by Maimafu villagers
Octomyrtus lebrmannii Diels, WT 11677
Octomyrtus phaeopetala (Ev.M.) Diels var. phaeopetala, WT 12424 (fr.), 12617 (fl.), 12759 (fr.)
Rhodamnia latifolia (Benth.) Miq., WT 11231
Rhodomyrtus porosinensis Diels, WT 12421
Syzygium acantholamin K. Schum., WT 12076
Syzygium baetternianum (K. Schum.) Niedenzu, SR, Maimafu, possibly S. subcorymbosum
Syzygium calliianthus Merr. & Perry, WT 12193
Syzygium decipiens (Koorders & Valeton) Merr. & Perry, or aff., WT 11767, 12118
Syzygium dictyophlebium Merr. & Perry, WT 11277
Syzygium effusum (A. Gray) C. Muell., WT 12173, 12844
Syzygium furfuraceum Merr. & Perry, SR, Maimafu
Syzygium cf. byhekera (Diels) Merr. & Perry, WT 12525, 'byhekera-phosostictum group'
Syzygium iteophyllum Diels, or aff., WT 12698, 12947
Syzygium longipes Merr. & Perry, WT 12655
Syzygium madaccense (L.) Merr. & Perry, sensu lato, WT 11943, 12017, 12940, 12944
Syzygium megadopromum (Laut. & K. Schum.) Merr. & Perry, WT 11676, or aff. megadopromum
Syzygium porphyrocarpon (Greves) Merr. & Perry, WT 12000, 12497-A, 12877
Syzygium aff. rosatum Merr. & Perry, WT 11847, possible sp. nov.
Syzygium cf. rubro-punctatum (Ridl.) Merr. & Perry, or aff., WT 11235, 11719, 13004; new
Syzygium subalatum (Ridl.) Merr. & Perry, WT 12075
Syzygium 'tirnaynnon group', SR, Haia & Maimafu, with diffuse inflorescence
Syzygium trachyanthum (Diels) Merr. & Perry, or aff., WT 11990
Syzygium tymbananthum (Diels) Merr. & Perry, WT 12598
Syzygium aff. womersleyi Hartley & Perry, WT 11258, possible sp. nov.
Xanthomyrtus spp., SR, Maimafu, sterile, more than one taxon

NEPENTHACEAE
Nepenthes maxima Neck., WT 12284, 12319
Nepenthes cf. paphiopus Dans., WT 11779

NYCTAGINACEAE
Pisotona longirostris Teysm. & Binn., WT 12010
Pisotona umbellifera (Forst.) Seem., LAE 61114, Purari, det. Hyland

OCHNACEAE
Schuermannia benningsii K. Schum., WT 12129

OLACACEAE
Anacolous paphiopus Schellenb., SR, near Pio
Olax ucriatica Roxb., C&S 829, Purari

OLEACEAE
Chionanthus riparius (Lingelsh.) Kiew, WT 11909
Chionanthus sp. nov., aff. salicifolius (Lingelsh.) Kiew, WT 12965
Chionanthus sessiliflorum (Hems.) Kiew, WT 12921
Chionanthus aff. sessiliflorum (Hems.) Kiew, WT 11175
Jasminum sp. nov., WT 11866

ONAGRACEAE
Ludwigia hyposiphonia (Don.) Exell, LAE 66517, det. Kerenga
Ludwigia sulcata (Jacq.) Raven, WT 11751, 12818

PASSIFLORACEAE
Passiflora foetida L., SR, Haia & lower Maimafu; cf. S&C 4596

PENTAPHRAGMATACEAE
Pentaphragma grandiflorum Kurz, WT 11163

PIPERACEAE
Peperomia cf. kurakorenai Dull, 'pupurea group', WT 11818; marches L-annotated sheet
Peperomia laevifolia (Bl.) Miq., WT 12342
Peperomia pellucida (L.) Kunth, SR, Haia
Piper aduncum L., SR, Haia
Piper betle L., SR, cultivated
Piper carinatum Bl., WT 12505
Piper cedriforme Opiz, or aff., WT 12106, 12124
Piper gilbifolium C. DC., WT 12393, 12455; hirtellous form
Piper gilbifolium C. DC., WT 12268; typical glabrous form
Piper macropiper Pennant, WT 11683, 12109
Piper majusculum Bl., SR, Pio; cf. S&G 4331, det. Leiden
Piper mexonii Bailey, WT 12879; ‘form stenocardium’
Piper novus-guirimensis Warb., WT 12090
Piperovia L., Schum. & Laut., WT 11681. 12911
Piper subbimatum K. Schum. & Laut., AM 232; WT 11143
Piper subcanirameum C. DC., WT 11741
Piper triangularare Chew, WT 12211, 12273. 12533, 12892
Piper umbellatum L. var. subpeltatum (Willdenow) C. DC., AM 655; WT 11224
Piper versteegii C. DC., WT 12150
Piper wilhelmsense Chew, SR, Maimafu
Piper sp. ?nov., WT 12453; unusual filiform peduncle

PITTOSPORACEAE
Pittosporum farririnum Aiton f. subsp. farririnum, WT 12670
Pittosporum pullifolium Burk., WT 11285, 11749
Pittosporum pullifolium ssp. ledermannii (Pritzel) Schoedle var. ledermannii, WT 12539, 12580
Pittosporum sinatatum Bl., WT 11153, 11279
Pittosporum sinatatum Bl. var. sinatatum, WT 12177

POLYGALACEAE
Epirixanthus (probably) papuana J. J. Sm., SR, Maimafu
Polygal a paniculata L., WT 12265-B
Scoridaria aristata Kassau, SR, Haia
Xanthophyllum papuana Whitmore ex Meijden, WT 11764, 12032

POLYGONACEAE
Polygonum chinense L., WT 12009

PROTEACEAE
Helicia cf. latifolia C.T. White, WT 12035

RANUNCULACEAE
Clematis papuana Merr. & Perry, SR, Pio; cf. S&G 4399, det. Tamura
Clematis phanerophlebia Merr. & Perry var. simplicifolia Tamura, WT 12390, 12567, 12780

Clematis phanerophlebia Merr. & Perry cf. var. tomentosa Eichler, WT 11256
Ranunculus sp., SR, upper Maimafu

RHAMNACEAE
Alphitonia excelsa (Fenzl) Reiss. ex Endl., WT 12218; sensu Schirarend
Alphitonia macrocarpa Mansf., SR, Pio
Emmenopteryx alphonsonoides F.v.M., SR, Haia
Gouania javanica Miq., WT 11711
Rhamnus nipalensis (Waltlich) Lawson ex Hook., WT 11690, 12277, 12674, 12716, 12718
Ventilago ?papuana Merr. & Perry, SR, Pio
Zizyphus augustifolius (Miq.) Hatsufima, WT 11985
Zizyphus djamaensis Laut., LAE 66318 near Wabo, det. Frodin

RHIZOPHORACEAE
Carallia brachiata (Lour.) Merr., SR, Pio; cf. S&G 4503
Gynotroches axillaris Bl., AM 428, 522, WT 12089

ROSACEAE
Prunus arborea (Bl.) Kalkman, SR, Haia
Prunus dolichobrotrpy (Laut. & K. Schum.) Kalkman, SR, Haia
Prunus gazelle-peninsulae (Kanehira & Hatsufima) Kalkman, WT 12642, 12661, 12858
Prunus goyantha Kalkman, WT 12802
Prunus schlechteri (Koehne) Kalkman, AM 328
Rubus moluccanus L. var. moluccanus, WT 12022
Rubus rosifolius J.E. Smith, WT 12095

RUBIACEAE
Airosperma aff. ramnense Laut. & K. Schum., WT 11877
Amaracarpus brassii Merr. & Perry, WT 12908
Amaracarpus aff. grandifolius Valeton, WT 12494
Antirhea sp., (possibly) macrocarpa Merr. & Perry, SR; Pio; cf. S&G 4293, det. Darwin
Argostemma hysophillum K. Schum., AM 513; WT 11132, 11150
Argostemma callitrichum Valeton, WT 12364, 12422
Cantania aff. cmygeron (Valton) B.L. Burtt, WT 11868, 12128, 12737, not the species
Cantania cf. longifolium (Valton) Merr. & Perry, WT 12106-R
Diplodora sp., WT 12934; also diff. sp. in S&C 4233, Gulf
Dolichobium gertrudis K. Schum., WT 12110, 12498
Dolichobium oxylolum K. Schum., WT 11965
Gardenia bankmanii K. Schum., SR, Pio; cf. C&S 768
Gardenia lamingtonii E.M. Bailey, SR, Haia; cf. S&C 4388, det. Leiden
Gardenia pallea Merr. & Perry, WT 12399, 12447, 12479, 12829
Hedyotis auriculata L., WT 12666
Hedyotis schlechteri (Valton) Merr. & Perry, WT 11820
Hydropyrum radicans Becc., LAE 61087, Purari R., det. Leiden
Hydropyrum teretius Huxley & Jebb, or aff., WT 12587, 12831
Isora leptopus Valton, or aff., WT 11926
Isora aff. moszkownskii Brem., WT 11936
Lasianthus chlorocarpus K. Schum., or aff., WT 12410, 12734
Lasianthus tomentosus Bl., WT 12158, 12220, 12732
Lasianthus (closest to) tomentosus Bl., WT 12885, 12894
Marchiodendron arborea K. Schum. & Laut., or aff., WT 11213; = M. simplex Merr. & Perry
Mattisiodendron pachyclados (K. Schum.) Melch., SR; cf. S&C 4278, Gulf D., det. Darwin
Morinda citrifolia L., C&S 821, E. Purari, det. Gideon
Morinda umbellata L. var. papuana Valton, WT 12058
Mussaenda berardi Fv.M., AM 214, 379; GW 723, det. Gideon
Mussaenda ferringiana K. Schum., WT 12049
Mussaenda oreasum Wernh., WT 12613, det. Gideon
Mussaenda scratchleyi Wernh., SR; cf. S&C 4238, 4306, det. Gideon
Mylestia javanica (Bl.) Reintw. ex Korth., WT 11182, 11221
Myrmecodia platytyna Becc. subsp. platytyna, WT 11193
Myrmecodia sp., SR, Maimafa near clinic, not platytyna
Nanepnea orientalis L., GW 803, det. GW
Neonoea acuminata Ridsd., WT 12055
Neonoea gordoniana (E.M. Bailey) Ridsd., WT 12462
Neonoea cf. perspicuerrvia Merr. & Perry, WT 11951
Opbiorhiza aff. amanera Valton, WT 12271, 12088
Opbiorhiza aff. zelbranyi Valton, WT 12100, 12084, 12246-B
Opbiorhiza tenelliflora Valton, WT 11149
Opbiorhiza sp., unplaced aff., WT 12441
Pachystylus gulediteranii K. Schum., AM 541; WT 12160, 12721
Psychotria amplithrysa Valton, WT 12099, 12900
Psychotria aff. amplithrysa Valton, WT 12028, vining, not the sp., not in Valton
Psychotria cf. drysanthra Merr. & Perry, 'miralahastra group', WT 12070, 12102, 12891, keys to fork 44
Psychotria diemensa Merr. & Perry, WT 12343
Psychotria bullandanii Valton, WT 12014
Psychotria leonardii Merr. & Perry, or aff., WT 12960
Psychotria aff. leptothrysa Miq., WT 12662, best result on key, not the sp.
Psychotria micralahastra (Laut. & K. Schum.) Valton, LAE 61167, Purari River, det. Sohmer
Psychotria multicostata Valton, WT 11152
Psychotria myrmecophila Laut. & K. Schum., LAE 66280, Wabo dam, det. Sohmer
Psychotria olivacea Valton, WT 11765; cf. also S&C 4317, Gulf
Psychotria aff. polita Valton, WT 13397
Psychotria purcarianii Sohmer, LAE 66298, 66349, det. Sohmer
Psychotria ramadeconbens Sohmer, WT 12122, 12904
Psychotria cf. ramulosa Merr. & Perry, 'microcoza group', WT 12035, keys to 77-78, stipule ramulosa
Psychotria pphaenophyrsa Valeton, WT 11678, 12979
Psychotria waltoniana Sohmer, WT 12817, 12843, 12893
Psychotria umberskyi Sohmer, WT 12028, 12056
Psychotria sp. nov., aff. boecroftii Takeuchi, WT 12130, 12602-B, 12920
Psychotria sp., unplaced aff., WT 12706
Randia decorata Valeton, WT 11915, genus name is problematic
Randia schumanniana Merr. & Perry, WT 11122
Randia sessilis Ev.M., WT 11917
Rhabdopus pappama S. Moore, WT 11630
Taracina harwoodii (Miq.) Valeton, WT 11684
Timonius bivenis Merr. & Perry, AM 415: WT 12961
Timonius grandifolius Valeton, WT 11925, 11236
Timonius timon (Spreng.) Merr., GW 758
Timonius trichanthus Merr. & Perry, WT 12187, 12548, 12808
Timonius sp., 'laevigatus-pulposus group', WT 12352
Uncaria barbara Wall. var. appendiculata (Benth.) Ridsd., AA 378: WT 11199
Uncaria nervosa Elmer, WT 12993
Urophyllum aff. 'brittanicum' Wernh., WT 11680
Verstegia minor Valeton, WT 11188, 11930
Wendlandia paniculata (Roxb.) DC., AM 514, 532, 553: WT 11252
genus indet., WT 12926, monospermous shrub

RUTACEAE
Acreonchya sp., SR, Haia
Evodia bortensis J. R. & G. Forst., WT 12490, 12497-B
Melitope denhamii (Scem.) T. Hartley, or aff., WT 12280, 12636
Melitope grandifolia B.L. Burtt, or aff., WT 11671
Melitope (probably) macronata Merr. & Perry, SR, upper Maimafu
Melitope cf. nova-guirvensis Valeron, WT 12212, keys to here but can't confirm
Melitope sp., Evodia §§ Coriaceae, SR; cf. S&C 4704, Gulf
Flindersia amboinensis Poir., SR; cf. S&C 4656, Gulf, det. Leiden
Flindersia sp., (possibly) laevicarpa C.T. White & Francis, SR, Haia-Pio
Halfordia drumfia (Ev.M.) Laut., WT 11857
Lanasia amara Blanco var. amara, WT s.n.
Liriodendron tulipifera (Forst. f.) W. & A., SR; cf. S&C 4542; C&S 1003, Gulf
Tetrapanax tetradrum (Roxb.) Merr., WT 12285, 12594
Wenzelia tenuifolia Swingle, WT 12938
Zanthoxylum conspersipunctatum Merr. & Perry, WT 12465
Zanthoxylum spp., SR, Haia-Pio
(possibly) nitidum (Roxb.) DC., S&C 4246, Gulf, det. Streinmann
(possibly) wildshutii Wright, C&S 1019, Gulf

SABIACEAE
Meliosma pinnata (Roxb.) Maxim. ssp. humilis (Merr. & Perry) Beus., SR, upper Maimafu
Meliosma pinnata (Roxb.) Maxim. ssp. macrophylla (Merr.) Beus., WT 11190, 12085
Sabia paniculata Bl., WT 12226, 12959, 12976

SANTALACEAE
Cladonysa aff. umbellata Danser, WT 12359, keys to umbellata but not the sp.
Decodonsera reinwardtiana (Bl.) Danser, WT 12348
Deodoropha amorphis Stauffer, WT 11856
Scleropyrum aurantiacum (Laut. & K. Schur.) Pilgr., AM 679; WT 11253, 11707

SAPINDACEAE
Alectryon myrmecophilus Leenh., WT 12746
Allophyllus cobbe (L.) Raeuschel, SR, Pio; cf. S&C 4680, det. Leiden
Capniopis macropetala Radl., WT 11146
Capniopis platycarpa Radl., ID based on fruits on ground, Haia
Capniopis rhytidocarpa Adema, WT 12864
Dictyoneura obtusa Bl., WT 11201
Dodonaea angustifolia L.f., WT 12418
Gouia mollissima Radl., or aff., WT 12664, 12995
Gouia suberosa Radl., WT 12276, 12283
Harpullia arborea (Blanco) Radl., SR; cf. S&C 4641, Gulf
Harpullia camptonera Radl., WT 11889
Harpullia cf. camptonera Radl., WT 12723, possibly H. campanuloides
**SAPOTACEAE**

*Pouteria anteridifera* (C.T. White & Francis) Baehni, AM 221

**SAXIFRAGACEAE**

*Quintinia* sp., SR, upper Maimafu

**SOLANACEAE**

*Capsicum annuum* L., SR, cultivated Haia & Maimafu

*Lycopersicon esculentum* Mill., SR, cultivated, also as *L. lycopersicum*

*Nicotiana tabacum* L., SR, cultivated

*Physalis peruviana* L., WT 12301

*Solanum americanum* Mill., WT 12015

*Solanum anfractum* Symon, WT 12912, 12928

*Solanum bifrons* Lour., WT 12508, 12688

*Solanum elaeagnifolium* Bitter, WT 12379

*Solanum cf. dallmannianum* Warb., WT 12705; possibly *S. troncholobatum*

*Solanum dendrophorum* Symon, WT 11854, det. Symon

*Solanum dunalanum* Gaud., SR, Pio; cf. S&G 4244, det. Symon

*Solanum oliverianum* K. Schum. & Laur., C&G 848, Purari, det. Symon

*Solanum peranomalum* Wernh., WT 11204, conf. Symon

*Solanum pastulatum* Symon, WT 11704, 11804, conf. Symon

*Solanum cf. pastulatum* Symon, or aff., WT 12085; does not key out

*Solanum torvioides* Merr. & Perry, WT 12549

*Solanum sp.,* (possibly) *leptacanthum* Merr. & Perry, cf. C&G 714; S&G 4623, det. Symon

**SPHENOSTEMONACEAE**

*Sphenostemon papuanus* (Laut.) Steen. & Erdtman, WT 12308, 12444

**STAPHYLEACEAE**

*Taphinia feustalndra* (Schltr.) v.d. Linden, AM 474; WT 11858, 12119, 12432, 12478

**STERICULIACEAE**

*Brachychiton carruthersii* Fv.M., or *B. relativus* Kosterm., WT 12021

*Commersonia harriana* (L.) Merr., SR, Haia

*Melochia odorata* L.F., WT s.n., partial sheet

*Pterocynium beccarii* K. Schum., C&S 770; WT s.n., carpological coll.

*Brygota boscia* (R. Br.) Kosterm., SR, Haia

*Sterculia angula* Bak. f., WT 11186, 12056

*Sterculia gilva* Miq., or aff., WT 12814

*Sterculia macrophylla* Vent., WT 11984

*Sterculia monticola* Mildbr. var. *laxiflora* Tantra, WT 12148, 12647

*Sterculia schumanniana* (Laut.) Mildbr., SR, Haia

*Sterculia shillinglawii* Fv.M. var. *shillinglawii*, WT s.n., partial sheet

*Sterculia arvenicata* J. Smith, S&G 4467, E. Purari R., det. Tantra

**STYRACACEAE**

*Braunussia styraoides* Boerl. & Koorders, WT 12423

*Stytrax aragaste* (Lour.) G. Don, SR, Pio & lower Maimafu

**SYMPLECTACEAE**

*Symphloco cochinchinesis* (Lour.) S. Moore ssp. *leptophylla* (Brand) Nooteb., AM 659; WT 11233

**THEACEAE**

*Adinandra forbesii* Bak. f., WT 12120

*Eurya aff. kamihorai* Kobuski, WT 11848; keys to here but leaf not crenate

*Eurya tigang* K. Schum. & Laur., WT 12063, 12299
Gordonia papuana Kobuski, WT 12767
Ternstroemia brittiniana Fv.M., WT 12405
Ternstroemia cherryi (F.M. Bail.) Merc., WT s.n.

**THYMELAEACEAE**
Phaleria macrocarpa (Scheffer) Boerl., SR, Haia; cf. LAE 61132, Purari R.
Phaleria pilista Stevens, WT 12069
Phaleria sogerensis S. Moore, WT 11808. 11888, 12182, 12659
Phaleria cf. sogerensis S. Moore, WT 12786

**TILIACEAE**
Grewia aff. bracteata Burnett, WT 13017
Mimosa cf. grandiflora Burnett, WT 11903. 12004
Mimosa tarasperma Merr. & Perry, WT 11682
Trichospermum tripepis (K. Schum.) Kosterm., WT 12366. 12743
Trimufetta sp., 'nigricans-pilosa group', WT 12396

**TRIMEINIACEAE**
*Trimeonia papuana* Ridl., WT 12857

**ULMACEAE**
*Ceiba hildebrandii* Soepadmo, WT 12095
*Ceiba sp.,* 'latifolia-philippines group', WT s.n., sterile
Girardinia (probably) birsa Ridl., SR, Haia
Parasponia rigida Merr. & Perry, WT 12206
Parasponia rugosa Bl., WT 12080. 12260
Trenta cannabina Lour., WT 11838
Trenta orientalis (L.) Bl., SR, Haia

**URTICACEAE**
Cypholophus aff. decipiens Winkler, WT 12384
Cypholophus cf. latifolius (Bl.) Wedd., WT 11728
Cypholophus cf. pachycarpus Winkler, WT 11750
Cypholophus rotundifolius Winkler, or aff., WT 12163. 12188
Cypholophus cf. retinum Winkler, WT 12823; keys to retinum on Winkler
Debrecensia longifolia (Burm. f.) Wedd., WT 12577
Debrecensia sp., WT 12207. 12846. 12868
Dendroncide petiata (Bl.) Chew, LAE 61082, Purari R.
Dendroncide ternatensis (Miq.) Chew, WT 12019

Elatoestea beccarilii Schröter, WT 12031. 12152
Elatoestea blechnoides Ridl., or aff., WT 12153; ? E. rubicante H. Winkler
Elatoestea cf. macrophyllum Bronn., WT 11229, 12090. 12246-A
Elatoestea aff. macrophyllum Bronn., WT 12584
Elatoestea morganiode Laut., WT 12270
Elatoestea morifolius Perry, WT 12380
Elatoestea cf. novoguineense Warb., WT 12089
Elatoestea polonerrum Hall. f., SR, Maimau
Elatoestea tridens Perry, WT 12385
Laportea decumana (Roeb.) Wedd., WT 12936
Lacosyce capitellata (Poir.) Wedd., SR, Pio; or related species
Notobocidea mollissima (Bl.) Chew, WT 12389
Notobocidea repanda (Bl.) Bl., S&C 4501; WT 11746
Oreocnida trinervis (Bl.) Miq., AM 527, 618; WT 11177, 12681
Pilea candata Winkler, WT 12254
Pilea cuneata Winkler, sensu Chew, WT 12279
Pilea effusa Winkler, WT 12175. 12529
Pilea papuana Winkler, WT 12267
Pilea venulosa Bl., WT 12117
Piiturius argentus (Forst. f.) Wedd., WT 11806, 12520, 12627
Porzolzia sp., SR, Maimau
Procris frutescens (Winkler) Schröter, WT 12096
Procris pedunculata (Forst.) Wedd., WT 12039
Procris cf. pedunculata (Forst.) Wedd., WT 12367

**VERBENACEAE**
Callicarpa longifolia Lamk., WT 12412, 12785
Callicarpa pedunculata R. Br., WT 12003
Clerodendrum brasili Beer & H. J. Lam, AM 217; WT 11227
Clerodendrum bursa-pastoris Miq., WT 11297
Clerodendrum inermis (L.) Gaertn., SR, Pio; cf. S&C 4474
Clerodendrum sp. nov., WT 12209; no result on Lam, no LAE match

NEW SPECIES
Bocilea sp., WT 11177, 12681
Lep люцерна aff, 217; 12785
Lam., 4474
Lam., 12209; no result on Lam, no LAE match
Genus piantador (Roxb.) Merr., WT 12425
Gmelina dalrympleana (F.v.M.) H.J. Lam, SR, Pio
Pronia serratifolia L., SR; cf. C&S 818, E. Purari
Teiipunindendron abernianum (Merr.) Bakh.,
WT. s.n.
Vitex cofassus Reimw. ex Bl., SR; cf. S&C 4497, Purari R.

VITACEAE
Ampheliasis sp., SR, Haia
Cayratia japonica (Thunb.) Gagn., WT 11712
Cayratia (close to) japonica (Thunb.) Gagn.,
WT 12108
Cayratia sp., cf. C&S 855, Purari, indet.,
'trifoliate faces'
Cissus aristata Bl., WT 11759
Cissus sp., aff. aristata Bl., WT 12094,
12985; not the species
Cissus baueri Planch., or aff., SR, Haia;
aff, C&S 4505
Notobasis panminorvis (F.v.M.) Lattif, LAE
61100, Purari R., det. Leiden
Tetrastigma sp., WT 12456, 12645

WINTERACEAE
Zygogynum aff. ?glancum (A.C. Smith) Vink,
WT 11268

MONOCOTS

AGAVACEAE
Cordyline cf. fruticosa (L.) A. Chev., WT
12574-B

AMARYLLIDACEAE
Crinum asiaticum L., LAE 61096, Purari
R., det. Leiden list
Curculigo capitulata (Lour.) Kuntze, WT
11688
Curculigo cf. capitulata (Lour.) Kuntze, WT
12789; leaves emarginate, inflorescence
creep

ARACEAE
Alocasia lancifolia Engler, SR, Pio
Alocasia macrorrhiza (L.) G. Don, WT 11296
Alocasia nicolsonii A. Hay, WT 12202

Abocasia cf. nicolsonii A. Hay, WT 12145,
12859
Anomorphophallus galbra F.M. Bailey, WT
11228, 11786
Amyalum zippelianum (Schott) Nicolson,
WT 12048
Colocasia excelenta (L.) Schott, SR, cultivated
Cryptocoryne ciliata (Roxb.) Schott, S&C
4449, E. Purari R., det. N. Jacobsen
Cyrtotigern cf. austrophilum Alderw., WT
11208
Epipremnum pinnatum (L.) Engl., AM 609
Holochlamys betarri Engl., WT 12097
Putos fulcifolius Engl. & K. Krause, AM
509, det. A. Hay

ARECACEAE (PALMAE)
Aracea catechu L., SR, cultivated
Calamus bolingarii Becc., WT s.n.
Caryota rupphiana Martelli, WT 12665
Coco nucifera L., SR, cultivated
Metrosychon sago Rottb., SR, Haia

COMMELINACEAE
Anelena cf. acuminatum R. Br., LAE 66362,
Wabo
Commelinia diffusa Burm. f., SR, Haia
Floropa scauden Lour., LAE 66360, Wabo
Forrestia mollissima (Bl.) Koords., s. lat.,
WT 11865, = ?Amschelatyle
Polka thyrisflora (Bl.) Steud., WT 11784

COSTACEAE
Costus speciosus (Koen.) J.E. Sm., SR, Haia
Tapeinoschilos annuus (Hassk.) K. Schum.,
WT 11859, det. Gideon
Tapeinoschilos brassii Gideon, pers. comm.
Gideon
Tapeinoschilos vestigen Valeton, AM 596;
WT 11156, 11179, det. Gideon

CYPERACEAE
Cyperus cf. nutans Vahl. var. elcsinoides
(Kurth) Haines, LAE 66361, Wabo, det.
Leiden
Paramoanania pericbactea (Clarke) Ustric,
LAE 66367, Wabo dam site, det. Henty
Scleria polyacarpa Boss., WT 11747
Scleria terestris (L.) Fass., WT 12686, 12787

DIOSCOREACEAE
Dioscorea bellisfera L., WT 13006
**ORCHIDACEAE**

- *Dendrobium* (probably) *esculentum* (Lour.) Burk., SR, Pio & lower Maimafu
- *Dendrobium* *amphilocalcar* Lamk., WT 11768, 12677

**FLAGELLARIACEAE**

*Flagellaria indica* L., WT 12216

**GEITONOPLESIACEAE**

*Geitoplesium cymosum* (R. Br.) Hook., WT 12571

**HELICONIACEAE**

*Heliconia papuana* W.J. Kress, WT 11882

**IRIDACEAE**

*Tritonias crocosmiflora* (Lemoine) Nichols, WT 12807

**LILIACEAE**

- *Disella** enisofila* (L.) DC., WT 12287, 12482
- *Disella javanica* (Bl.) Kunth, or aff., WT 12658

**MUSACEAE**

*Ensete glaucum* (Roxb.) Cheesman, SR, common giant herb, Maimafu

**ORCHIDACEAE** (dets. N.H.S. Howcroft)

- *Bulbophyllum antennatum* Schltr., He 38
- *Bulbophyllum* *cf.* *caudatum* J.J. Sm., He 8
- *Bulbophyllum interstitium* J.J. Vermeulen, He 1
- *Bulbophyllum lepanturflorum* Schltr., He 1
- *Bulbophyllum* (close to) *venematopodium*, He 33
- *Bulbophyllum picaenanthum* J.J. Vermeulen, He 37
- *Bulbophyllum trifidum* subsp. *trifidum* J.J. Sm., WT 12810, 12903, 12975
- *Bulbophyllum urakoi* N.H.S. Howcroft, type coll.
- *Calanthe ventrilabrum* Rchb. f., He 21
- *Calanthe werneri* Schltr., WT 11133
- *Coelogyne bacarri* Rchb. f., WT 12774
- *Coelogyne fragrans* Schltr., WT 12536, 12579, 12824
- *Coelogyne* *cf.* *fragrans* Schltr., He 13, 30; He 8
- *Corynborhis verratifolia* (Reinw.) Bl., WT 11240
- *Cyrtorchis* *cf.* *dentifera* Schltr., WT 11165
- *Dendrobium bellophyllodes* Schltr., WT 12825
- *Dendrobium* *cf.* *dilloniannum* §*Grastidium*, WT 12872, 12899; ?authority
- *Dendrobium finisterre* Schltr., WT 12967
- *Dendrobium globulosum* Schltr., WT 12812
- *Dendrobium* *cf.* *obtusipetalum* J.J. Sm., §
- *Calypetrochilus*, WT 12290, 12372
- *Dendrobium pleianthum* Schltr., He 33
- *Dendrobium pseudoglowanatum* Reeve and J. Woods, WT 12673
- *Dendrobium pseudopeloricum* J.J. Sm., WT 12371
- *Dendrobium tapestric J.J. Sm., He 17
- *Dendrobium* *aff.* *subclausum* Rolfe, §
- *Calypetrochilus*, WT 12773
- *Dendrobium corolliflorum* Krz., §
- *Oxyphollhum*, WT 12357
- *Dendrobium* *aff.* *vexillarius* J.J. Sm., §
- *Oxyphollhum*, WT 12398
- *Dendrobium* sp. A, § *Calypetrochilus*, He 16, 28
- *Dendrobium* sp. B, § *Grastidium* (mixed coll.), WT 12712
- *Dendrobium* *sp.* C, § *Grastidium*, WT 12986
- *Dendrobium longifolium* Rchb. f., He 2; WT 12134, 12229, 12517, 12988
- *Diploranthes contristrips* Schltr., WT 12135, 12298
- *Diploranthes* sp., WT 12856
- *Dipodium pandanum* Bail., WT 12603; LAE 66276, Wabo dam site
- *Epiphyllum* sp., WT 12045
- *Eria imbricata* J.J. Sm., He 36
- *Eucoris papuana* Schltr., WT 12136
- *Glomera* sp., WT 12376
- *Habenaria* or *Peristylus*, sp. A, WT 12101
- *Habenaria* or *Peristylus*, sp. B, WT 12195
- *Habenaria* or *Peristylus*, sp. C, WT 12484
- *Habenaria* or *Peristylus*, sp. D, WT 12586
- *Liparis caespitosa* Lindl., WT 12327
- *Liparis* *aff.* *gibbosa* Finet, He 25
- *Liparis* sp., § *Distichium*, WT 12714
- *Medinacalcar quadridifolium* Schuipman, WT 12855
- *Medinacalcar* sp. A, WT 12446
- *Medinacalcar* sp. B, WT 12815
- *Neuwiedia verratifolia* Bl., WT 11770
- *Octarhena angraecoides* Schltr., He 12
- *Peristylus* *ditichocaules* (Schltr.) Schltr., WT 11284
Phainius montanus Schltr., WT 12233
Phainius cf. montanus Schltr., WT 12760, 12826
Phainius sp., WT 12286
Phreatia teckleus Ames, WT 12297
Phreatia elata Schltr., WT 12933
Phreatia sp. A, WT 12794
Phreatia sp. B, WT 12816
Olearonia sp., WT 12288
Robiquetia cf. moranana (Rolfe) J.J. Sm., WT 11127
Spathojllottis Ev.M., WT 12289
Spathobolitis plicata Kruhl., WT 11286
Spathobolitis plicata Bl. subsp. puberula N.H.S.
Howcroft, WT 11207
Vanuilla warrenis Schltr., WT 11842
Vrydagynia cf. albostrigata Schltr., WT 12383
Vrydagynia cf. albostrigata Schltr., or salomonensis Schltr., WT 12251
Vrydagynia sp., WT 12341

PANDANACEAE
Freyvinitia angustissima Ridl., SR of common climber
Freyvinitia aff. lagenarica Warb., WT 11761
Freyvinitia maricatolida Hems., WT 11955
Pandanus spp., WT s.n.

POACEAE (GRAMINEAE)
Aplada nutica L., SR; cf. C&S 1065
Centocharis latifolia (Osb.) Trin., WT 11717
Chrysochloa arenicola (Reez.) Trin., SR; cf. S&C 4593, det. collectors
Coix lacryma-jobi L., WT 12019
Curvularia aereoccursii Trin.(Trin.) Stapf, WT 12639
Garuwia striata Brong. var. longiata Hack., WT 12470
Ichnanthus vicinus (E.M. Bailey) Merr., WT 12717
Imperata conferta (Presl) Ohwi, WT 12408
Imperata cylindrica (L.) P. Beauv., WT 12599
Isab демо pulmagrinita Jansen, WT 12054, 12059, 12064
Isab demo nymotis Nees, WT 12565
Nastus longispicata Holttum, WT 12600
Oplismenus birtellus (L.) P. Beauv., WT 12002, 12715
Penisetum sp., (probably) macrostachyum (Brongn.) Trin., SR, Maimauf
Saccharum edule Hassk., SR, cultivated
Saccharum officinarum L., SR, cultivated
Saccharum sp., 'robustum - spontaneum complex', WT 12597
Scrotonia urceolata (Rosb.) Judziewicz, SR Setaria palmifolia (Koen.) Stapf, WT 12006
Zeas mays L., SR, cultivated

TRIURIDACEAE
Sciaphila densiflora Schltr., LAE 66347, det. Leiden list
Sciaphila torulosa Bl., LAE 66268, Wabodam site, det. Leiden

ZINGIBERACEAE
Alpinia werneri Valeton, § Pykanthus, WT 11787
Alpinia sp., § Dieromalpina, WT 11831
Curcuma antranidasica Hook. f., AM 382: WT 11295
Elingera dekkii, or E. versteegii, WT 11705; need flower color
Hornstedtia sottiana (Ev.M.) K. Schum., WT s.n.
Phrynium aff. pedunculatum Warburg, WT 11880
Placanthium macroxyanthum (Valeton)
R.M. Smith, WT 11136
Riedelia corallina Valeton, WT 11141
Riedelia macrantha K. Schum., WT 11173

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The Lae National Herbarium served as the principal logistical base and provided facilities for processing and identification of collections. N.H.S. Howcroft illustrated the new species and colleague J. Pipoly of the Botanical Research Institute of Texas corrected the Latin diagnoses. Keiko Muto provided the Japanese translation.

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REFERENCES


VAScULAR PLANTS ON A GYPSUM OUTCROP IN SOUTHERN NEW MEXICO: A LISTING, A NEW VARIETY AND TAXONOMIC REALIGNMENTS IN THE ANULOCAULIS LEIOSOLENUS COMPLEX (NYCTAGINACEAE), AND A NEW VARIETY OF MENTZELIA HUMILIS (LOASACEAE)

RICHARD SPELLENBERG and THOMAS WOOTTON

Department of Biology
New Mexico State University
Las Cruces, NM 88003-8001, U.S.A.

ABSTRACT

A survey of the flora on a hitherto unexplored gypsum outcrop on the west face of the Guadalupe Mountains in southern New Mexico has revealed a new variety of Anulocaulis (Nyctaginaceae), A. leiioleinaus (Torr.) Standl. var. howardii Spellenb. & Wootten (var. nov.). This variety has a combination of characteristics in various degrees intermediate to other taxa, an observation that results in the inclusion of A. gypogenus Waterf. into A. leiioleinaus as A. leiioleinaus var. gypogenus (Waterf.) Spellenb. & Wootten (comb. nov.). Also from this outcrop is described Mentzelia humilis (A. Gray) J. Darl. var. guadalupensis Spellenb. (var. nov.). Fifty-nine species in 29 families were observed to occur on the gypsum outcrop. A key is provided to all known Anulocaulis taxa and a list is presented documenting the other plant species that occur with it and the new variety of M. humilis.

RESUMEN

La exploración de la flora en un afloramiento de yeso, inexplorado previamente, en la ladera oeste de las Montañas Guadalupe en el sur de Nuevo México ha revelado una variedad nueva de Anulocaulis (Nyctaginaceae), A. leiioleinaus (Torr.) Standl. var. howardii Spellenb. & Wootten (var. nov.). Esta variedad tiene una combinación de caracteres intermedios en varios grados con otros taxa, una observación que da como resultado la inclusión de A. gypogenus Waterf. en A. leiioleinaus así como A. leiioleinaus var. gypogenus (Waterf.) Spellenb. & Wootten (comb. nov.). También, Mentzelia humilis (A. Gray) J. Darl. var. guadalupensis Spellenb. (var. nov.) está descrita de este afloramiento. Cincuenta y nueve especies de 29 familias de plantas fueron observadas en este afloramiento de yeso. Se ofrece una clave para todos los taxa conocidos de Anulocaulis y se presenta una lista documentando las otras especies de plantas que conviven con las dos variedades nuevas.

INTRODUCTION

While deer hunting in southern Otero County, New Mexico, about a decade ago, Michael Howard of the Bureau of Land Management, Las Cruces District, traversed a gypsum outcrop on the western slope of the northern portion of the Guadalupe Mountains and noted an Anulocaulis. In the summer of 1996 he showed the plant to Wootten, who collected a voucher, identified
the plant as *Anabacaldis gypsogenus* Waterf., and brought it to the New Mexico State University herbarium for deposition. Spellenberg immediately recognized the plant as near *A. gypsogenus* but somewhat different. That collection also brought attention to a previously unbotanized area on the west face of the Guadalupe Mountains.

Wootten and Howard visited the southern portion of the gypsum outcrop in September and November, 1996, and escorted Spellenberg to that site in early August 1997. Spellenberg and Wootten returned to the southern portion of the outcrop in September 1997 and April 1998, and to the northern, more lengthy portion of the outcrop in July, 1998. Our survey revealed new varieties of *Anabacaldis leiosolensis* and *Montezia humilis*, herein described, and resulted in a collection of plants documenting the flora of this gypsum outcrop (Appendix 1).

**CHARACTERISTICS AND FLORA OF GYPSUM OUTCROP**

This gypsum outcrop is part of the Permian age Yeso Formation (Hunt 1977). Most of the outcrop consists of limestone rubble, the stones 2–10 cm in diameter, or larger, overlying a pale tan, sandy, gypseous clay. In a few places, when walked upon, the gypsum makes the hollow sound characteristic of other gypsum outcrops in the Southwest. On the steeper slopes there is little limestone rubble, the gypseous matrix being completely exposed.

The outcrop is not continuously exposed and consists of two main sections. The southern section extends for about 5 km in a NNW-SSE direction, and perhaps up to 3/4 km in an E-W direction, with an elevational range of about 250 meters beginning at about 1350 m. It occurs on the lower slopes of the western escarpment of the Guadalupe Mountains, beneath The Rim, at the upper edge of the bajadas that extend westward to Crow Flats. The southern end of this section lies about 48 air km NNE of Dell City, Texas, centered on about 32°02'N, 105°04'W (Sec. 25 to estimated Sec. 11, T22S, R18E), just north of the mouth of Pup Canyon. Most of the outcrop has a very steep western exposure, the slopes 30–45° and steeper. Near the base of the outcrop at the southern end of the outcrop, and also about 2 km to the south, there are a few low, gypseous hills that have slopes of all exposures, and within the major portion of the outcrop, gullies and arroyos provide northern and southern exposures.

The southern portion of the outcrop disappears near the northern end of a small south-facing box canyon. It or a similar gypseous outcrop reappears on the western slopes of the mountains about 3 km to the NNW. From there the outcrop continues in a northwesterly direction in a discontinuous manner for about 12 km (Sec. 33, T21S, R18E northward to Sec. 25, T20S, R17E).

This outcrop occurs in an remote area where access is comparatively difficult. The entire outcrop lies on public lands, some portions entirely on
those of the Bureau of Land Management, Las Cruces District, in other areas the eastern portions on the Guadalupe Ranger District of the Lincoln National Forest. Browsing of a few of the species that occur on this outcrop, probably by deer and rabbits, was noted; no sign of domestic livestock, common in the valley below, was observed. According to a local rancher, Mr. George Rauch, the livestock simply do not get up to this rather inhospitable site (he was speaking of the southern section, but conditions are similar along the length of the outcrop). The two new endemics discovered here presently do not seem to be impacted by human-related activities.

The *Anulocaulis* and the *Mentzelia* are both common and conspicuous on the outcrop. Because there are no records in collections of these taxa from here, we believe that the outcrop had not been explored by botanists prior to our work. Only a minor portion of the outcrop consists of highly concentrated gypsum, and here obligate gypsophiles such as *A. leiosolenus*, *M. humilus*, and *Selinocarpus lanceolatus* occur. On this portion we document 59 plant species in 29 families (Appendix 1), including the two new varieties described below. We stopped noting species when we crossed off the gypsum and onto the cobbly limestone bajadas that support Chihuahuan Desert vegetation consisting of * Larrea tridentata* (DC.) Cov., *Parthenium incanum* Kunth, *Acacia newermicosa* Isely, *Fouquieria splendens* Engelm., *Yucca torreyi* Shafer, *Ephedra aspera* Engelm., *Dasylirion wheeleri* S. Wats., *Echinocereus pectinatus* (Scheidw.) Engelm., *Krameria erecta* Willd. ex Schultes, *Allionia incarnata* L., *Stenandrium barbatum* Torr. & A. Gray, *Polygala macreadenia* A. Gray, among numerous other species.

**A NEW VARIETY AND TAXONOMIC REALIGNMENTS IN *ANULOCaulIS***

Spellenberg (1993) provided a taxonomic review of *Anulocaulis* and recognized five species, one of them, *A. leiosolenus*, with two varieties. Turner (1993) described a sixth species. This present paper reduces one of the species recognized by Spellenberg to a variety in *A. leiosolenus*, and adds a fourth variety to that species. We now consider *Anulocaulis* to have five species, one with four varieties.

*Anulocaulis leiosolenus* (Torr.) Standl. var. *howardii* Spellenb. & T. Wootten, var. nov. Type: UNITED STATES, NEW MEXICO, Otero Co.: 48 km NNE of Dell City, Texas, W base of Guadalupe Mts., N of mouth of Pup Canyon, ca. 50 m SW of NE corner S26, T22S, R18W, 32°22.14'N, 105°03.92'W, elev. 1360 m, 5 Aug 1997, Spellenberg, Wootten, and Howard 12433 (holotype: NMC; isotypes: NY, TEX, UNM).

A *Anulocaulis leiosolenus* var. *leiosoleno* *perianthii* *rubro-rosceae* (vs. *albis vel subrosae* *dilutis*) foliis leviter glaucis et parce tuberculatis (vs. *viridis non glaucis et dense tuberculatis*) differt.

Strong perennial from gnarled woody root. Stems 1-ca. 6, ascending, branched in upper 70%, up to ca. 1.2 m tall, glabrous, glaucous. Leaves usually in 2-3 pairs in basal 1/4 of plant; petioles 35-50 mm long, blades more or less
orbicular, commonly wider than long, 45–105 mm long, 45–135 mm wide, semi-glaucous, bluish-green, with sparse purplish pustules, pustules slightly denser on abaxial surface. Inflorescences widely paniculate, forming the upper 2/3 of the plant, the flowers borne terminally and on short side branches in more or less congested clusters. Buds with minute hairs at the apex. Perianth deep rose-pink, obliquely funnelform, 22–32 mm long, limb 10–17 mm wide, stamens exerted ca. 20 mm, the style 25 mm. Fruit biturbinolate, 4.3–5.9 mm long, 3.7–4.5 mm wide, with 10 irregular longitudinal ridges and an equatorial wing 0.2–0.9 mm wide.

At present, the new *Anulocalulis* is known only from the western slope of the Guadalupe Mountains in south-central New Mexico on tannish, shaley, gypsumous clays, and then only from the southern portion of the gypsum outcrop, immediately north of Pup Canyon. Exploration of the outcrop to the north revealed no other populations. We name the plant for its discoverer, Michael Howard, of the Las Cruces District of the Bureau of Land Management, whose attention to natural biota resulted in the discovery of this *Anulocalulis*. Mike has a strong sense of responsibility for the nation’s natural resources, shares his knowledge willingly with the public, and works toward making land-use in the Southwest compatible with needs for conservation.

Paratypes: NEW MEXICO. Otero Co.: ca. 30 air mi NE of Dell City, Texas, foothills of Guadalupe Mts. at mouth of Pup Canyon, extreme SE corner of Sec 23, T22S, R18E, 26 Sep 1996, Wootton and Howard s.n. (NMC); 48 km NNE of Dell City, Texas, W base of Guadalupe Mts., N of mouth of Pup Canyon, edge of Lincoln National Forest, ca. 500 m ENE of SW corner S24 T22S R18W, 32°22.22'N, 105°7.4'W, elev. 1360 m, 5 Aug 1997, Spellenberg, Wootton and Howard 12435 (ARIZ, NMC, UC); 49 km NNE of Dell City, Texas, W base of Guadalupe Mts., N of mouth of Pup Canyon, NE Sec 23, T22S, R18W, 32°22.75'N, 105°03.99'W, elev. 1460 m, 5 Aug 1997, Spellenberg, Wootton and Howard 12438 (NMC).

*Anulocalulis leiosolenus* var. bouvardii is immediately distinguishable from close relatives by the combination of the semi-glaucous leaves with only a few large multicellular trichomes, the reddish-pink perianth, and the moderately broad rim on the fruit (Table 1). The fruit is most similar to that illustrated in Spellenberg (1993, Fig. 1E), a fruit from a Texas race of *A. leiosolenus* var. *leiosolenus*. Within the complex, minute hairs at the tip of the perianth, best seen in bud, were previously known only in the var. *leiosolenus*.

As illustrated in Table 1, the new variety has some of the characteristics that are used alone or in combination to distinguish among other members of the *A. gypsogenus-leiosolenus* complex (Spellenberg 1993). For this reason we believe the newly discovered entity is best recognized as a variety in a more broadly reconstructed *A. leiosolenus*, in which *A. gypsogenus* is included at the varietal level. The entire complex presents a classic representation of completely allopatric, closely related, more or less distinguishable races, this structure commented upon by Spellenberg (1993). Mayr (1969, ch. 3) dis-
Table 1. A comparison of some characteristics used to distinguish varieties within *Anulocaulis leiosolenus*.

<table>
<thead>
<tr>
<th>Variety of <em>A. leiosolenus</em></th>
<th>Perianth limb color</th>
<th>Perianth pubescence</th>
<th>Leaves</th>
<th>Fruit wing</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>gypsogenus</em></td>
<td>white to very pale pinkish</td>
<td>none</td>
<td>pale bluish green, glaucous, smooth, pale gray or whitish when dried</td>
<td>0.8–1.2 mm</td>
</tr>
<tr>
<td><em>howardii</em></td>
<td>deep rose pink</td>
<td>minute trichomes at tip in bud</td>
<td>bluish green, semi-glaucous, few large conical tubercules, grayish green when dried</td>
<td>0.2–0.9 mm</td>
</tr>
<tr>
<td><em>lasianthus</em></td>
<td>pale pink to pink</td>
<td>minute trichomes at tip in bud</td>
<td>green, semi-glaucous, dense conical tubercules, dull green when dried</td>
<td>0.2–0.6 mm</td>
</tr>
<tr>
<td><em>leiosolenus</em></td>
<td>white to pale pink</td>
<td>none</td>
<td>green, not especially glaucous, dense conical tubercules, dull green when dried</td>
<td>0.2–0.6 mm</td>
</tr>
</tbody>
</table>

Discussed problems with deciding taxonomic divisions in allopatric populations; Stuessy (1990, ch. 12) discussed problems with assigning infraspecific taxa to varieties or subspecies. With regard to *Anulocaulis*, the tradition of using variety is followed for taxonomic recognition of closely related, internally rather homogeneous populations that can be distinguished from other, similar populations.

Spellenberg (1993) noted the similarity between the large, pale perianth of the western race of *A. leiosolenus* var. *leiosolenus* and that of *A. gypsogenus*. On a more subtle note, the var. *howardii* has flowers clustered in the inflorescence reminiscent of var. *lasianthus*. This characteristic is somewhat developed in *A. gypsogenus* and much less so in the var. *leiosolenus*. The leaves of the var. *howardii* are more similar to *A. gypsogenus*. The fruits are rather intermediate between *A. leiosolenus* and *A. gypsogenus*, as traditionally recognized. It is our view that with the discovery of the easily recognizable race now named as *A. leiosolenus* var. *howardii*, the other phases in this complex of gypsophilic endemics are best recognized as belonging to one geographically fragmented (Fig. 1) species of variably differentiated allopatric races. For that reason, we transfer *A. gypsogenus* into *A. leiosolenus* as a variety restricted to the gypsum along the Pecos River, slightly to the east of, but completely disjunct from var. *howardii*. 
Fig. 1. Map of states of southwestern United States and northwestern Mexico showing the distribution of *Anulocaulis leiosolenus* varieties.


**Basionym:** *Anulocaulis gypsogenus* Waterf., *Rhodora* 47:329. 1945. **Type:** UNITED STATES. NEW MEXICO. CHAVES CO.: COMANCHEAN BLUFFS, 7 mi E of Roswell, 9 Oct 1944, *Waterfall* 5707 (holotype: GH!; isotypes: NY! MO!).

**KEY TO TAXA OF ANULOCaulIS**

1. Anthocarp without a prominent equatorial ridge or wing; perianth less than 16 mm long, the lobes flaring but not reflexed.

2. Perianth 15–16 mm long at anthesis, purplish, the tube externally glabrous, minutely glandular-pubescent near the apex; anthocarp ellipsoid or broadly fusiform (southern Coahuila).

3. Flowers usually 3–15 in umbel-like clusters; tube of perianth not elongating after anthesis; anthocarp broadly fusiform (southeastern California).

4. Anthocarp usually borne singly; tube of perianth markedly elongating after anthesis; anthocarp turbinate, bluntly 5-angled, ridges indefinite (southern Texas, western Coahuila, possibly eastern Chihuahua).

1. Anthocarp with a prominent equatorial ridge or wing; perianth 10–35 mm long, the lobes flaring or sharply reflexed.
4. Perianth ca. 10 mm long, the lobes sharply reflexed (northeastern Chihuahua and immediately adjacent Texas). ......................... A. reflexus I. M. Johnst.
4. Perianth 22–35 cm long, the lobes flaring, not reflexed .............. A. leiosolenus (Torr.) Standl.

5. Leaves smooth, glaucous; perianth glabrous externally at apex (Pecos River in southeastern New Mexico and western Texas). ................ var. gypsogenus (Waterf.) Spellenb. & T. Wootten
5. Leaves at least sparsely tuberculate; perianth minutely puberulent or glabrous at the apex.
6. Perianth glabrous externally at the apex (extreme western Texas, south-central New Mexico, north-central Arizona, and southern Nevada)

6. Perianth minutely pubescent externally at the apex (visible best when in late bud).
7. Leaves grayish green; purplish tubercules on leaves sparse; perianth deep rose-pink (south-central New Mexico, W face of Guadalupe Mts. ................... var. howardi Spellenb. & T. Wootten
7. Leaves green or dark green; purplish tubercules on leaves dense; perianth pale pink to pink (Big Bend region of Texas and immediately adjacent Chihuahua) .................. var. lasianthus I.M. Johnston

A NEW VARIETY OF MENTZELIA HUMILIS

Mentzelia humilis (Urb. & Gilg) J. Darl. is a variable yet distinctive member of sect. Bartonia Torr. & A. Gray restricted to gypseous substrates in southeastern New Mexico and western Texas (Thompson 1997). Leaves vary from pectinate to entire. Usually leaves in a population are similar, but occasionally populations will have pectinate and entire leaves (Sivinski and Lightfoot 2634; cited Mentzelia specimens comprise Appendix 2). Leaves may be clearly pectinate, the lobes distantly spaced and linear, 1–2 mm wide and about 15 mm long, or lobes may be much shorter. Lobes may be straight or somewhat falcate, curving toward the leaf apex. In either case, the margins of a lobe are approximately parallel and the apex of the lobe is almost always rounded. In some cases lobes are completely absent and leaves are entire and linear. Basal leaves may be much less lobed than cauline leaves (Higgins 6845). Other than by flower color (not given, but presumably white) Higgins 6845, from western Texas, cannot be distinguished from a pectinately lobed form of M. perennis H. J. Thompson (incl.) from central New Mexico (Edwards and Repass 4726; Spellenberg and Willson 4233; Ward et al. 81–281), leaving one to ponder the distinction of these two taxa.

Specimens of this complex in NMC have been annotated as either M. humilis or M. perennis by H. J. Thompson. Martin and Hutchins (1981) separated these two taxa in their key on a vegetative character, tufted (M. perennis) vs. not tufted (M. humilis), a feature that will not distinguish them. They give flower color of the former as “pale lemon-yellow,” which is approximately correct, vs. “yellow” for M. humilis, which is incorrect (pale ochroleucous
to white). Perhaps Martin and Hutchins were following to some degree Wooton and Standley (1915) who noted petals to be “pale yellow” (in Nuttallia gypsea Wooton & Standl., a synonym of M. humilis), or Darlington (1934), who “keyed” M. humilis under “flowers lemon-yellow to golden.” This assumption of yellow-colored flowers is understandable because buds are cream and dried petals in fresh specimens are definitely yellowish. Thompson and Zavortink (1970) may be the first to have indicated that M. humilis corollas and androecia were white. Later Thompson (1997) described the petals as “white or very pale yellow.” Mentzelia perennis has pale yellow petals.

In Thompson (1997) and Thompson and Zavortink (1970), Mentzelia specimens from the gypsum outcrop discussed earlier key to M. strictissima (Wooton & Standl.) J. Darl., but this is a very different, tall plant that occurs in (often) sandy soil. It has dentate leaves and cylindrical capsules. Leaves of the novel Mentzelia much more closely resemble those of M. mexicana H. J. Thomps. & Zavort. or M. saxicola H. J. Thomps. & Zavort. as illustrated in Thompson and Powell (1981, fig. 7). These are yellow-flowered species of western Texas and northern Mexico once confused with M. multiflora (Nutt.) A. Gray. Unfortunately, Thompson and Powell did not discuss the relationship of M. humilis to any of these species. In a survey of other specimens, leaves from the novel plants from the gypsum outcrop on the western slope of the Guadalupe Mountains more closely resemble those of some specimens of M. multiflora, and also resemble that illustrated in Thompson and Powell (1981, fig. 7) for this species.

Thompson and Powell (1981) illustrated, described, and compared the seed coats of M. multiflora with seed coats of M. mexicana and M. saxicola. They noted the first to have cells with swollen outer walls covered by numerous small papillae. This gives the seed coat a coarsely granular appearance or, as stated in Thompson (1997), it is “rough with papillae.” Seed coats of the latter two have fewer papillae and appear “smooth” (Thompson 1997), but actually are very finely granular under a microscope at about 20x. Thompson did not give the characteristics of seed coats of M. humilis; we note them to be very similar to those of M. multiflora, as are the seed coats of the novel Mentzelia in question.

Thompson, in attempting to work out distinctions between New Mexico populations of M. multiflora, M. jenezensis, M. humilis, and M. strictissima sent Spellenberg a letter (29 Apr 1980), a map, and color photographs (without provenance) explaining his interpretation (filed at NMC, accession #60536, in M. jenezensis folder). Mentzelia multiflora and M. humilis have very distinct flowers, the first yellow (Thompson’s photo is more yellow than most races in southern New Mexico, which may be pale yellow), M. humilis near white. More important M. multiflora has broader petals with the transition to stamens with expanded filaments comparatively abrupt, whereas M. humilis
has narrower petals, the transition to stamens more gradual. Flowers from
the new Mentzelia in question very strongly resemble those of the photo
and of specimens of *M. humilis* and are not like those of *M. multiflora*.

Thompson (1997) indicated capsules of *M. multiflora* to be cylindrical,
15–25 mm long, whereas he wrote that *M. humilis* has capsules cup-like,
6–13 mm long. The novel Mentzelia has capsules that are cup-shaped and
in the lower range of length for those of *M. humilis*. Plants of the new pop-
ulation are densely clumped, like some races of *M. humilis*, and leaves are
sub-entire, dentate, or pinnatisect, reminiscent of those of *M. multiflora*. When
the leaves are pinnatisect, the lobes taper from a broad base to a narrow,
acute or even acuminate tip. The flowers and capsules are like those of *M.
humilis*. The inflorescence is much more congested than in any of the spe-
cies mentioned.

The map Thompson provided with his letter to Spellenberg (29 Apr 1980)
shows *M. humilis* to occur in western Texas and eastern New Mexico in the
Pecos River drainage, distinctly, but not distantly, east of the population in
question. He maintained this distribution for *M. humilis* in his 1997 manu-
script. On his map accompanying the letter, *M. perennis* is shown to occur in a lim-
ited area to the northwest of the site from which the new Mentzelia origi-
nates. Mentzelia multiflora, in contrast, is widespread in the western United
States and northern Mexico (Thompson 1997). It is known from robust to
smaller plants in the Guadalupe Mountains (e.g., Spellenberg 3660, Wooton
s.n.). Both these specimens have broad petals and cylindrical capsules rep-
resentative of the species; Spellenberg noted flower color as “pale yellow”
on the specimen label. In his letter Thompson alluded to the possibility of
gene flow between isolated edaphic endemics and more widespread edaphically
unrestricted species. Such a process might explain in the new variety the
leaves similar to *M. multiflora* and the flowers and capsules similar to *M.
humilis*. Observations from these populations reveal that flowers and cap-
sules of the novel *Mentzelia* are consistent, foliage and habit are variable.
Nevertheless, the race is consistently distinct from *M. humilis* var. *humilis*
and is geographically isolated from it: var. *humilis* east of the Guadalupe
Mountains, var. *guadalupensis* restricted to the western slope.

**Mentzelia humilus** (A. Gray) Darl. var. *guadalupensis* Spellenb., var. nov.
(Fig. 2). Type: UNITED STATES. NEW MEXICO. Otero Co.: 48 km NNE of Dell
city, Texas, W base of Guadalupe Mts., N of mouth of Pup Canyon, S14 T22S R18W,
32°22.74′N, 105°04.26′W, elev. 1460 m., 22 Sep 1997, Spellenberg & Wooten 12455
(HOLOTYPE: NMC; ISOTYPES: NY, TEX, UC, UNM).

A Mentzeliae humili var. humili foliis dentatis vel pinnatisectis (vs. pectinati vel integris),
racemibus 2–8 mm (vs. 1–2 mm) latibus, inflorantissimis congestibus (vs. noncongestibus),
et plerumque pedicellis capitulis breviorebus (vs. aequantibus vel longioribus) different.

Plants 0.5–2.5 dm tall; basal leaves spatulate, dentate, with 2–4 teeth
Fig. 2. Illustration of plants comprising the type collection of Mentzelia bunila var. guadalupensis (Spellenberg & Wootten 12455). Collection was made with the intent of illustrating the major aspects of variation in the population: habit and leaf dissection. All plants are clearly identified in distributed specimens by small tags affixed to them. All plants in photograph are at NMC. Plant A is the holotype plant, which has been mounted separately from isotypes at NMC; other portions of plant A have been distributed with other isotype plants to NY, UC; plant B, NMC, NY; plant C, NMC, NY; plant D, NMC, TEX, UC, UNM. Plants similar to A–C are common in the population; plants with leaves dissected to the extent of plant D are less common.
per side, or sometimes the smallest basal leaves nearly entire; midstem leaves, 3.0–8.5 cm long, 8–21 mm wide, the blade spatulate or lanceolate in outline, tapering gradually to a slender petiole, the blade from shallowly to deeply dentate or pinnatisect, 3–7 teeth or lobes per side, when pinnatisect or deeply dentate the rachis 2–8 mm wide and the lobes straight or sometimes falcate, tapering from base to acute tip; bracts beneath the heads pinnatisect, 2–4 lobes per side; petals white or pale ochroleucous when fresh (drying ochroleucous), about 10 (intergrading with the outer stamens with broad filaments), 10–13 mm long, 1.6–2.1 mm wide, acute; capsules cupulate, 5–8 mm long, 5–6 mm wide, the length 1–1.7 times the width, the calyx lobes on capsules 4–9 mm long, narrowly triangular-subulate; seeds 1.8–2.2 mm long with a wing 0.5 mm wide, the seed coat conspicuously papillate (use 20x), the papillae hemispheric and minutely granular.

As far as is known, Mentzelia humilis var. guadalupensis is restricted to the west slope of the Guadalupe Mountains on gypsum of the Yeso Formation, probably occurring throughout the outcrop as described in the introduction. The varietal epithet refers to its presence in the Guadalupe Mountains.

Paratypes: NEW MEXICO. Otero Co.: 49 km NNE of Dell City, Texas, W base of Guadalupe Mts., N of mouth of Pup Canyon, NE S23, T22S, R18W, 32°22.75'N, 105°03.99'W, elev. 1460 m, 5 Aug 1997, Spellenberg, Wooten, and Howard 12440 (NMC); 2.5 km S of the Chaves Co. line, just west of The Rim on the west slope of the Guadalupe Mts., about 100 m inside the Lincoln National Forest, center S7, T21S, R18E, 32°29.65'N, 105°08.28'W, elev. 1540 m, 27 Jul 1998, Spellenberg & Wooten 12500 (NMC, RM).

Appendix 1

The following list provides the names of plants that we collected or observed on the outcrop; collection numbers are Spellenberg’s. Deposition of specimens is indicated by herbaria codes as presented in Holmgren et al. (1990). Each name is also followed by “C, O, or U,” signifying generally “common, occasional, or uncommon,” respectively, on the outcrop.

Agavaceae: Dasylirion wheeleri S. Wats. [O]; Yucca elata Engelm. [U]; Yucca toreyi Shafer [O]
Amaranthaceae: Tidestromia suffruticosa (Torr.) Standl. var. suffruticosa, 12481 (NMC) [U]
Anacardiaceae: Rhus microphylla Engelm. [U]
Apocynaceae: Acanthosyopsis longiflora Torr. var. salpignatha (Woodson) McLaughlin, 12434 (NMC, NY, UNM), 12441 (NMC, NY), 12474 (NMC, NY), 12501 (NMC, NY) [C]
Asclepiadaceae: Asclepias macrorrhiza Torr., 12507 (NMC, NY) [U]
Asteraceae: Brickellia laevisata A. Gray [U]; Gaillardia multiceps Greene [U]; Gutierrezia microcephala (DC.) A. Gray [O]; Haplopappus greggii A. Gray, 12437 (NMC) [C]; Macleaya pinnatifida (Hook.) Shinn. var. pinnatifida, 12505 (NMC) [U]; Porophyllum scoparium A. Gray, 12436 (NMC, UC) [C]; Sauvelia flavescens A. Gray [U]; Thelesperma megapotamicum (Spreng.) Kunze [U]; Thymophylla acerosa (DC.) Strother, 12484 (NMC) [U]; Thymophylla pentachroa (DC.) Small var. hartwegii (A. Gray) Strother, 12475 (NMC, NY), 12483 (BRIT) [O]; Viguiera stenoloba S. F. Blake [O]
Boraginaceae: Tiquilia hispidissima (Torr.) A. Richardson, 12502 (NMC) [O]
Brassicaceae: Nerisyrenia camporum (A. Gray) Greene, 12442 (NMC) [C]
Cactaceae: Coryphantha tuberculosa (Engelm.) A. Berger, 12482 (NMC) [U]; Echinocactus horizonthaludinis Lemarie [U]; Echinocereus dayanacantho Englem., 12486 (NMC) [O]; Opuntia imbricata (Haw.) DC. [U]; Opuntia macrocentra Engelm., 12487, spineless (NMC), 12488, spines (NMC) [O]; Opuntia phaeacantha Engelm. var. phaeacantha [U]

Chenopodiaceae: Atriplex canescens [Pursh] Nutt. [U]

Ephedraceae: Ephedra aspera S. Wats., 12473 (NMC) [O]

Euphorbiaceae: Chamaesyce fendleri (Torr. & Gray) Small, 12458 (NMC), 12471 (NY) [O]; Croton dinicus Cav. [O]

Fabaceae: Acacia neomexicana Isely [O]

Fouquieriaceae: Fouquieria splendens Engelm. [O]

Hydrophyllaceae:Nama carnosum C. L. Hitchc., 12503 (NMC), [O]

Krameriaceae: Krameria erecta Schult., (12478) [O]

Lamiaceae: Hedcoma humata (Torr.) Briq., 12479 (NMC) [U]

Linaceae: Limon vernale Wooton, 12480 (NMC) [U]

Loasaceae: Cavallah sinuata Lag. [U]; Mentzelia hamburghs (A. Gray) J. Darl. var. guadalupensis Spellenb., 12440 (NMC), 12455 (NMC, NY, TEX, UNM), 12500 (NMC, RM) [C]

Malvaceae: Sphaeralcea coccinea (Nutt.) Rydb., 12476 (NMC) [U]

Nyctaginaceae: Allamia incarnata L. var. incarnata [O]; Atriplex leiodenmus (Torr.) Standl. var. balearica Spellenb. & T. Wooten, 12433, 12435, 12438 (C); Mirabilis linearis (Pursh) Heimerl, 12506 (NMC) [U]; Selinocarpus lanceolatus Wooton var. lanceolatus, 12452 (NMC), 12499 (NMC) [O]

Oleaceae: Mentheola scabra A. Gray [U]

Onagraceae: Gaura comosa Nutt. [U]; Calylophus hartwegii (Benth.) Raven subsp. filifolius (Eastw.) Towner & Raven, 12472 (NMC) [O]

Poaceae: Aristida purpurea Nutt. var. macleyi (Vasey) Alred. 12453 (NMC) [U]; Aristida purpurea Wooton & Standl. var. purpurea, 12456 (NMC) [U]; Botriochloa labiatus (DC.) Herter subsp. torreyana (Steud.) Alred & Gould, 12459 (NMC) [U]; Bontelosia warmwinkii Gould & Kapadia, 12443 (NMC) [O]; Duriochloa pulchella (Kunt.) Steud. [U]; Digitaria cognata (Schult.) Pilg. subsp. pubiflora Wipfl & Hatch, 12457 (NMC) [U]; Setaria leucopila (Scribn. & Merr.) K. Schum. [U]; Sporobolus cryptandrus (Torr.) A. Gray, 12504 (NMC) [O]; Stipa carystoida Swallen, 12477 (NMC, NY) [U]; Tridens muticus (Torr.) Nash var. muticus, 12454 (NMC) [U]

Polygonaceae: Ergoonyon bautardii S. Wats., 12439 (NMC) [C]

Pteridaceae:Asplenium cochliostis (Goodd.) D. M. Benham & Windham, 12444 (NMC) [O]

Rosaceae: Fallopia paradoxa (D. Don) Endl. [U]

Rubiacaeae: Heliotropium nigricans (Lam.) Fosberg, 12445 [O]

Solanaceae: Nictandra trigonophylla Dunal (NMC) [U]

APPENDIX 2

Collections of Mentzelia cited in discussion of M. hamburghs var. guadalupensis. Deposition of specimens is indicated by herbaria codes as presented in Holmgren et al. (1990).


Mentzelia multiflora (Nutt.) A. Gray.—Spellenberg 3660, New Mexico, Otero Co., Guadalupe Mts. on Guadalupe Rim Rd #67, 8 Sep 1973 (NMC); Wooton s.n., New Mexico, [without county], Guadalupe Mts., west slope, 3 Aug 1909 (NMC).
MENTZELIA PERENNIS Wooton.—*Edwards & Rose* 4726. New Mexico, Socorro Co., ca. 8 mi E of Socorro, 23 Jul 1977 (NMC); *Spellenberg & Willson* 4233. New Mexico, Socorro Co., 8 mi (by air) ENE of Bingham, W edge Chupadera Mesa, 8 Jul 1976 (NMC); *Ward, Spellenberg, & Soreng* 81-281. New Mexico, Lincoln Co., W base of Cerro Tecolote Peak, 12 mi SSW of Corona, roadside or US 54, 3 Jul 1981 (MO, NMC, NY—originally identified as *M. pumila* (Nutt.) Torr. & A. Gray).

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We thank several individuals for assisting in various ways with this study. Mike Howard brought the *Anabolaena* to our attention and accompanied us to the site on our first visits. Jane Shafer and George Rauch, ranchers on Crow Flats in southern New Mexico, allowed access to the site across deeded land. Manual Tanner and J.T. Tanner allowed access from their leased land to the gypsum outcrop to the north of the Pup Canyon outcrop. Photocopies of specimens of *Mentzelia mexicana* from SRSC were supplied by A. Michael Powell. Richard Worthington supplied information from UTEP. Help with Latin diagnoses was received from John Strother and Alan Smith, and Strother carefully read a preliminary version of the manuscript. Robert Kiger assisted with a nomenclatural problem. A thoughtful and very helpful review of the manuscript was provided by Denis Kearns.

REFERENCES


Turner, B.L. 1993. A new species of *Anabolaena* (Nyctaginaceae) from southern Coahuila, Mexico.

BOOK REVIEW


This ambitious field guide boasts almost 900 color photos picturing 850 of Arizona's over 3,000 species of plants. It covers wildflowers, cacti, trees, shrubs, vines, and ferns. The grasses and "weeds," as is often the case, are left out. After a brief introduction on scope and use, the six life zones of Arizona are delineated by altitude, rainfall, and vegetation parameters. Thereafter follows a captivating 176 pages of color photos. Anywhere from three to seven photos are pleasingly laid out in horizontal and vertical formats on each page. I found the photos to be a well-executed variety of what appears to be totally naturally lit, fill flash, and pleasantly "natural" full flash images. Many species are represented by two photos: one habit shot and a close up, or fruiting shot etc.

The photo section begins with the ferns and is followed by the trees, which are grouped by leaf shape. The cacti, grouped by general pad morphology, then logically segue into the agaves. Wildflowers and shrubs with conspicuous flowers are next, grouped by flower color, number of segments (basically number of petals), and sometimes regular versus irregular flowers. These and other additional sub-groupings make the photo section more diagnostic and useful compared to the simply color grouped format found in many field guides. Each photo is sequentially numbered, followed by a common name, and referenced to a text page where the description is found.

Next come the 295 pages of descriptions. Though some entries are somewhat brief all offer useful and interesting information. The text section is grouped phylogenetically by family. Each family entry has a common name, the scientific name (with phonetic pronunciation) and a general description of the family. Each species entry has one or more common names, the scientific name, description, elevation, habitat, and a comments section. The description sections vary in length and in some cases are somewhat sparse but in other cases are very informative and botanical, requiring some facility with technical terms. What ever the descriptions may lack is more than made up by the comments section of each entry. I found them chocked full of wonderful little bits of information such as wildlife uses, medicinal uses, toxicity, derivation of the plant names, and addition curiosities of the plant. Also included is a pronunciation of the genus and the number of different species of that genus found in Arizona, and finally the location and date of the photo.

I really like the glossary that follows. Besides containing the usual defined botanical terms, it also includes the definitions of many Latin descriptors used in scientific plant names along with their various endings (Bravo!). This is a real plus for the amateur attempting to tackle the mumbo jumbo of the Latin lingo. And, no, I wouldn't leave out the index, the real proof of the pudding. Thirty-two pages of wonderfully readable and uncluttered bold-faced genera and scientific family names interspersed among the regular type faced common names and specific epithets.

This is a must have for anyone interested in the flora of Arizona. Practically every photo is a masterpiece and there is plenty of information in the text to keep anyone interested. Congratulations on a huge project so well-executed.—Robert J. George.
A NEW SPECIES OF PORTULACA (PORTULACACEAE)

JAMES HENRICKSON

Department of Biology
California State University
Los Angeles, CA 90032, U.S.A.

THOMAS R. VAN DEVENDER

Arizona-Sonora Desert Museum
Tucson, AZ 85743, U.S.A.

ABSTRACT

Portulaca yecorensis is described from the conglomeratic mudflow barrens at 1500–1600 m elevation in the Yécora valley in the Sierra Madre of eastern Sonora, Mexico. This annual is related to P. oleracea and P. retusa but differs in small size, strong reddish pigmentation, smaller seeds, larger flowers and pollen, distribution, and habitat.

RESUMEN

Se describe la especie nueva Portulaca yecorensis del Valle de Yécora de la Sierra Madre Occidental en la parte oriental de Sonora, México; crece en áreas con conglomerados de lodolita casi sin vegetación. Esta especie anual está relacionada con P. oleracea y P. retusa, pero difiere de éstas por su tamaño pequeño, pigmentación rojiza fuerte, semillas más pequeñas, flores y polen más grandes, distribución, y hábitat.

KEY WORDS: Portulaca, Portulacaceae

INTRODUCTION

As part of their floristic surveys in the Sierra Madre Occidental of eastern Sonora, México, Tom Van Devender and Ana L. Reina G. encountered a surprisingly rich flora on gentle hills and level areas at about 1500–1600 m elevation near Yécora, Sonora. The plants growing on barren, apparently edaphically severe sites, are of particular interest. These surfaces are on debris and conglomerate deposits in the Baucarit Formation that formed as mudflows sometime after the beginning of the modern basin and range morphology (17 million years ago, Cochemé & Demant 1991).

With a mean annual rainfall of 913 mm/yr at Yécora (Búrquez et al. 1992), the vegetation is grassland in the valley bottom and pine-oak forest on the surrounding slopes (Reina et al. 1999). Dominant trees in pine-oak forest are Pinus engelmannii (Apache pine) and P. yecorensis (Yécora pine). Other common forest trees include P. chihuahuana (Chihuahua pine), Quercus arizonica (Arizona oak), Q. chihuahuensis (Chihuahua oak), Q. durifolia, Q. oblongifolia (Mexican blue oak), Q. vininea (willowleaf oak), and Juniperus deppeana (táscate,
alligator bark juniper). East of Yécora, shallow soils on mudflow surfaces support open oak woodland-grassland transition with common Q. chihuahuensis and Q. towneyi (Towney oak).

Considering the moderately high rainfall at Yécora, bare areas without vegetation and minimal soil development on the mudflow surfaces are not easily understood. Perhaps erosion rates are excessive. In the spring, the surfaces are very dry with few visible plants. However, from July through September, heavy rainfall keeps the surfaces wet and a diverse dwarf herb flora flourishes including sedges (10 species in 7 genera), succulents (Agave polianthiflora, Echinocereus stoloniferus var. tayapensis, Mammillaria sabaoe var. bandeana, M. urfttii var. wilcoxii, Sedum vinitlor, TaUnum marginatum), grasses (Microchloa kunthii, Muhlenbergia annua, M. shepherdi, M. texana), legumes (Aeschynomene americana var. glandulosa, Dalea confusa, D. filiformis, Stylosanthes sp.), and many others. Thus far, four taxa have been described as new from the mudflow areas including Mammillaria sabaoe var. bandeana (A. Lau & Wagner) Glass & R. Foster, Aneodora yeconiana T. Van Devender & B.L. Turner, Pectis vandevenderi B.L. Turner, and Tridax yeconana B.L. Turner. A new Boerhavia known only from these mudflow surfaces is under study by Richard Spellenberg and Luis A. Pérez. To this list, we add a small, reddish, annual succulent Portulaca.

TAXONOMY

Portulaca yeconensis Henrickson & T. Van Devender, sp. nov. (Figs. 1, 2).


Plantae annuae, rubro-marroniae; folia leviter compressae, 2–7.5 mm longae, 1.5–3.5 mm latae, petioli curtae; flores 10–20 mm diametro, petala aureae, fortiter emarginatae; stamina 12–17; lobi styli 3–4; seminae 0.7–0.8 mm longae, parum compressae.

Apple red to nearly maroon, succulent, low, spreading-ascending annuals, locally common on exposed shallow-soiled mudflow surfaces, the plants (1–)2.5–5.0(–10.5) cm in diameter; stems 0.7–1.0 mm in diameter, alternate or opposite branched, with internodes 0.5–8 mm long. Leaves fleshy, the blades ovate to obovate, 2–7.5 mm long, 1.5–3.5 mm wide, slightly compressed, obtuse to rounded at the tip, broadly obtuse-rounded at the base above obscure petioles 0.2–0.7 mm long; axillary hairs very sparse, obscure, to 0.5 mm long. Flowers 2–5(–4) at the stem tips where subtended by clusters of sessile leaves; bracts 3, fleshy-membranous, ovate, reddish, conduplicate, attached along a broad base, obtuse, the bracts 1–1.8 mm long, the paired bractlets 0.9–1.2 mm long, all persistent; pedicels ca. 0.5–0.7 mm long, ca. 0.7 mm wide, expanding to 1.5–2.5 mm wide at the lower hypanthial margin; sepals 2, apple red, glabrous, conduplicate with one external
to the other, fleshy with membranous margins, obtuse at the cucullate tip, slightly keeled above, but not crested below the tip, 3–3.5 mm long in flower, enlarging to 5.5 mm long in fruit, the two sepals connate for 0.5 mm at the base; petals 5, spreading, bright yellow, obovate, (4.5–)6–8(–9) mm long, to (4–)5–6(–7) mm wide at the tip, strongly emarginate with an apical notch to ca. 1.0–1.8 mm deep, the flowers averaging 14.7 mm in total diameter (range 10–20 mm, n = 30, field measured), the petals connate and adnate to the sepals for about 0.4 mm at the sepal base; stamens (12–)15–17; filaments 5.5–6.5 mm long, bright yellow, ascending, glabrous, adnate to the petal-sepal bases for ca. 0.4 mm; anthers ca. 0.8–1.0 mm long, bright yellow, with 4 elongate thecae, each ca. 0.2 mm in diameter (wet), the two pair of anther sacs slightly twisted (i.e., not perfectly parallel); pollen globose, polyporate, (72–)90–98(–119) μm in diameter, light to strong yellow; style exserted beyond the stamens, bright yellow, 7.6–9 mm long, the lobes 3–4, 1.5–2.5 mm long, the stigmatic surfaces long papillae with some hairs to 0.3 mm long; ovules to 24. Ovary top obconic, to 1 mm long in flower to 2.5 mm long, and 2.5 mm in basal diameter in fruit, the fruit wall thin, with a slight constriction in the upper third; seeds (5–)10–19 per ovary, reddish-black with a slight oil sheen, cucullate with a whitish patch
where attached to the funiculus at the radicle bulge, 0.7–0.8(–0.86) mm wide, to 0.5–0.56 mm thick, with some lateral cells tuberculate (Figs. 1, 2).

Additional specimens: MÉXICO. Sonora. Municipio de Yécora: 2 km E of Yécora 28°22′51″N, 108°54′53″W, 1600 m, 3 Sep 1996, A. Flores M. 4930, J. Sánchez E. (USON); 3.4 km N of Yécora on road to Agua Blanca, oak woodland on bare volcanic hilltops, 28°29′35″N, 108°55′11″W, 1520 m, 23 Sep 1997, A. L. Reina G. 97-1194; T. R. Van Devender; W. Trombley (ARIZ, HUNT, NY, TEX, USON); ca. 1 km ESE of La Otra Banda (the Pima Indian portion of Yécora) on road to Talayotes, open pine-oak forest on locally bare mudflow surfaces, 28°21′42″N, 108°5′12″W, 1600 m, 19 Nov 1997 A. L. Reina 97-1519, with T. R. Van Devender, A. M. Rea, C. Cassa, A. E. Gondor (ARIZ); 2 km E of Yécora, 28°22′51″N, 108°54′53″W, 1600 m, 3 Sep 1996, A. Flores M. 4930; J. Sánchez (USON).

The new taxon appears related to the *Portulaca oleracea* complex. Like *P. oleracea*, the plant is largely glabrous, moderately branched, and has crested sepals, small axillary hairs, and yellow flowers. The new taxon differs from *P. oleracea* in its much smaller size, smaller leaves, the distinctive reddish color on all vegetative portions, the smaller and more sparse axillary hairs, much larger flowers, larger pollen grains, poorly developed crest or keel on the sepals, and seed shape and sculpturing (Fig. 1). The small size and smaller leaves are, of course, a factor of its exposed, shallow-soil habitat and are features not restricted to this species, as *P. oleracea*, in similar habitats, may be equally reduced. The red coloration caused by the presence of betalain pigments in the outermost epidermis layer, is apparently a genetically fixed feature allowing adaptation to the exposed, high-insolation habitat. Axillary hairs are few and very short, measuring to 0.3 mm in length. In *P. oleracea* they are slightly more conspicuous, extending to 1 mm in length. *Portulaca oleracea* has very small flowers (5–10 mm in diameter) while those of
the new species are 10–20 mm in diameter, as measured in the field by Van Devender and Reina.

*Portulaca oleracea* is commonly reported as autogamous with flowers opening for only about four hours during a day (Matthews et al. 1993; Gceisnk 1969). The larger and more showy flowers of *P. yecorensis* are more conspicuous, a feature that may be associated with attracting pollinators and possibly outbreeding. The sphaeroidal, polyporate, pollen grains of *P. yecorensis* are very large, measuring (72–90–98–119) μm in diameter; pollen of *P. oleracea* is much smaller, 55–69 μm in diameter, but otherwise similar in structure. Anthers in the new species are also much larger, 0.8–1 mm long (wetted). Anthers of *P. oleracea* are about 0.5 mm in length (similarly wetted). Seeds in the new species measure 0.68–0.83 in maximum diameter, which is comparable to those of *P. oleracea*, but the body of the seed is more globose, not compressed as in *P. oleracea*. The seed surface sculpturing pattern observed in the new taxon gives evidence of its relationship. There are rows of cells on the lateral surfaces of the body that are used to characterize the sculpturing of the seeds (Danin 1978). The surface patterns found in the new species are not entirely consistent, however, most lateral surface cells have a slight metallic sheen and are stellate, to 0.2 mm wide, and have broad or narrow, unbranched to forked or truncated radii that interlock with those of adjacent cells (Fig. 2). In some seeds this pattern is very similar to that of *P. retusa* Engelm. (=*P. oleracea* L. subsp. *impolita* Danin & H.G. Baker) except that distinct tubercules are absent except from some cells on the lateral walls. In other seeds the sculpturing pattern is more obscure, but the pattern found is more like that of *P. retusa* than those of *P. oleracea*. This leads me to consider that the new species may be more closely related to *P. retusa* than *P. oleracea*, if relationship indeed falls within this group. Matthews et al. (1993) recently combined *P. retusa* with *P. oleracea*; the senior author is in strong disagreement with this action.

The contrasting dark red foliage and large, bright yellow petals make the plant very conspicuous. Red vegetative pigmentation is a common stress response in many succulent and non-succulent species (e.g., *Amaranthus, Portulaca, Sedum*) in answer to high insolation. This commonly develops over a season as light stress increases. However, its development can be controlled genetically. Danin et al. (1978) note that some cultivated subspecies of *P. oleracea* characteristically developed pigmentation of the sepals, etc., while other subspecies would not, which would indicate genetic control of pigment placement. The red pigments are betalains (Clement & Mabry 1996) and, in this taxon, are largely confined to epidermal layers. Such red pigments would reflect red and absorb green wavelengths of light, while the green chlorophyll pigment would absorb the remaining red and reflect green
wavelengths; this to some extent reduces absorptivity of solar radiation (Von Willert et al. 1992). In areas of high insolation, however, this does not impede the light available for photosynthesis. The result is dark (apple) red or maroon foliage. In the new species all vegetative portions of the plant (stems, leaves, sepals) had the distinctive, dark red coloration and this developed from the beginning—it was present throughout seedling stage into the adult plant, irregardless of the amount of light given to the plant. Even seedlings grown in the senior author’s shaded, north-facing office window developed and retained the characteristic apple-red pigmentation on all vegetative structures.

The mudflow barren habitat is so open that the plants are fully exposed throughout their two to three month life span. Surveys in this habitat on August 17, 1998, revealed seedling Sedum vinicolor but not Portulaca yeorensis. Peak flowering collections were made on September 23, 1997, and September 29, 1998, nearing the end of the summer monsoon rains. The November 19, 1997, collection was mostly of dead, dried plants. It is interesting to note that the life cycle of P. yeorensis appears to be delayed compared to the annual composites (Patens vandetenderi, Tridax yeorensi) which senesce in October. Likely the succulent leaves allow it to persist longer than non-succulent annuals after the summer rains taper off.

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Neil Harriman provided the Latin translation. Richard Felger, Robert Kiger, Phil Jenkins, and Myron Kimnach gave helpful early suggestions as to the plant’s identity. Agustin Flores M. and Jesús Sanchez E. of the Universidad de Sonora collected the plants in 1996 and stimulated our interest in it. Father William Trauba of Yécora helped in all aspects of the field work. Bob Scarborough provided information on the geology of the mudflow surfaces.

REFERENCES


BOOK REVIEW


This second edition of a truly classic floristic work includes 25 species not previously reported in the 1967 edition, has additional illustrations for all of those taxa, and provides a key to the additions and to supplement the other keys in the main section of the book when (as in the Lycopsods) generic concepts in the family have changed. The small size of the book and its simple terminology, concise descriptions, literature citation, common name, habitat, range and distribution within the state, all make this an ideal field tool, just as its author intended. The simple yet clear illustrations, with accompanying dot-distribution maps are also very useful.

The introduction and keys to the orders and also, the genera, of ferns and their allies contain information requisite for any pteridology course. The Appendix of 47 pages, including additions, changes to keys, descriptions of taxa not previously included, distribution maps, etc. is a little cumbersome, but I can imagine that it would have been extraordinarily time-consuming to have integrated the updated information into the appropriate niche within the main text body. The glossary is short, simple and concise.

Certainly, the first edition of this book is already dog-eared, taped many times with library repair tape, and otherwise patched, on the shelves of everyone who botanizes in the vicinity of Illinois. Certainly I will have mine in the car when I go back to those septentrional stomping grounds in and around the Land of Lincoln. There is nothing as welcome as an update to a classic and this book fits the bill perfectly. I am delighted that Mohlenbrook was able to update this classic work so that younger botanists and "Phren Physicians" might better enjoy the marvelous fern flora. Southern Illinois Press deserves a salute for printing this fine book; truly a bargain!!! I hope more institutions in the state and adjacent ones will consider teaching a pteridology course if they are not presently doing so, given the importance of the group and its abundance in the state.—John J. Pipoly III.
REVIEW OF EARLY NOMENCLATURE IN
EUTHAMIA (ASTERACEAE: ASTEREEAE)

GUY L. NESOM

Biota of North America Program
North Carolina Botanical Garden
Coker Hall CB 3280
University of North Carolina
Chapel Hill, NC 27599, U.S.A.

ABSTRACT

A review of the early nomenclature of Euthamia summarizes observations by Siren (1981) and Reveal (1991) and adds other perspectives. Nuttall published the group in 1818 in the format of a new subdivision of Solidago, interpreted here at sectional rank, but noted it as "a subgenus, or rather genus." Cassini in 1825 provided the elements for validation of Euthamia at generic rank, but he did so unintentionally and ascribed the name to Nuttall. In this interpretation, separate citations of lectotype and type are required for the two names (sect. Euthamia Nutt. and genus Euthamia Nutt. ex Cass., respectively). Also in this interpretation, Nuttall in 1841 validated nomenclatural combinations for E. graminifolia (L.) Nutt. and E. tenuifolia (Pursh) Nutt. and added E. occidentalis Nutt. as a new species. The name Euthamia caroliniana (L.) Greene ex Porter & Britt. was validated in 1894, based on Erigeron carolinianus L., and includes E. tenuifolia as a synonym. There is reason to maintain Euthamia galetorum Greene at specific rank rather than as a variety of E. caroliniana or E. graminifolia. The discussion includes application of several potentially controversial interpretations of the ICBN: disposition of "alternative names;" "the term type or an equivalent" in typification; and conditions of "indirect reference" for valid publication.

RESUMEN


Reveal (1991) clarified the application of the Linnaean name Erigeron

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carolinianus L., confirming earlier opinions that it represents a species of *Euthamia* and that this species is correctly treated as *Euthamia caroliniana* (L.) Greene ex Porter & Britton, of which *Euthamia tenuifolia* (Pursh) Nutt. is a synonym. Reveal also noted that the name for *Euthamia* at generic rank should be cited as *Euthamia* (Nutt.) Nutt. ex Cass. (see below) and that the choice of lectotype for the genus by Britton and Brown in 1913 should stand as *Euthamia graminifolia* (L.) Nutt. Except for details regarding the generic authorship and typification and the authorship of *E. tenuifolia*, his observations are firm, but several other associated nomenclatural points were left unresolved, these discussed here. Previous perspectives regarding authorship are summarized, additional comments are provided, and a nomenclatural summary of the names involved follows at the end of the comments. Other published comments regarding *Euthamia* on a more limited or regional basis have not touched upon the nomenclatural topics discussed here.

**Euthamia** at generic rank

*Euthamia* was ambiguously described by Nuttall (1818, p. 162) as “A sub-genus, or rather genus, reciprocally allied to *Solidago* and *Chrysoma*.” Various botanists (e.g., Elliott 1823; de Candolle 1836; Greene 1902; Gleason & Cronquist 1991, Cronquist 1994, as inferred from citation of the genus simply as “*Euthamia* Nutt.”) have tacitly accepted 1818 as the validation date for the genus, but others have not (e.g., Nuttall himself in 1841; Sieren 1981, monographer of the genus, who cited “(Nutt.) Nutt.” as the authority, regarding 1841 as the date of validation). The only other previous, explicit, and published consideration (Reveal 1991) of this problem concluded that the elements of validation were not provided in 1818. The implication of the 1994 ICBN Article 34.2 regarding identical, simultaneously published names at different ranks (“alternative names”) after 1 January 1953 appears to be that such names are not necessarily invalid if published before that date. The position here, however, and that perhaps implicitly taken by Reveal, is that a name at only one of the ranks should be recognized as valid, if a balance of evidence regarding the author’s intention suggests a resolution to the ambiguity.

Nuttall in 1818 placed two species under the heading of *Euthamia*, which was marked by an “asterisk” (indicating a new taxon) near, but before, the end of the *Solidago* treatment. Thus *Euthamia* was not in the numbered sequence of genera treated by Nuttall (*Solidago*, including *Euthamia*, is genus 560; *Brachyris* is genus 561). Nor is *Euthamia* included in the index to generic names in the Genera of North American Plants. The two *Euthamia* species are numbered “50” and “51,” terminating the numbering sequence for species of *Solidago*. After the comments on *Euthamia*, Nuttall returned to *Solidago* in a summary paragraph (provided in a manner and position similar
to such summaries for many other genera) that noted the overall geographic
distribution of the genus and suggested that arborescent species of St. Hel-
ena and New Zealand probably should be excluded from *Solidago*. In con-
trast to the other species of *Solidago*, however, and lending to the ambigu-
ity, Nuttall provided basionyms and author and publication citations for
the *Euthamia* species, listing “50. graminifolia. *Chrysocoma graminifolia*” and
“51. tenuifolia. *Solidago*. *tenuifolia*,” giving an impression of his intention
to make new nomenclatural combinations for these two species. The man-
ner in which the treatment of *Euthamia* is imbedded within *Solidago*, how-
ever, is viewed here as more explicit evidence for regarding *Euthamia* of 1818
at infrageneric rank.

Nuttall’s description of *Euthamia* as a “subgenus, or rather genus” was in
the second paragraph of description following the “EUTHAMIA” heading,
but the format for the delimitation of *Euthamia* is identical with other infrageneric
names proposed in the same volume and long-accepted at sectional rank
(see comments below, “Euthamia at infrageneric rank”). Nuttall (p. 151)
applied almost exactly the same description to his group “II” of *Inula* sect.
*Chrysopsis*, noting that “This genus, or subgenus, appears to be peculiar to
North America.” This heterogeneous group (as now seen) was composed of
white-rayed species of *Aster* (compared to typical yellow-rayed *Chrysopsis*)
with a double pappus, and it seems clear that the description here of “ge-
nus, or subgenus” was meant to be taken informally. The situation in *Euthamia*
is analogous: the species were treated as a section within *Solidago*, but Nuttall’s
accompanying comment suggests that a higher rank for them is reasonable.
In fact, it is the directness of this suggestion (and its close proximity to the
listing of the new name) that has created the ambiguity of interpretation.

More than 20 years later, Nuttall (1841, pp. 325–326) provided a more
definite account of *Euthamia*, explicitly treating it at generic rank. Here he
cited the basionym for *Euthamia* “As a section of *Solidago*, Nutt., Gen. Am.,
Vol. II., p. 162. Decand. Prod., Vol. V., p. 341.),” indicating that he re-
garded the *Euthamia* of his 1818 publication to have been at infrageneric
rank, as was *Euthamia* of de Candolle. Nuttall apparently intended to rec-
ognize the name at generic rank, with the authority understood to be “(Nutt.)
Nutt.” Remarkably, however, his ambiguity regarding the status of the name
was perpetuated even here, as he did not provide *Euthamia* (in the “header”) with
an asterisk characteristic of the new names (e.g., *Ericameria* Nutt.) and
new combinations (e.g., *Amphiachrysis* (DC.) Nutt.) at generic rank elsewhere
in the treatise. His treatment of *E. graminifolia* and *E. tenuifolia* (see below)
also might be taken to imply that he assumed those names had already been
incorporated into the valid nomenclature for *Euthamia*.

Meanwhile, as pointed out by Reveal, Cassini (1825) had preceded Nuttall’s
1841 comments in providing the elements of validation for *Euthamia* at
generic rank. Here Cassini referred to "Le genre Enthamia de M. Nuttall" (a clear but indirect reference), apparently assuming that Nuttall in 1818 had effectively established it at generic rank and giving Nuttall credit for its publication. In his associated description and comments, Cassini unambiguously treated Enthamia as a genus, although he surely did so without the specific intention of publishing a formal validation at that rank. In contrast to the suggestion of Reveal (1991) that the authority for the genus Enthamia be cited as "(Nutt.) Nutt. ex Cass.," its citation simply as "Nutt. ex Cass." acknowledges Cassini's role in validating the name as well as his explicit recognition that the name should be ascribed to Nuttall. This appears to be in accord with guidelines for citation outlined in Article 46.4 of the 1994 ICBN. Cassini did not furnish the necessities for any nomenclatural combinations in Enthamia at specific rank.

In summary, evidence indicates the name Enthamia was originally published at infrageneric rank (interpreted here to be sectional), and despite Nuttall's ambiguity both in 1818 and 1841, the most explicit parts of his treatments suggest that the validation of Enthamia at generic rank was effected by Cassini (as "Nutt. ex Cass."). Or, if Cassini's protologue were considered an insufficient basis for validation, Sierén's interpretation could be followed by citing the authority as "(Nutt.) Nutt." Other interpretations would read the evidence as favoring validation of the name in 1818 as a genus rather than section or subgenus or else perhaps find the evidence so evenly equivocal that the name from 1818, with Nuttall as sole author, could be regarded as valid at two or even three ranks (as noted above, according to ICBN Article 34.2). Or, perhaps any degree of ambiguity should lead to the formal acceptance of alternative names.

**Enthamia at infrageneric rank**

Although Nuttall's descriptive phrase for Enthamia in the 1818 publication was "a subgenus, or rather genus," he stated in 1841 that Enthamia was positioned "as a section of Solidago" in 1818. The latter rank is accepted here for the original publication of the name, as it is Nuttall's most unambiguous taxonomic characterization and one that is the most consistent with his 1818 format for analogous names in other genera. Other supraspecific taxa, securely accepted at sectional rank, were described by Nuttall in 1818 with exactly the same format as Enthamia (e.g., *Immola* sect. *Chryopsis* Nutt., p. 150; *Erigeron* sect. *Caenotus* Nutt., p. 148; see Semple 1981 and Cronquist 1947, respectively). Each of these names was given in small-sized capital letters, preceded by an asterisk to indicate that it was a newly proposed name, and followed by a period and a dagger, referring to a footnote providing the name's derivation.

Alternatively, in view of ambiguity regarding the rank of Nuttall's 1818...
Euthamia, it nevertheless may be considered validly published as an unranked subdivision of Solidago, according to ICBN Article 35.2: “A new name or combination published before 1 January 1953 without a clear indication of rank is validly published provided that all other requirements for valid publication are fulfilled; ... it may serve as a basionym or replaced synonym for subsequent combinations. . .”

De Candolle (1836, p. 341) explicitly treated Euthamia as a section of Solidago, citing both Nuttall (1818) and Cassini (1825) as having treated it at generic rank, although he acknowledged that the group might be acceptable as a genus (“An genus proprium ut innuit Nuttall et asserit Cassini?”). De Candolle’s choice of a less than fully forceful verb (“innuo”) for Nuttall’s description appears to signal a degree of uncertainty about the rank, especially as the phrase is ended with a question mark.

Erigeron sect. Multiflori G. Don in Loudon (1830) comprised only two species in its original description, Erigeron villarsii Bell. (= Erigeron atticus Villars) and Erigeron carolinianus (= Euthamia caroliniana). Sect. Multiflora was lectotypified (Nesom 1989) by Erigeron carolinianus partly to avoid displacing the widely used Erigeron sect. Trimorpha (Cass.) DC. (Prodr. 5:290. 1836), of which E. villarsii is a member, and partly because, at the time, the identity of Erigeron carolinianus appeared to have little chance of being removed from the realm of ambiguity.

Discussion of infrageneric categories within Euthamia is largely academic, because the distinctiveness of the genus, apart from any other, is now generally accepted, and marked homogeneity among the relatively few species (6–8 total) suggests that formally designated categories will hardly be necessary or useful.

Typification of Euthamia
If valid publication of Euthamia at generic rank is attributed to Cassini as a new name (as in the interpretation here) rather than a new combination, typification of the genus also was effected by Cassini. His technical description of Euthamia (1825, p. 471) was explicitly drawn from Chrysocoma graminifolia L. (“en traccant ici les caractères génériques observés par nous sur la Chrysocoma graminifolia de Linné”) and only that species. The position of this species in fixing the application of the name Euthamia in Cassini’s discussion is unambiguous. At the time of Cassini’s work, his short phrase “indicating the generic characters,” in reference to C. graminifolia, was a clear and concise “equivalent” to the term “type,” as that term is understood today in botanical nomenclature, apparently satisfying the requirements of the 1994 ICBN (Article 7.11).

In the description of Solidago sect. Euthamia, Nuttall in 1818 did not specify which of the two included species should serve as the type. Nor did
he in 1841 make a choice among the three species included in *Euthamia* at generic rank. De Candolle (1836) included only two species in his treatment of *Solidago* sect. *Euthamia* and did not indicate which was to be regarded as the type. As noted by Reveal, Britton and Brown (1913) cited *E. graminifolia* as the generitype, which can be taken as an effective lectotypification; Sieren (1981) cited *E. tenuifolia* as the generitype. Alternately, if Reveal’s interpretation of the validation of *Euthamia* as a new combination by Cassini were accepted, Cassini’s presentation and documentation apparently can be be taken as the first effective lectotypification, based on *Chrysocoma graminifolia* (= *Euthamia graminifolia*), assuming that he provided an acceptable equivalent to the term “type.”

Discussions of the process of lectotypification and its formal codal (ICBN) requirements have outlined ambiguities of interpretation (e.g., Barrie et al. 1992a, 1992b; Winter et al. 1992; Zijlstra 1992). A summary example of the problem of “the term type or an equivalent” is given in Brummit (1994), referring to a proposal by Reveal (1991). The course suggested here for the lectotypification of “*Euthamia* (Nutt.) Cass.” does not appear to be contradicted by the current Code (ICBN 1994), unless unwritten interpretations or implications are brought to the fore. In any case, *Euthamia graminifolia* is the lectotype of any name based on *Solidago* sect. *Euthamia* Nutt., whether designated by Cassini or by Britton & Brown.

**Authorship of *Euthamia* species**

Various botanists have used the names *Euthamia graminifolia* (L.) Nutt. and *Euthamia tenuifolia* (Pursh) Nutt., interpreting Nuttall’s epithets from 1818 as validly published in *Euthamia*. In one of the earliest examples, Elliott (1824) cited both names as such in lists of synonyms under their accepted names in *Solidago*. Greene, both in 1894 (in Porter and Britton) and in his later overview of the genus (1902), regarded 1818 as the date of valid publication for the genus and for Nuttall’s two names at specific rank. Sieren (1981) regarded *E. graminifolia* as validated by Nuttall in 1841 but *E. tenuifolia* in 1818. Cronquist (1980) referred to *E. tenuifolia* (Pursh) Greene but later (in Gleason and Cronquist 1991) changed the citation to *E. tenuifolia* (Pursh) Nutt. Reveal (1991) regarded the latter to have been validated by Greene (1902) as *E. tenuifolia* (Pursh) Greene.

In Nuttall’s 1841 treatment of *Euthamia*, he included three species, *E. graminifolia*, *E. tenuifolia*, and *E. occidentalis* (sp. nov.), each epithet associated with the generic name. Nuttall did not cite basionsyms or citations of earlier publication for *E. graminifolia* and *E. tenuifolia*, but it is clear that he was referring to the taxa originally published by Linnaeus and Pursh, respectively, as an update of the descriptions in his 1818 publication. The 1841 descriptions for these two species are rewritten and somewhat expanded
compared to the earlier ones, where the earlier sources of the names were cited. In contrast, *E. occidentalis* Nutt. was marked as a newly proposed name by an asterisk preceding the epithet, this symbol lacking from the other two names. Despite omission of basionyms for the first two species, Nuttall's 1841 treatment of *Euthamia* provided a specific reference to his 1818 publication, and there can be little doubt that he regarded the first two names in *Euthamia* to be in parallel with those of his previous manuscript, which included the basionyms and publication citations. This appears to satisfy the condition of "indirect reference" for valid publication of names (1994 ICBN Articles 32.4 and 32.5), and the validation of *E. graminifolia* and *E. tenuifolia* in 1841 is accepted here.

After Nuttall's formal treatment of *Euthamia* in 1841, this group of plants apparently was not again recognized at generic rank until 1894, when Porter and Britton (1894) provided E.L. Greene's view of the group in a formal nomenclatural summary for the species in northeastern North America. The three species listed were *E. caroliniana* (including *E. tenuifolia* as a synonym), *E. graminifolia*, and *E. leptocephala*; the first and third are regarded here as receiving formal validation at specific rank in the 1894 publication. In a more comprehensive treatment of *Euthamia*, Greene (1902) separated the concepts of *Euthamia caroliniana* and *E. tenuifolia*, but it is now generally acknowledged that the types of these two names represent a single species.

**Status of *Euthamia galetorum***

With acknowledgment that the correct name of *Euthamia tenuifolia* is *E. caroliniana*, a decision is required regarding a varietal combination within *E. tenuifolia*. *Euthamia galetorum* Greene has been treated as a variety of both *E. tenuifolia* (Fernald 1921, as *Solidago tenuifolia* var. *pycnocephala* Fern.) and *E. graminifolia* (House 1924, as *Solidago graminifolia* var. *galetorum* [Greene] House). Friesner (1933) and Harris (1943), as well as the recent monographer of *Euthamia* (Sieren 1981), maintained *E. galetorum* at specific rank. While Roland and Smith (1969) noted that *S. tenuifolia* and *S. galetorum* are "evidently closely related," they also maintained both entities at specific rank. In contrast, Taylor and Taylor (1983) formalized the varietal status of *E. galetorum* within *E. tenuifolia* (as var. *pycnocephala* [Fern.] C.&J. Taylor), noting that "field studies along with examination of types and other herbarium specimens support Fernald's treatment as a variety of *tenuifolia*" (p. 178).

Fernald (1921, pp. 143–144) observed that *Solidago tenuifolia* var. *pycnocephala* is "very distinct goldenrod ... everywhere dominant [in southern Nova Scotia] and thoroughly characteristic of these sandy and cobbley lake-margins" but that "Too many collections ... show direct transition [to var. *tenuifolia*] in all these characters to allow the specific separation of the Nova Scotian plant." Most of the intermediacy described by Fernald involves features of habit
and leaf morphology. In later descriptions, Fernald (1950) noted that heads of *E. galeotorum* have 25–50 flowers, in contrast to the 12–20 flowers per head in *E. tenuifolia* (this comparison modified to 20–50 vs. 10–20 by Sieren).

Sieren (1981, p. 560) noted that *Enthamia galeotorum* “is readily separated from *E. tenuifolia* by its large numbers of flowers, especially the disc, its wider, ascending leaves, and the absence of axillary fascicles. In its gross morphology, *E. galeotorum* most closely approaches the wide, bluntish-leaved variety of *E. graminifolia*, variety major.” In specimens of *E. galeotorum* I have examined, its few-branched stems, relatively short leaves, and small, compact inflorescences of few, large heads with numerous flowers, appear to be distinct from *E. tenuifolia* in the same region, in agreement with the view of Sieren and others. Until stronger evidence is presented to counter the observations and broadly based consideration of Sieren, it seems reasonable to maintain *E. galeotorum* at specific rank rather than placing it varietally under *E. caroliniana*.

*Enthamia galeotorum* was known only from Nova Scotia by Sieren (1981), but it has subsequently been identified from Maine and New Hampshire (Bruce Sorrie, pers. comm.), and House (1924) described the entity from various parts of New York, distinguishing it from *E. tenuifolia* and other related taxa.

**NOMENCLATURAL SUMMARY**

Taxa listed are those included in the present discussion. Those in bold, with accompanying authorship, are as accepted in the interpretation here.

*Enthamia* Nutt. ex Cass. in Cuvier, Dict. Sci. Nat. 37:471. 1825. **Type:** *Chrysocoma graminifolia* L. (= *Enthamia graminifolia* (L.) Nutt.).


*Solidago* sect. *Enthamia* (Nutt.) DC., Prodr. 5:341. 1836. (nom. superfl.).


*Eriogonum carolinianum* L., Sp. Pl. 863. 1753.


*Solidago tenuifolia* Pursh, Fl. Amer. Septent. 2:540. 1814.


*Solidago tenuifolia* var. *pygmeophila* Fern., Rhodora 23:293. 1921.
Review of early nomenclature in Euthamia


Chrysocoma graminifolia L., Sp. Pl. 841. 1753.
Solidago graminifolia (L.) Salisb., Prodr. 109. 1796.


*Postscript.*—After review and revision of the present manuscript, a commentary by K.N. Gandhi appeared in print, covering many of the same topics and reviewing similar rationale. Gandhi (1999) also concludes that the 1818 publication of *Euthamia* was at infrageneric (but subgeneric) rank and credits Cassini with its validation at generic rank, although he interprets the authorship as "(Nutt.) Cass.," noting that Cassini's indirect reference to Nuttall's earlier work brings the basionym into consideration. As noted by Gandhi, this brings the number of possibilities for formal citation of the generic authorship to four. Validation of *E. graminifolia* and *E. tenuifolia* is attributed to Nuttall in 1841, as in the interpretation here.

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I am grateful to Rogers McVaugh for his ideas regarding various points discussed in the present paper, Jim Reveal for information on concepts of lectotypification, Ken Wurdack for comments on an early version of the manuscript, and to an anonymous reviewer for a different point of view, which helped to focus the presentation here. A discussion with John Strother also illuminated different interpretations and was helpful.

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A NEW BULBOPHYLLUM (ORCHIDACEAE) SPECIES FROM THE CRATER MOUNTAIN AREA IN PAPUA NEW GUINEA

N.H.S. HOWCROFT
P.O. Box 30, Keravat
East New Britain, PAPUA NEW GUINEA
howcroft@daltron.com.pg

ABSTRACT

A new species Bulbophyllum wakoi, section Brachystele Schltr., collected from the Crater Mountain Wild Life Management Area in Papua New Guinea is described. It resembles B. foetidum Schltr. and its variety B. foetidum Schltr. var. grandiflorum J.J. Smith. However, it differs from these in the size and the shape of the sepals, petals, labellum, and column arms.

INTRODUCTION

The section Brachystele Schltr. in New Guinea comprises about three taxa. These are B. foetidum Schltr., B. foetidum Schltr. var. grandiflorum J.J. Sm. and B. pachyanthum Schltr. The Crater Mountain species is closely related to B. foetidum Schltr., to which it has been compared with, but differs in size and shape of the floral parts and more specifically in some features of the column and the labellum. The newly recognised taxon is described here.

Bulbophyllum wakoi Howcroft, sp. nov. (Fig. 1). TYPUS: PAPUA NEW GUINEA. SIMBU PROVINCE: EX Herowana, Crater Mountain Wildlife Management Area, S. Wako 105, 10 Apr 1995 (HOLOTYPE: LAE 79035).

Species nova affinis B. foetidum Schltr., et B. foetidum var. grandiflorum J.J. Smith sed floribus majoribus, sepalis et petalis latisioribus, labello non oblongo sed cordato et majoribus, brachiis spatulatis et majoribus.

Epiphytic, the creeping and branching habit typical of the section. Pseudobulbs ca. 3–4 cm x 1.4 cm, oblong, transversely elliptic, slightly flattened. Leaves petiolate, the petiole semi-conduplicate. Inflorescence 33 cm or more long, 9 or more flowers; rachis short, 2.5 cm long, glabrous, nodding; peduncle more than 31 cm long, 0.59 cm in diameter, sheaths more than 4, glabrous, tubular; floral bracts ovate to oblong-ovate, 2.7 cm long, 1.2 cm wide, concave, acute, glabrous. Flowers positioned in all directions, more or less patent, very large,
Fig. 1. Bulbophyllum wakoi. A. Leaf and apex of pseudobulb. B. Inflorescence, 5 cm scale. C. Flower. D–G. Floral bract, dorsal sepal, lateral sepal, petal, 1 cm scale. H. Column and labellum, lateral view. I–K. Labellum back, dorsal and ventral views, 1 cm scale. L–M. Column, ventral and lateral view.
moderately to wide opening; dorsal sepal ovate, 4.3 cm long, 1.6 cm wide, glabrous, tip acuminate, semi-conduplicate slightly recurved; lateral sepals free, obliquely triangular 5.0 cm long, 2.1 cm wide; glabrous, lower basal margin obliquely triangular or lobed, tip acuminate, semi-conduplicate; petals ovate-lanceolate to elliptic, slightly concave, glabrous, 3.7 cm long, 1.1 cm wide, tip long acuminate; labellum mobile, thick, fleshy, in general outline cordiform or broadly ovate, 1.8 cm long, 1.2 cm wide near base, apex blunt but ventrally bilobed, convex above with a longitudinal groove producing 2 slight longitudinal ridges and terminating in a mildly raised cushion at apex, margin slightly papillose; adaxial side slightly concave with an inconspicuous median ridge; column dorsally slightly curved, from ovary to tip of stelid 1.2 cm long, to tip of rostellum 1.0 cm long; dorsal stelid short and blunt, stelids on lower margin conspicuous, subulate; basal arms of column porrect, equal in length to stelids, spathulate, from column foot ca. 1.0 cm long, ca. 0.5 cm broad; column foot at the right angles to column, ca. 1.0 cm long curved towards base, broad, quadragular, truncate ca. 1.0 cm wide, with a lateral falcate lobe, internal face longitudinally convexed with a raised ridge; anther hooded; stigma more or less quadrangular; ovary ca. 1.0 cm long, glabrous; pedicel ca. 4.0 cm long, glabrous; pollen not seen; fruit not seen.

Distribution.—Papua New Guinea. Herowana area in the Crater Mountain wild life management area, Simbu Province.

Habitat.—Upper montane rainforest zone. No records accompanied the holotype specimen, but all the New Guinea species come from areas with rainfalls between 2,000–4,000 mm per annum. Species of this section Brachystele are found growing in the thick root and leaf litter of rainforests and as epiphytes climbing the trunks of trees. Information on altitude was not available but Herowana is located at 850 m altitude and Crater Mountain rises to 2100 m. The most likely altitude for this species is around 1,500 m.

This new species is a closely allied to Bulbophyllum foetidum Schltr. (Fig. 2) including B. foetidum var. grandiflorum J.J.Sm., but has larger flowers, wider sepals and petals; the labellum is not oblong but is cordate and larger; arms of column are spathulate and larger. The most important differences between B. wakoi and B. foetidum lie in the shape of the labellum (Figs. 1 C, I, J and Figs. 2 B, H–J) and the differences in the size, shape and posture of the basal arms of the column (Figs. 1 H, L and Figs. 2 F, M, N, L; Figs. 2 M and L represent two specimens from different locations).

The illustration of B. foetidum by Schlechter (1913) and Smith’s illustration of variety grandiflorum (1929) compare fairly well with Figure 2, but the differences between the basal arms of the column, in length and shape, in both illustrations, do not fit that of B. wakoi. Smith’s variety was also described as having pustules on the rachis. These are not present in the new species.

Bulbophyllum foetidum, as the name suggests, produces as foul odor. When
extracting the specimen of *B. wakoi* from the alcohol, in which it has been preserved, it was noted that the alcohol gave off a fairly strong foul odor as well. Since the production of a foul odor is common with other members of this section, it is presumed that the new species does the same.

**Etymology.**—The new species has been named for Mr. Simon Wako who collected and submitted the specimen to me—along with many other specimens—for identification. Mr. Wako comes from Crater Mountain area where he and others from that area are involved with the Wild Life Management project there.

**Notes.**—Only spirit material of the new species was available and the illustration of *B. wakoi* (Fig. 1) was drawn from this material. Based on color photos provided by Mr. Wako and Crater Mountain Project staff, and by Dr. Geoff Stocker of a flowering specimen in his private collection, the petals and sepal are glossy olive-green with purple to maroon veins and deep purple to maroon at their base; externally they are darker, almost glossy brown in color. The labellum is deep glossy red with the two dorsal ridges paler, almost pink. The column is dorsally white to pink with some red lines near its base and ventrally deep red. The anther is red and the pedicel and ovary are green. The new species differs from *B. foetidum*, in the color and color patterns of the sepals, petals, and column. The pedicel and ovary of the latter species is purple black with white spots whilst that of the *B. wakoi* is green.

**ACKNOWLEDGMENTS**

I wish to thank Mr. Simon Wako for providing the specimen of *B. wakoi*. Dr. J. Stocker made valuable comments and suggestions during the preparation of this paper. To Mr. R. J. F. Henderson, Queensland Herbarium, Brisbane, I owe a special thanks for providing assistance with the Latin text.

Technical support for Mr. Wako and other village parabiologists in the Training Local Observer Program has been provide by the Research and Conservation Foundation of Papua New Guinea and the Wildlife Conservation with support from the Biodiversity Support Program (BSP) and their assistance is gratefully acknowledged here. BSP is a Consortium of the World Wildlife Fund, The Nature Conservancy and the World Resources Institute, with funding by the United States Agency for International Development. The opinions expressed herein are those of the author and do not necessarily reflect those of the U.S Agency for International Development.

**REFERENCES**

BOOK REVIEW


This book contains a series of summary papers from a symposium held in 1995 during the annual meeting of the Ecological Society of America. While the information may be somewhat dated, the volume is clearly a well-balanced summary of the most important concepts involved with habitat fragments, their restoration and long-term management of the biota resident therein. Given that tropical habitats are increasingly fragmented, the basic principles outlined in this book become a pre-requisite element in the formation of every new conservation biologist. It is important to note that while the papers presented in the book were written for 1995, they have all been supplied with updated references, so that frequent references to material published in 1997 is included.

The book is divided in seven sections, including: 1) The scale and economics of tropical deforestation, 2) physical processes and edge effects, 3) tropical forest faunas, 4) plants and plant-animal interactions, 5) restoration and management of fragmented landscapes, 6) site selection and design of tropical nature reserves, and 7) summary and new perspectives.

Tropical Forest Remnants would be an ideal book for a graduate seminar series. Given that our planet is largely comprised of a mosaic of remnant landscapes, varying in size, aspect, slope, hydrology, climate and proximity to other fragmented landscapes, specific training in fragment dynamics is increasingly important. To introduce the concept of tropical forest fragmentation to student conservation biologists, I heartily recommend that papers from Section VII, summary and new perspectives, be presented first, especially Chapter 32, "Tropical Forest Fragmentation: Synthesis of a Diverse and Dynamic Discipline." From there, reading of the chapters cited therein provide the most useful way to present the copious material of this book, the large reference list, and indeed, supplementary material published since 1997. The book covers, like no other I have seen, a cogent summary of how landscapes have become fragmented, how fragmentation among various elements of the biota should be measured, and what the long-term effects of fragment size, shape, location, etc., mean to each of those phyla for which we have data. Whether one is strictly concerned with tropical phenomena or not, there are valuable lessons for application in understanding habitat fragmentation for other biomes as well. I highly recommend this book to all who concern themselves with natural history, conservation biology, natural resource management, ecology and systematic biology.—John J. Pipoly III.
NEW COMBINATIONS IN THE 
MELASTOMATACEAE FROM HISPANIOLA

HENRI ALAIN LIOGIER

Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060, U.S.A.

ABSTRACT

Eighteen new combinations are made in the Hispaniolan Melastomataceae, transferring the species of Ossaea and two species of Clidemia into the genera Henriettea, Leandra, and Sagraea.

RESUMEN

Se hacen diez y ocho nuevas combinaciones en las Melastomataceae de la Española, transfiriendo las especies de Ossaea y dos especies de Clidemia a los géneros Henriettea, Leandra y Sagraea.

Several years ago, Walter S. Judd and J. Dean Skean (Judd 1986, 1989; Judd & Skean 1991) pointed in several publications to the genus Ossaea DC. as an arbitrary group; the genus was originally described as having narrowly triangular to ovate petals with more or less acute apices. I had already observed that the species considered as belonging to this genus did not show consistent characters that would help to keep them in the same genus.

As Judd studied the problem further, he concluded that the species of Ossaea had to be transferred to several other genera, taking into account the inflorescence position and structure and other characters of generic importance. He separated the species into several groups belonging to different genera. After studying the herbarium specimens available and with the type specimens at hand, I am now able to place these species in their proper genera: Clidemia D. Don, Leandra Raddi, and Sagraea DC.; I have also determined one species in Henriettea DC. I am also transferring two species of Clidemia to Sagraea. My work is based on Judd's and Skean's publications and conclusions. Several species have already been transferred either by Judd or by his associate, James D. Skean, Jr.

In this paper, I am transferring these species originally described in Ossaea from the island of Hispaniola to their proper taxonomic position, primarily according to the inflorescence position and structure, and to the number of petals in the flowers, in the preparation for my forthcoming treatment of the family Melastomataceae.

Leandra has terminal inflorescences with relatively long calyx-lobe projections, and 4–6-merous flowers.

Sagraea has lateral inflorescences which may occur below the leaves on former nodes, shorter calyx-lobes; the 4-merous flowers are solitary or paniculate.

Clidemia has terminal inflorescences which may appear axillary or pseudoaxillary or occur below the leaves on former nodes, with 4–9-merous flowers and rounded or retuse petals.

Henriettae has acute to acuminate petals, with lateral inflorescences, the flowers solitary or in glomerules, 4–6-merous.

I have not been able to see all of the type specimens; some were obviously lost in the Berlin Herbarium. In some cases, the isotypes are available in several herbaria.


This plant has been collected several times by E.L. Ekman in Massif de la Hotte and near Jérémie, in Haiti. It fits in Henriettae by its axillary glomerate inflorescences and its acuminate petals; it is 4-merous. Several collections are from the same area as the type collection. It is endemic to Hispaniola.


This is a small shrub with terminal solitary sessile 4-merous flowers, and acuminate petals. It has been collected several times both in Haiti and in the Dominican Republic. Endemic to Hispaniola.


This is a small tree with corymbose terminal inflorescences and 4 acuminate petals. Known only from the type collection. Endemic to Hispaniola.


This shrub has terminal paniculate inflorescences with 4 acuminate petals. Known only from the type collection. Endemic to Hispaniola.


A shrub with terminal head-like inflorescences, the flowers 5-merous with lanceolate petals. The species has been collected several times in the same region. Endemic to Hispaniola.

Note.—Urban described two species in *Ossaea* with quite similar names: *Ossaea polychaeta*, now *Leandra polychaeta*, and *Ossaea polychaete* now *Sagraea polychaete*. This was the reason for a new name published by me as *Ossaea urbaniana* Alain (1968), now obsolete.


A small tree with axillary, pedunculate head-like inflorescences, 4-merous flowers and acuminate petals. Known only from the type specimen. Endemic to Hispaniola.


A 2 m tall shrub with axillary, racemose or paniculate inflorescences, 4-merous flowers and petals narrowed at apex, not acuminate. Rare in the area. Endemic to Hispaniola.


A shrub with sessile, glomerate, 4-merous flowers; the petals are acute, not acuminate. It has been collected several times in southern Haiti. Endemic to Hispaniola.


A shrub up to 2 m tall, with axillary, subcymose, subsessile inflorescences 1–3-flowered, 4-merous flowers. Known from the type collection and from Formon (*Judd 3469*, FLAS). Endemic to Hispaniola.


A shrub up to 2 m tall with axillary, subsessile cymose inflorescences, 1–5-flowered; the flowers are 4-merous, the petals ovate. It has also been collected in the Dominican Republic: Prov. Pedernales, Bahoruco Mountains. Endemic to Hispaniola.

A slender shrub with axillary 1-flowered capillary peduncles, 4-merous flowers and triangular petals. It is fairly common both in the Central Mountains and in the Bahoruco Range. Endemic to Hispaniola.


A small shrub, about 1.5 m tall with axillary solitary pedunculate flowers, these 4-merous, the petals acute. It is fairly common in the area. Endemic to Hispaniola.


Shrubby with axillary, subsessile, cymose, 1–3-flowered inflorescences; the flowers are 4-merous, the petals acuminate. Known only from the type collection. Endemic to Hispaniola.


A shrub 2–3 m tall with axillary, paniculate, 3–7-flowered inflorescences, 4-merous flowers and ovate, obtuse petals. It has been collected several times, both in Haiti and in the Dominican Republic. Endemic to Hispaniola.


Shrubby with flowers in axillary sessile groups, 4-merous, the petals rectangular, rounded and minutely acuminate. Known only from the type collection. Endemic to Hispaniola.


A small shrub about 1 m tall, with axillary nearly sessile, subsolitary flowers, these 4-merous. This plant is fairly common, both in Haiti and in the Dominican Republic. Endemic to Hispaniola.

A shrub with axillary paniculate few-flowered inflorescences, the flowers are 4-merous, the petals acute. Another collection from Torbec; also numerous collections from the Formon region, Haiti, by Judd and Skean. Endemic to Hispaniola.


A shrub or small tree to 4 m tall, with axillary fasciculate few-flowered cymes; the flowers are 4-merous, the petals acute. There are numerous collections from the Formon area at FLAS. Endemic to Hispaniola.


**ACKNOWLEDGMENTS**

I am grateful to the BRIT facilities, both in the Herbarium and in the Library; to the New York Botanical Garden, to The Rijksherbarium at Stockholm, and to the Herbarium of the Botanic Garden in Santo Domingo, for the loan of specimens. And through the years, for the use of the facilities of the several herbaria visited to study their collections. I am also grateful to James D. Skean, Jr. for his revision of this manuscript and his helpful suggestions.

**REFERENCES**


BOOK REVIEW


The Trans-Pecos region of Texas, with its numerous montane habitats and low, arid basins is substantially different from other regions of the state. The Trans-Pecos is defined geographically rather than floristically in this work, such that portions of the Edwards Plateau Vegetational Area, and the Chihuahuan Desert are also included. Of course, the Davis Mountains are also home to a great number of interesting and endemic species. Five general vegetation types are recognized.

The present revision of the first edition includes taxonomic or nomenclatural updates in 62 genera treated, and new distributional or taxonomic data for another 60. The nomenclature and presentation more closely correspond to hierarchies recognized by John Kartesz and others, with supplements from monographers and other sources. In some significant cases, keys were re-written. The book covers 447 species of woody plants in 203 genera and 70 families, and is divided into 6 functional parts, including the 1) introduction, 2) key to the classes and subclasses, 3) descriptive flora, 4) selected glossary, 5) literature cited, and 6) index.

Trees and Shrubs of the Trans-Pecos and Adjacent Areas is very straightforward, easy to use, and will surely be useful to all who visit, botanize, study, or otherwise witness the beauty of the Trans-Pecos area of Texas. If we can overlook a few typesetting errors (Ju N glandaceae and not Juglandaceae), the book is perfect for a floristic seminar, any nature study tour, or just to have along to botanize. The glossary is concise and useful, although it is not illustrated, the literature cited is extensive, and the index is very helpful and easy to use. As one might expect, the revision of a classic work has produced something BIGGER AND BETTER, a handy field guide and yet another volume to fit in the side pocket of one’s car, so it can be drawn more quickly. I recommend it for everyone in the region!!—John J. Pipoly III.
PENNISETUM ADVENA SP. NOV.  
(POACEAE: PANICEAE): A COMMON ORNAMENTAL GRASS THROUGHOUT THE SOUTHERN UNITED STATES

JOSEPH K. WIPFF  
Pure Seed Testing, Inc.  
P.O. Box 449  
Hubbard, OR 97032, U.S.A.  
joseph@turf-seed.com

J.F. VELDKAMP  
Rijksbureau (L)/ Hortus Botanicus  
P.O. Box 9514  
NL-2300 RA  
Leiden, THE NETHERLANDS  
veldkamp@ru.nl

ABSTRACT

*Pennisetum advena* Wipff & Veldkamp, a common ornamental grass in the southern United States, is described and illustrated. A key is provided to separate it from similar taxa (*P. macrostachys*, *P. orientale*, and *P. setaceum*). *Pennisetum advena* is readily distinguished from *P. setaceum*, its closest putative relative, by vegetative, inflorescence, fascicle, and spikelet characters.

RESUMEN

Se describe e ilustra *Pennisetum advena* Wipff & Veldkamp, una gramínea ornamental frecuente en el sur de los Estados Unidos. Se ofrece una clave para separarla de taxa similares (*P. macrostachys*, *P. orientale*, y *P. setaceum*). *Pennisetum advena* se distingue fácilmente de *P. setaceum*, la especie más próxima, por los caracteres vegetativos, de la inflorescencia, del fascículo y de la espiguilla.

*Pennisetum* Rich., a genus of \(\pm 80\) species, is found in tropical, subtropical, and temperate regions (Clayton & Renvoize 1986). It occupies a diverse range of habitats, including riparian, savanna, desert, forest, and montane. Of the \(\pm 80\) species, 40 are known to occur in the New World. Twenty-six of the 40 are native to México, Central and/or South America, 14 are introduced into the New World. Seventeen species have been introduced into the United States. This genus contains species that are important as grain (cereals) [e.g. *P. glaucum* (L.) R.Br.], forage [e.g. *P. ciliare* (L.) Link, *P. flaccidum* Griseb., *P. glaucum*, *P. orientale* Willd. ex Rich., and *P. purpureum* Schumach.], soil binding and lawns (e.g. *P. clandestinum* Hochst. ex Chiov.; and orna-
mentals [e.g., *P. advena* Wipff & Veldkamp, *P. alopecuroides* (L.) Spreng., *P. macrostachys* (Brongn.) Trin., *P. orientale*, *P. purpureum*, *P. setaceum* (Forssk.) Chiov., and *P. villosum* R.Br. ex Fresen.].

Aposporous apomixis has been reported in Old World species of *Pennisetum* [e.g., *P. advena* (reported under the name *P. setaceum* purple-type, by Simpson & Bashaw 1969), *P. ciliare*, *P. flaccidum*, *P. orientale*, *P. setaceum*, and *P. villosum*]. Research is still needed to understand the intricate morphological patterns and relationships, that are complicated by the presence of aposporous apomixis. The genus is morphologically and nomenclaturally complex and is in need of revision. In some cases the relationship of *Pennisetum* to allied genera (e.g., *Cenchrus* L.) is unresolved.

Since *Pennisetum* is not native in the United States, it is not well known to American agrostologists. This, in part, has lead to the overlooking of *P. advena* as a distinct species which has become a common ornamental grass in the United States. This overlooked species will be referred to as *P. setaceum* 'Rubrum,' its current horticultural name.

The first record of *P. setaceum* 'Rubrum' in the United States was reported by Hitchcock (1916) as a form of *P. rappeii* Steud. (= *P. setaceum*). Hitchcock (1916) wrote, “A half-hardy form with dark purplish foliage and purplish crimson spikes has recently been intro. under the name *P. cupreum*. It does not reproduce reliably from seed.” The name *P. cupreum* is a horticulture name and was never validly published [see also the index to Bailey (1917), where *P. cupreum* is cited as a horticultural name and a form of *P. rappeii*]. The use of *P. cupreum* Hitchc. (or Hitchc. ex L.H. Bailey) is incorrect, since Hitchcock and other authors have only accepted it as a horticulture name for a “form” or “horticultural variety” of *P. setaceum* and not as a validly published combination (Greuter et al. 1994: Article 34.1). Since its introduction in 1916, *P. setaceum* ‘Rubrum’ has since become one of the most popular ornamental grasses in the United States (Greenlee 1992). Darke (1994) commented that *P. setaceum* ‘Rubrum’ might not belong to *P. setaceum*.

Simpson and Bashaw (1969) published cytological and reproductive characteristics of *P. setaceum*. The two morphological types of plants studied were designated as “green” or “purple.” The description of the “purple” type appeared to refer to *P. setaceum* ‘Rubrum’. Fortunately, Simpson (Texas Agricultural Experiment Station, Stephenville, Texas) had maintained a clone of this plant in a greenhouse. In 1987, Kenneth Hignight and the senior author were able to examine this plant and confirmed that it was *P. setaceum* ‘Rubrum’. So began a 10-year search for a valid scientific name for *P. setaceum* ‘Rubrum’.

In 1987, a specimen of *P. setaceum* ‘Rubrum’ sent to the Royal Botanical Gardens (K) was reported as being “similar” or “with affinities” to *P. macrostachys*, a robust species from Malesia which also has purple leaves. This research into *P. setaceum* ‘Rubrum’ continued as time permitted. In November 1992,
while working on the treatment of Pennisetum for the forthcoming Manual of North American Grasses, photographs of the plate of Gymnotrix macrostachys Brongn. (= Pennisetum macrostachys) in Duperrey (1829) and of the type specimen from the Muséum National d’Histoire Naturelle (P), were obtained. Upon examination, it was obvious that P. setaceum ‘Rubrum’ and P. macrostachys were not the same taxon. Pennisetum macrostachys has only antrorsely scaberulous bristles in a fascicle, one spikelet per fascicle, and a puberulous inflorescence axis. Pennisetum setaceum ‘Rubrum’ has two kinds of bristles in a fascicle; an inner series of plumose, ciliate bristles and an outer series of antrorsely scaberous bristles, 1–3 spikelets per fascicle and a papillose pubescent inflorescence axis.

Germplasm of P. macrostachys from National Germplasm Center in Georgia was obtained. This accession (PI 354266), originally collected in New Guinea (Malesia), is actually a green form of P. setaceum ‘Rubrum’. In 1995, the senior author sent a specimen of P. setaceum ‘Rubrum’ to the junior author, who is an authority on the grasses of Malesia. The junior author spent two years searching for the validly published name for this taxon. Also, in 1995, W.D. Clayton (K) was contacted for assistance, but he too was not able to put a name to this mysterious taxon.

After years of unsuccessful searching for a satisfactory identification and careful examination of the species of Pennisetum known to science, we believe that this is an undescribed species.

Pennisetum advena Wipff & Veldkamp, sp. nov. (Fig. 1). TYPUS: UNITED STATES, TEXAS, Brazos Co.: Cultivated at Texas A&M University, College Station, Texas, commonly used ornamental grass in the area, 18 Sep 1990, Joseph K. Wipff 1723 (HOLOTYPE: L; ISOTYPES: K, MO, US, UTC).

Pennisetum advena a P. setaceo cognatio sua proxima ut videtur facile distinctum in folii laminis 6–11 mm latis planis costa non-incassata, culmo in nodis aeriis plerumque ramoso, inflorescentiae medio-involucris 10–17 per sectionem 1 cm ramo primario 1–2 mm longo, involuco setarum serie interiore setis 8–16 ciliatis vel plumosis, gluma primaria 0.5–1 mm longa, flore inferiore staminaro.

Plants perennial (annual in temperate climates), cespitose, without rhizomes or stolons. Culms 100–150 cm tall, erect; nodes glabrous, usually with some secondary branching at aerial nodes. Leaves: (measurements taken from the 2nd and 3rd uppermost leaves); sheaths glabrous, margins ciliate; ligules 0.5–0.8 mm long, a ciliate membrane; blades 33–52 cm long, 6–11 mm wide, flat, burgundy (rarely green), mid-vein not noticeably thickened, margins antrorsely scaberulous and ciliate at base. Panicles 23–32 cm long, 30–58 mm wide, flexuous and drooping, burgundy (rarely pale or whitish-green); central axis terete, pubescent with papillose trichomes. Fascicles (Involucres): 10–17 per 1 cm section (mid-inflorescence), with 1–3 spikelets. Primary branch 1–2 mm long (the length from base of branch to uppermost bristle (primary bristle). Fascicle stalk (or stipe) 0.5–1.1 mm long (the length
from base of primary branch to first (or lowermost) bristle. Primary bristle 21.3–33.6 mm long, noticeably longer than the other bristles, papillose ciliate. Two types of bristles in fascicle: an outer bristles series of 43–68 bristles, 1.2–18.5 mm long, antrorsely scaberulous; an inner bristles series of 4–10 bristles, 11.7–25 mm long, papillose ciliate. Spikelets sub(sessile or pedicelled in fascicle. Central Spikelet 5.3–6.5 mm long; pedicel 0.1–0.3 mm long. Glumes unequal; first glume 0.5–1 mm long, 0-veined; second glume 1.9–3.6 mm long, 0–1-veined, about 1/2 as long as spikelet; Lower Floret stamineate. First lemma 4.7–6.1 mm long, 5(–6)-veined. Palea 4.5–5.0 mm long.
Anthers 3, 2–2.5 mm long. Upper Floret: second lemma 5.2–6.1 mm long, 5-veined. Palea 4.7–5.6 mm long, 2-veined. Anthers 3, 2.5–2.7 mm long. Caryopses infrequently produced in United States plants.

Chromosome number.—2n = 54 [reported under the name *P. setaceum* purple-type (Simpson & Bashaw 1969)].

Method of reproduction.—Aposporous apomixis [reported under the name *P. setaceum* purple-type (Simpson & Bashaw 1969)].

Phenology.—May until first freeze.

Distribution.—Cultivated throughout the United States. Will not persist in areas where winter temperatures fall below freezing for any length of time. In areas with below freezing temperatures, it is used as an annual and replanted every year or moved into a greenhouse. In southern Florida, Texas, and California, and Hawaii it will persist, but rarely escapes.

Etymology.—The specific epithet, *advena*, is Latin for “visitor” or “stranger”; referring to its mistaken identity and unknown origin. It is believed to have originated from the Old World.

KEY TO SIMILAR TAXA OF *PENNISETUM*

1. Fascicle with two types of bristles: an inner series (bristles closest to spikelet) with bristles long-ciliate, and an outer series of antrorsely scaberulous bristles. Primary bristle noticeable longer than other bristles in fascicle. Fascicles with 1–10 spikelets per fascicle. Inflorescence axis pubescent ........................................ 2
2. Mid-culm leaf blades (3–)3.5–11 mm wide, flat, green or burgundy; mid-vein not noticeably thickened .......................................................... *P. macrochrys*
3. Mid-culm leaf blades 2–3.5 mm wide, convolute or folded, green; mid-vein noticeably thickened .......................................................... *P. setaceum*
4. Culm nodes pubescent. Plants with rhizomes. Ligule 1–2 mm long. Fascicles white. Outer bristle series of fascicle with 0–24 terete, scaberulous bristles. Leaf blades green. Inflorescence erect or arching .................. *P. orientale*
5. Culm nodes glabrous. Plants without rhizomes. Ligule less than 1 mm long. Fascicles burgundy (rarely pale green). Outer bristle series of fascicle with 43–58, terete, scaberulous bristles. Leaf blades burgundy (rarely green). Inflorescence flexuous and drooping .................. *P. advena*

*Pennisetum advena* is readily distinguished from *P. setaceum*, its closest putative relative, by the following characters. *Pennisetum advena*: 1) leaf blades 6–11 mm wide; flat, mid-vein not thickened; 2) usually with secondary branching at aerial culm nodes; 3) 10–17 fascicles per 1 cm section (mid-inflorescence); 4) primary branch of fascicles (mid-inflorescence) 1–2 mm long; 5) inner bristle series of fascicle with 4–10 ciliate or plumose bristles; 6) first glume 0.5–1 mm long; and 7) lower floret staminate. *Pennisetum setaceum*: 1) leaf blades 2–3.5 mm wide, convolute, mid-vein conspicuously thickened; 2)
no secondary branching at aerial culm nodes; 3) 8–10 fascicles per 1 cm section (mid-inflorescence); 4) primary branch of fascicles (mid-inflorescence) 2.3–4.5 mm long; 5) inner bristle series of fascicle with 8–16 ciliate or plumose bristles; 6) first glume absent (rarely present, up to 0.3 mm long); and 7) lower floret neuter (rarely staminate).

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REFERENCES


NEW COMBINATIONS IN SETARIA
(POACEAE: PANICEAE)

WILLIAM E. FOX, III and STEPHAN L. HATCH
S.M. Tracy Herbarium (TAES)
Department of Rangeland Ecology & Management
Texas A&M University
College Station, TX 77843-2126, U.S.A.
s-hatch@tamu.edu

ABSTRACT

Setaria subgenus Reverchonii is proposed. New combinations in subgenus Reverchonii, Setaria reverchoni (Vasey) Pilg. subsp. raiimseta (Scribn.) W.E. Fox, S. reverchoni (Vasey) Pilg. subsp. formula (Hitchc. & Chase) W.E. Fox are proposed. New combinations in subgenus Panaroaetim, S. ntonanana (Scribn.) Pilg. var. opbitidota (Hitchc. & Ekman) W.E. Fox, S. ntonanana (Scribn.) Pilg. var. subtramiicns (Hitchc. & Ekman) W.E. Fox are also proposed. Keys separating the subgenera, subspecies of S. reverchoni, species of subgenus Panaroaetim, and varieties of S. ntonanana are included.

RESUMEN

Se propone Setaria subgénero Reverchonii. Son propuestas combinaciones nuevas en el subgénero Reverchonii, S. reverchoni (Vasey) Pilg. subsp. raimseta (Scribn.) W.E. Fox y S. reverchoni (Vasey) Pilg. subsp. formula (Hitchc. & Chase) W.E. Fox. Son también propuestas combinaciones nuevas en el subgénero Panaroaetim, S. ntonanana (Scribn.) Pilg. var. opbitidota (Hitchc. & Ekman) W.E. Fox y S. ntonanana (Scribn.) Pilg. var. subtramiicns (Hitchc. & Ekman) W.E. Fox. Se incluyen claves para separar los subgéneros, subspecies de S. reverchoni y las variedades de S. ntonanana.

INTRODUCTION

Setaria P. Beauv. is a cosmopolitan genus important in cultivated crops [S. italic (L.) P. Beauv.], perennial forage grasses [S. macrostachya H.B.K.] and noxious weeds [S. viridi (L.) P. Beauv.].

Setaria (Poaceae:Paniceae) is one of several genera closely related to Panicum. Tribal and generic arrangement of the species of the Poaceae as classified by Häckel (1887) has been revised by Prat (1936), Pilger (1954), Stebbins (1956), Clayton and Renvoize (1986) and Soderstrom (1986). However, the circumscription of the Paniceae has remained rather stable. For additional discussion of previous work see Fox (1999). Most taxa in Setaria can be easily differentiated from its closest relatives Panicum and Paspalum by the presence of bristles subtending the spikelets, these representing modified inflorescence branches.

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Rominger (1962) monographed the species of *Setaria* from North America and classified 43 species occurring in three subgenera: *Ptychophyllum* (6 species), *Setaria* (27 species) and *Panarocharium* (10 species). Twenty-five are native to North America, ten originate from South America and eight are from the Old World (Rominger 1962).

The subgenus *Panarocharium* forms an “artificial group” (Rominger 1962) distinguished from the remainder of the genus by the occurrence of only one bristle usually below the terminal spikelet of the primary branches. The subgenus occurs as two separate complexes. The first complex ranges from southern Florida through the West Indies and into the Yucatan region of Mexico and Belize. The complex includes *Setaria distansiflora* (A. Richard) Pilg., *S. pradana* (Léon) Léon, *S. leonis* (Ekman) Léon, *S. opbittica* (Hitchc. & Ekman) Léon, *S. subtransiens* Hitchc. & Ekman, *S. utovanaea* (Scribn.) Pilg., and *S. chapmanii* (Vasey) Pilg.. The second complex occurs from northeastern Mexico through the western two-thirds of Texas, into southern Oklahoma and west into New Mexico. It extends from the Balcones Escarpment of Texas to Chaves County, New Mexico. The complex includes *S. firmula* (Hitchc. & Chase) Pilg., *S. ramiseta* (Scribn.) Pilg. and *S. reverbonii* (Vasey) Pilg.. Not included in Rominger (1962) is the species *S. variifolia* (Swallen) G. Davidse found in the Yucatan Peninsula of Mexico and south.

Rominger (1962) separated the subgenus from the remainder of *Setaria* by the presence of a single bristle “usually” below the terminal spikelet of each primary branch. Gould (1975) used the same character to separate the species that occur in Texas; however, he reported a problem with the identification of specimens based on this character. These problems led to the current research in the subgenus.

The objectives of the research were to 1) determine the relationships of the taxa in the Texas/Mexico/Oklahoma/New Mexico complex and 2) provide a taxonomic treatment of all taxa recognized by Rominger (1962) in the subgenus *Panarocharium* and *S. variifolia*.

**MATERIALS AND METHODS**

Field collections were made during the flowering periods of the species throughout Texas, Florida and Belize. To insure isolation between the populations, a minimum distance of five miles was traveled between successive collection sites. Ten independent specimens from each site were semi-randomly collected and pressed; selection was biased in favor of mature plants that did not show any signs of damage from insects, herbivores, trampling, etc. The West Indies species were studied from herbaria specimens. In some cases sufficient samples were available of a single collection to serve as a “real” population. In others, “artificial” populations were created based upon similar geographic location. A total of 78 populations were studied for the subgenus.
Table 1 lists the 52 characters measured from representative populations to determine the relationship between the 11 species. All characters of selected populations were measured and statistically analyzed to determine significant characters for the detailed study of the subgeneric relationships. Nineteen characters were determined to be significant and included in that analysis. The following hypothesis was tested: taxa of subgenus *Paurochaetium* should be classified in one subgenus versus the need to describe a new subgenus. Two hundred and ninety-two operational taxonomic units (OTU’s), representing all species included in the study, were measured.

Univariate statistics (mean, standard deviation and range) were obtained using the PSI-Plot software package (Poly Software International 1996). Multivariate statistics of principal component analysis (PCA) was obtained using the NT-SYS software package (Rohlf 1990). Principal components were derived using correlation matrices.

**RESULTS AND DISCUSSION**

**Subgeneric Study**

Based upon the analysis of the 11 species classified in *Setaria* subgenus *Paurochaetium*, two distinctly separate entities were discovered. These differences matched the two complexes within subgenus *Paurochaetium* mentioned earlier. Figure 1 illustrates the separation between the two complexes.

Based upon the relationships revealed through the PCA, geographical separation, consistent morphological differences and similar habitat requirements of the complexes, the subgenus *Reverchoniae* is proposed.


*Setaria* subgenus *Reverchoniae* ab subgeneri *Paurochaetium* per absentiam paleae flosculi inferior, paniculam erectam, spiculam grandiorem (2.1–4.5 mm long, 1.2–2.6 mm latam) fortuito dispositam (non dispositam), arque axe inflorescentiae scabro differt.

*Setaria* subgenus *Reverchoniae* differs from subgenus *Paurochaetium* in the absence of a palea of the lower floret, erect panicle, larger spikelets (2.1–4.5 mm long, 1.2–2.6 mm wide) that are randomly disposed (not distichous), and the scabrous axis of the inflorescence.

*Setaria* subgenus *Reverchoniae* contains three taxa previously classified in the subgenus *Paurochaetium* (Rominger 1962) including the proposed sub-species: *Setaria reverchonii* (Vasey) Pilg. subsp. *reverchonii*, *S. reverchonii* (Vasey) Pilg. subsp. *ramiseta* (Scribn.) W.E. Fox and S. *reverchonii* (Vasey) Pilg. subsp. *firma* (Hitchc. & Chase) W.E. Fox. *Setaria variifolia* was included in the subgenus, but was not treated originally by Rominger (1962). The lack of a palea in the lower floret best circumscribes the subgenus *Reverchoniae*.
Table 1. Fifty-two characters used to assess morphological and reproductive variation in *Setaria* subgenus *Paurochaetium*. All characters were measured for quantitative variation except those labeled as TS (two-state (binary)) and MS (multi-state quantitative). Italicized characters were found as significant and used in the final analysis.

| Vegetative: growth habit (MS), culm height, culms branched/unbranched (BS), internodes hollow/solid (BS), node pubescence present/absent (BS), leaves basal/throughout (BS), leaf sheath pubescence present/absent (BS), leaf sheath pubescence length (if present), leaf length, leaf width (widest point), leaf base width, leaf involuted/not involuted (BS), leaf pubescence abaxial/axial present/absent (BS), leaf pubescence adaxial present/absent (BS), leaf pubescence margin present/absent (BS), collar pubescence present/absent (BS), collar pubescence length (if present), auriculate trichomes present/absent (BS), auriculate pubescence length (if present), ligule type (MS), ligule length |
|---|---|
| Inflorescence: inflorescence length, inflorescence axis pubescence present/absent (BS), distance between lower primary branches, distance between upper primary branches, terminal bristle length lowest branch, terminal bristle length upper primary branches, terminal bristle length terminal primary branch, bristle exceeding spikelet lowest branch (BS), bristle exceeding spikelet upper branch (BS), bristle exceeding spikelet terminal branch (BS) |
| Spikelet: spikelet length, spikelet width, lower glume length, lower glume apex shape, lower glume # of veins (MS), lower glume length, upper glume equal/not equal fertile lemma, upper glume length, lower glume # of veins (MS), sterile lemma equal/not equal fertile lemma (BS), sterile lemma length, sterile lemma # of veins (MS), sterile palea present/absent (BS), sterile palea length, fertile lemma length, fertile palea length, Caryopsis length, Caryopsis width, filament length, anther length, anther width |

(exception *S. variifolia* that shares other characters aligning it with the subgenus). None of the members of subgenus *Reverchoniaceae* are sympatric with subgenus *Paurochaetium*. For further detail of the relationships of the two subgenera refer to Fox (1999).

**KEY TO SUBGENERA OF SETARIA**

1. Bristles one to many below each spikelet (some without bristles); leaf blades plicate ........................................... 2

2. Leaf blades plicate; bristles present below only some of the spikelets
   Pycnophyllum

2. Leaf blades not plicate; bristles below all spikelets (rarely missing) ................. *Setaria*

1. Bristles present usually only below the terminal spikelet of branch as an extension of branch; leaf blades not plicate ........................................... 3

3. Panicles nodding (except *S. praedans*), bearing remote, appressed, mostly racemose branches with spikelets two ranked on an undulating axis; central inflorescence axis glabrous; palea of lower florets present and conspicuous
   Paurochaetium

3. Panicles erect; spikelets arranged randomly on branch; central inflorescence axis scabrous; palea of lower florets absent (except *S. variifolia*) ........ *Reverchoniaceae*

**SUBGENUS REVERCHONIAE**

Four taxa are classified in the subgenus *Reverchoniaceae*: *Setaria reverchonii* subsp. *reverchonii*, *S. reverchonii* subsp. *ramiseta*, *S. reverchonii* subsp. *firma* and *S. variifolia*. Figure 2 illustrates the relationship of the taxa in *Reverchoniaceae*. 
Rominger (1962) classified *S. reverchonii*, *S. ramiseta*, and *S. firma* as separate species following the combinations proposed by Pilger (1940). Other authors who have classified these taxa as species include Hitchcock (1935), Silveus (1942), Hitchcock (1951) and Gould (1975). When using the keys prepared by these authors, it becomes evident that the characters used do not result in consistent identifications. This problem resulted in the study of this complex and the following combinations.


Fig. 2. Two-dimensional representation illustrating the relationships of the taxa described in *Setaria* subgenus *Reverchoniae*.

*Setaria reverchonii* subsp. *ramiseta* can be separated from the other taxa of the subgenus *Reverchoniae* with a shorter culm length, shorter penultimate leaf length, narrower leaf width, shorter second glume, shorter upper and lower lemma and shorter palea of the upper floret. *Setaria reverchonii* subsp. *reverchonii* is separated from subsp. *formula* by a longer, narrower and usually involute leaf blade, a narrower leaf blade base above the collar and a longer lemma of the lower floret. Further references to the subspecies can be found in Fox (1999).

**KEY TO SUBGENUS REVERCHONIAE**

1. Palea of lower florets present and well developed; palea of upper (fertile) florets 3.0–3.1 mm long; distribution Yucatan peninsula of Mexico and Central America .................................................. *S. variifolia*

1. Palea of lower florets absent or rudimentary; palea of upper florets (1.0–)1.8–2.5(--3.1) mm long; distribution Texas, New Mexico, Oklahoma and northern Mexico ........................................................................................................... 2

2. Spikelets (2.4–)2.7–2.8(--3.4) mm long, (1.1–)1.5–1.6(--1.9) mm wide; second glumes (1.9–)2.4–2.5(--3.1) mm long; lemma of lower florets (1.0)2.3–2.5(--3.2) mm long; lemma of upper florets (1.0)2.2–2.3(2.9) mm long; penultimate leaf blades (3.0–)6.8–7.6(--12.1) cm long; panicles (3.7)17.7–20.7(--38.1) cm long .................................................. *S. reverchonii* subsp. *ramiseta*

2. Spikelets (2.9–)3.2–3.6(4.0) mm long, (1.2–)1.8–2.0(--3.6) mm wide; second glumes (2.4–)2.8–3.0(3.6) mm long; lemma of lower florets (1.4)2.8–3.0(--3.7) mm long; lemma of upper florets (2.2–)2.7–2.9(--3.4) mm long; penultimate leaf blades (3.6–)7.9–13.3(--28.6) cm long; panicles (9.5)25.3–32.6(--64.8) cm long ........................................................................................................... 3
3. Penultimate leaf blades (3.6–)11.7–13.3–(28.6) cm long, (1.4–)2.1–2.3–(3.4) mm wide, involute; leaf blade bases above collar (0.7–)1.3–1.5–(2.1) mm wide; lemma of lower florets (1.4–)2.9–3.0–(3.7) mm long ... S. reverchonii subsp. reverchonii

3. Penultimate leaf blades (5.1–)7.9–8.8–(15.4) cm long, (2.7–)4.4–4.7–(9.2) mm wide, flattened; leaf bases above collar (1.4–)3.0–3.2–(5.3) mm wide; lemma of lower florets (1.9–)2.8–2.9–(3.2) mm long ... S. reverchonii subsp. firmula

SUBGENUS PAUROCHAITIUM

The remaining seven taxa are retained the subgenus Paurochaetium as described by Rominger (1962). These include the original species of Setaria distansflora, S. leonis, S. ophiticola, S. pradana, S. subtransiens, S. utowanaea and S. chapmanii. Taxonomic interpretation was difficult in the subgenus Paurochaetium due to a small sample size. Unfortunately, few specimens have been collected over time and available for the study. Hitchcock (1936) and Rominger (1962) classified S. utowanaea, S. ophiticola and S. subtransiens as distinct species. However, based upon the specimens examined in this study the following combinations are proposed.


Based upon the mid-leaf width, leaf base width, spikelet length, lower lemma length and palea length of the upper floret, the varieties of Setaria utowanaea are classified separately from the remainder of subgenus Paurochaetium. Figure 3 illustrates the relationship of the three taxa in the Setaria utowanaea complex. Setaria utowanaea var. subtransiens differs from the other members of the species with a single bristle present below most spikelets on the branch, bristle length exceeding the spikelet, and spikelet width. Setaria utowanaea var. utowanaea is separated from S. utowanaea var. ophiticola by blade length, spikelet width, lack of tufted basal leaves and the presence of involute leaves on the upper culm. Setaria utowanaea var. ophiticola has shorter involute leaves, narrower spikelets, a tufted lower leaf arrangement and upper leaves that are slightly folded or flat. The following key separates the species of subgenus Paurochaetium. A key to separate the varieties of Setaria utowanaea will follow. Further reference to the taxa of subgenus Paurochaetium can be found in Fox (1999).
Fig. 3. Two-dimensional representation of the relationship between Setaria italica var. italica, S. italica var. ophitica and S. italica var. subtransiens.

KEY TO SUBGENUS PAURICHAETIUM

1. Spikelets (1.8–2.0–2.2–2.4) mm long, (1.0–1.1–1.2–1.3) mm wide, ovate, lacking pala of lower florets; penultimate leaf blades (9.3–15.1–19.1–34.4) cm long, (2.3–3.2–3.9–7.7) mm wide; leaf blade bases above collar (1.1) 1.2–2.7 (–6.0) mm wide; second glumes subequal to equal fertile lemmas S. chapmanii

1. Spikelets (1.3–1.4–2.4–2.5) mm long, pala of lower florets conspicuously present; leaf blade bases above collar (0.8–0.9–1.1–1.8) mm wide; second glumes conspicuously shorter than fertile lemmas S. pradana

2. Panicles subculmose; spikelets (1.8–1.9–2.4–2.5) mm long (except S. distantiflora (1.3–1.4–1.5–1.7)), not spreading; lower lemmas (1.6–1.9–2.2–2.4) mm long; lower pales (0.8–1.2–1.8–1.9) mm long; upper pales (1.4–1.6–1.9–2.1) mm long S. distantiflora

3. Spikelets (1.3–1.4–1.5–1.7) mm long; first glumes (0.4–0.6–0.7–0.9) mm long; second glumes (0.6–0.9–1.1–1.3) mm long; lower lemmas (1.1–1.3–1.4–1.5) mm long; palea of lower florets (0.3–0.9–1.1–1.3) mm long; palea of upper florets (0.9–1.0–1.1–1.3) mm long S. distantiflora

4. Penultimate leaf blades (3.6–4.7–5.9–7.4) mm wide; leaf blade base above collar (1.1–1.3–1.5–1.8) mm wide; spikelet (1.6–1.8–2.0–
2.3) mm long; lemma of lower florets (1.2–)1.6–1.8(–2.2) mm long;
palea of upper florets (1.2–)1.4–1.5(–1.7) mm long

S. iconis

4. Penultimate leaf blades (0.9–)1.1–1.3(–4.2) mm wide; leaf blade above
collar 0.4–1.3(–1.4) mm wide; spikelets (1.8–)2.2–2.4(–2.5) mm long;
lemma of lower florets (1.6–)1.9–2.2(–2.4) mm long; palea of upper
florets (1.4–)1.6–1.9(–2.1) mm long

S. utowanaea

KEY TO VARIETIES OF SETARIA UTOWANAE

1. Bristles present below most spikelets on branch, (2.5–)4.0–5.1(–6.4) mm
long, exceeding spikelet ........................................... S. utowanaea var. subtransiens

1. Bristles present below only terminal spikelet of branch, (0.4–)0.5–3.3(–3.9) mm
long, not exceeding spikelet ........................................... 2

2. Leaf blades (7.8–)13.1–16.0(–21.9) mm long; spikelets 0.7–0.8(–0.9) mm
wide; basal leaves not tufted, upper leaves involute .......................... S. utowanaea
var. utowanaea

2. Leaf blades 3.3–5.4(–6.2) mm long; spikelets 0.5–0.7 mm wide; basal
leaves tufted, upper leaves flat or slightly folded toward apex .......... S. utowanaea
var. ophiticola

CONCLUSIONS

Rominger (1962) stated that the separate classification of Setaria subgenus
Pauropachetium is "artificial." However, based upon this study and input
from various others, it is our opinion that, although "artificial" by definition,
the eleven taxa form a distinct group distinguishable from the remainder
of Setaria. Based upon this analysis, keys have been developed that consist-
tently separate the taxa from the subgenera Setaria and Ptychophyllum.

However, our understanding of the relationships within what was originally
classified as Setaria subgenus Pauropachetium have changed based upon
these analyses. The proposal of the new subgenus, Setaria subgenus Reverchoniae,
provides a natural separation of the original taxa recognized by Rominger
(1962). With the proposal of the new subgenus, Setaria now has four recog-
nized subgenera.

The inclusion of Setaria variifolia with the remainder of Setaria subgenus
Reverchoniae added a little known taxon to the subgenera of Setaria that has
a single bristle usually located below the terminal spikelet of the branch. Davidse
(1981) suggested that S. variifolia was closely related to taxa of subgenus
Pauropachetium as defined by Rominger (1962). This taxon provides a chal-
lenge to its classification due to the overlapping characteristics with sev-
eral of the subgenera. However, based upon these analyses, the taxon is best
classified with the subgenus Reverchoniae. Setaria variifolia warrants further
study to determine if this classification is truly defined. A comparative analysis
of all of the subgenera would determine if the classification is correct.

Within Setaria subgenus Reverchoniae two name combinations have been
proposed. Based upon numerical study of morphology, leaf anatomy and
DNA content analyses S. reverchonii subsp. *firmula* and S. reverchonii subsp. *ramiseta* have been proposed (Fox 1999). The taxa of the subgenus (excluding *S. variifolia*) show a substantial amount of intergradation.

The remainder of the species originally classified by Rominger (1962) are retained in the subgenus *Paurochaetium*. However, name combinations have been proposed for two of the taxa, *S. atouwanaea* var. *ophitricola* and *S. atouwanaea* var. *subtransiens*.

There is a need for the study of the reproductive behavior of the three subspecies of *S. reverchonii*. The results of such research would help better understand the relationship of the taxa. If these taxa do not hybridize, it may indicate a trend towards speciation.

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BOOK REVIEW


This book is aimed at the amateur naturalist, to introduce the major groups of timber trees, their uses, and the forests they grow in. While I have difficulty with terms such as “male flowers” of Spruce and Fir (microsporangiate strobili), I understand that the author is purposely trying to keep as many of the species descriptions parallel throughout the text, which he accomplishes. The text is filled with interesting trivia, important general ecological concepts, important dendrological and morphological features of the trees, many of their uses and distribution. It is copiously illustrated and extremely easy to “leaf” through. There are numerous editorial comments, akin to those sometimes made by senior distinguished lecturers, but they do not seriously affect the delivery of important information in the text. It is obvious that Walker is a pragmatic practitioner, and while the theoretical concepts may be slightly out of date, the general summary information for each group of species is very useful, particularly to those unfamiliar with which species are commercial, where they grow, and what is important about them.

Perhaps because I am not a forester, I found such terms as “stink-bomb tree” for Ginkgo amusing, as I did the discussion of its “leaf spigots” and “living scissors” (Chapter 28). While the terminology may be “folksy” and very informal, it is aptly suited to the intended audience and painlessly injects some biological knowledge directly into the reader. The “Projects for the Amateur Naturalist” section at the end of every chapter are clever exercises that teach the audience how foresters do their work. While most are very straightforward, they are all time- and resource-consuming, but again, most things worth doing are. The reading lists and glossary are extremely useful.

In summary, I recommend this book for every backyard naturalist who is curious to know how the forestry community views the most important kinds of timber trees and their environments.—John J. Pijpely III.
THE TAXONOMY OF CYPERUS VIRENS AND CYPERUS DRUMMONDII (CYPERACEAE) IN THE SOUTHEASTERN UNITED STATES

RICHARD CARTER and DAVID K. ALEXANDER
Herbarium. Biology Department
Valdosta State University
Valdosta, GA 31698-0015, U.S.A.

CHARLES T. BRYSON
USDA. ARS
Southern Weed Science Research Unit
P.O. Box 350
Stoneville, MS 38776, U.S.A.

ANDREAS LAZARI
Mathematics and Computer Science Department
Valdosta State University
Valdosta, GA 31698, U.S.A.

ABSTRACT

Data for 20 morphological characters taken from recent collections of the *Cyperus virens* group from the southeastern United States were statistically analyzed using principal components analysis and discriminant analysis. Based upon results of the analyses and recent field observations, it is concluded that *C. drummondii* and *C. virens* are distinct at the rank of species. The taxonomy is revised accordingly. A taxonomic key, technical descriptions, distributional, and ecological data on the two species are presented.

RESUMEN

Los datos de 20 caracteres morfológicos de colecciones recientes del grupo de *Cyperus virens* del sureste de los Estados Unidos fueron analizados estadísticamente usando el análisis de componentes principales y el análisis discriminante. En base a los resultados de los análisis y de recientes observaciones de campo, se concluye que *C. drummondii* y *C. virens* son distintas en el rango de especie. Se revisan de acuerdo con esto la taxonomía. Se presentan una clave taxonómica, descripciones técnicas, datos ecológicos y sobre la distribución de las dos especies.

INTRODUCTION

*Cyperus virens* and *C. drummondii* are closely related and belong to section *Luzuloidei* and are characterized by persistent rachillas; bimarginate, deciduous scales; and 1–2 stamens per floret (Kükenthal 1935–1936; Denton 1978).

Both taxa have sharply three-angled (triquetrous) culms, which, in combination with the characteristics listed above, easily separates them from all other *Cyperus* species in the southeastern United States. Carter (1990) provides a key separating *C. virens* and *C. drummondii* from other members of section *Luzuloidei*.

*Cyperus virens* Michx. has historically presented a taxonomic problem because of its complex pattern of variation and wide distribution. According to Denton (1978), *C. virens* consists of four varieties: *C. virens* var. *virens*, *C. virens* var. *drummondii* (Torr. & Hook.) Kükenthal, *C. virens* var. *minarum* (Boeck.) Denton, and *C. virens* var. *montanus* (Boeck.) Denton. Of these taxa, only *C. drummondii* and *C. virens* var. *virens* occur in the United States. *Cyperus drummondii* was first described in 1836 based upon a specimen collected in Texas by Thomas Drummond (Torrey 1836). *Cyperus drummondii* has been treated variously since.

Chapman (1889), like Torrey (1836), recognized *Cyperus drummondii*. Subsequently, several floristic manuals include only *C. virens* with no mention of *C. drummondii* as either a taxon or a synonym (Chapman 1897; Mohr 1901; Small 1933; Correll & Johnston 1970; Correll & Correll 1975; Godfrey 1979; Wunderlin 1982, 1998; Clewell 1985; Thomas & Allen 1993). Hatch et al. (1990) did not recognize *C. drummondii* at any rank, while Tucker (1994) treated it as a synonym of *C. virens*. *Cyperus drummondii* was first treated as a variety of *C. virens* by Kükenthal (1935–1936); this view was upheld by McGivney (1938), Denton (1978), and Adams (1994). Koyama (1970) treated *C. drummondii* as a subspecies of *C. virens*. Other recent authors (Bryson & Carter 1994; Jones et al. 1997) recognized *C. drummondii* at the rank of species.

*Cyperus virens* and *C. drummondii* are widely distributed in the New World and are sympatric in the coastal plain of the southeastern United States. Although *C. drummondii* has been known from Louisiana and Texas (Torrey 1836; McGivney 1938), it is infrequently collected elsewhere in the southeastern United States. Recently, it was reported new from Mississippi (Bryson & Carter 1994). Kükenthal (1935–1936) and Denton (1978) documented the distribution of *C. drummondii* outside the United States in Nicaragua, Jamaica, Surinam, Ecuador (Galapagos Islands), and Brazil.

**Materials and Methods**

We examined 57 specimens of *C. virens* and 44 specimens of *C. drummondii*. Specimens were reproductively mature and from the southeastern United States. Initially, each specimen was identified by a unique number and after preliminary examination was assigned to *C. drummondii* or *C. virens*.

After a survey of the critical literature (Kükenthal 1935–1936; Denton 1978) and a preliminary study of our collections 20 characters were selected
for analysis. The characters are listed in Table 1, and all character states are continuous quantitative. These data were subjected to principal components analysis (PCA) and discriminant analysis (DA) using Minitab© release 11.21 (Sneath & Sokal 1973; Seber 1984; Anonymous 1996). Data points plotted using PCA were identified by specimen number and their a priori species categories, and eigenvectors generated from a PCA were used to determine which characters most accounted for the variance observed. All characters were analyzed using DA to determine order of reliability of characters and which minimal combination of characters would allow classification of our specimens into the taxonomic groups defined by PCA.

RESULTS

Results of PCA, shown in Table 2 and Figure 1, indicate the specimens form discrete clusters corresponding with our a priori classification and that no single character is outstanding in accounting for the variation in principle components one and two. Variation in principal component one is primarily due to SCALL, INFLW, BCRAT, BRACTW, RAYL, BRACNL, CIRAT, ACHNL, ACHNLW, SPIKLTW, PPEDN, and ASRAT, and variation in principle component two is primarily accounted for by CULML and CULMW. The results of DA are used to rank individual characters (Table 3) in order of taxonomic reliability and to determine which combinations of characters (Table 4) best classify our specimens into their categories as determined by PCA.

**Table 1. List of characters used in analysis.**

<table>
<thead>
<tr>
<th>Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPEDN</td>
<td>number of primary peduncles</td>
</tr>
<tr>
<td>BRACNL</td>
<td>number of primary inflorescence bracts exceeding longest ray</td>
</tr>
<tr>
<td>CULML</td>
<td>culm length (cm)</td>
</tr>
<tr>
<td>BRACTL</td>
<td>maximum primary inflorescence bract length (cm)</td>
</tr>
<tr>
<td>RAYL</td>
<td>maximum ray length (cm)</td>
</tr>
<tr>
<td>INFLW</td>
<td>maximum inflorescence width (cm)</td>
</tr>
<tr>
<td>SPKW</td>
<td>maximum spike width (cm)</td>
</tr>
<tr>
<td>CULMW</td>
<td>mid-culm width (mm)</td>
</tr>
<tr>
<td>BRACTW</td>
<td>maximum mid-bract width (mm)</td>
</tr>
<tr>
<td>LEAFW</td>
<td>maximum mid-leaf width (mm)</td>
</tr>
<tr>
<td>SPKLTW</td>
<td>spikelet width (mm)</td>
</tr>
<tr>
<td>SCALL</td>
<td>scale length (mm)</td>
</tr>
<tr>
<td>ACHNL</td>
<td>achene length (mm)</td>
</tr>
<tr>
<td>ACHNW</td>
<td>achene width (mm)</td>
</tr>
<tr>
<td>ANTHL</td>
<td>anther length (mm)</td>
</tr>
<tr>
<td>SCALN</td>
<td>scale number per spikelet</td>
</tr>
<tr>
<td>CIRAT</td>
<td>ratio of culm length to inflorescence width</td>
</tr>
<tr>
<td>ASRAT</td>
<td>ratio of achene length to scale length</td>
</tr>
<tr>
<td>ACHLW</td>
<td>ratio of achene length to width</td>
</tr>
<tr>
<td>BCRAT</td>
<td>ratio of longest primary inflorescence bract to culm length</td>
</tr>
</tbody>
</table>
Kükenthal (1935–1936) treated *Cyperus drummondii* as a variety of *C. viridis* with no justification other than brief diagnoses of the taxa. Denton (1978), in a numerical taxonomic analysis of the *Luzulae* group of *Cyperus*, came to the same conclusion as Kükenthal (1935–1936). Denton (1978, p. 257) stated that *C. drummondii* and other varieties of *C. viridis* could not be elevated in rank because of overlap in scale and achene dimensions in some collections. However, Denton’s research involved little fieldwork and included few *C. drummondii* specimens from the southeastern United States.

Our analysis included numerous recent collections of *Cyperus drummondii* from the southeastern United States, not seen by Denton (1978). Discrete clusters obtained with PCA indicate our specimens can be readily identified as either *C. drummondii* or *C. viridis* based upon our character set and that *C. drummondii* and *C. viridis* are distinct species. Further, DA shows that six characters (SCALL, SPKLTW, ACHNL, ASRAT, CIRAT, BCRAT) are particularly effective in correctly classifying our specimens and that these six
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Fig. 1. Results of principle components analysis of Cyperus virens (open circles) and C. drummondii (closed circles).

<table>
<thead>
<tr>
<th>Individual Characters</th>
<th>Proportion Correctly Classified</th>
<th>Individual Characters</th>
<th>Proportion Correctly Classified</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCALL</td>
<td>0.986</td>
<td>BRACNL</td>
<td>0.832</td>
</tr>
<tr>
<td>SPKL TW</td>
<td>0.968</td>
<td>PPEDN</td>
<td>0.828</td>
</tr>
<tr>
<td>ACHNL</td>
<td>0.953</td>
<td>RAYL</td>
<td>0.780</td>
</tr>
<tr>
<td>ASRAT</td>
<td>0.946</td>
<td>BRACTL</td>
<td>0.752</td>
</tr>
<tr>
<td>BCRAT</td>
<td>0.915</td>
<td>ANTHL</td>
<td>0.726</td>
</tr>
<tr>
<td>CIRAT</td>
<td>0.905</td>
<td>SPKW</td>
<td>0.720</td>
</tr>
<tr>
<td>ACHLW</td>
<td>0.885</td>
<td>LEAFW</td>
<td>0.695</td>
</tr>
<tr>
<td>CULML</td>
<td>0.875</td>
<td>CULMW</td>
<td>0.649</td>
</tr>
<tr>
<td>BRACTW</td>
<td>0.849</td>
<td>ACHNW</td>
<td>0.615</td>
</tr>
<tr>
<td>INFIW</td>
<td>0.833</td>
<td>SCALN</td>
<td>0.548</td>
</tr>
</tbody>
</table>

characters are the minimum combination required to classify all of our specimens into the two groups defined by PCA. Our specimens were classified with 99.3% accuracy using two combinations of four characters each (SCALL, SPKL TW, ACHNL, ASRAT and SPKL TW, CIRAT, ASRAT, BCRAT), two combinations of three characters (SCALL, SPKL TW, ACHNL and ASRAT, BCRAT, CIRAT), and three combinations of two characters (SCALL, ASRAT; SCALL, CIRAT; and SCALL, BCRAT). Moreover, DA showed the combination of key characters (SCALL, SPKL TW, PPEDN, RAYL, LEAFW, ASRAT) used by Denton (1978) correctly classifying 99.1% of our specimens. Ad-
Tab. 4. Proportion of specimens correctly classified in discriminant analysis by selected groups of characters.

<table>
<thead>
<tr>
<th>Grouped Characters</th>
<th>Proportion Correctly Classified</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCALL, SPKLTW, ACHNL, ASRAT, BCRAT, CIRAT, ACHLW, BRACTW, INFLW, BRACNL, PPEDN, RAYL</td>
<td>1.000</td>
</tr>
<tr>
<td>SCALL, SPKLTW, ACHNL, ASRAT, CIRAT, BCRAT</td>
<td>1.000</td>
</tr>
<tr>
<td>SCALL, ACHNL, BCRAT, CIRAT, BRACTW, INFLW, BRACNL, RAYL</td>
<td>0.993</td>
</tr>
<tr>
<td>SCALL, SPKLTW, ACHNL, ASRAT</td>
<td>0.993</td>
</tr>
<tr>
<td>SPKLTW, CIRAT, ASRAT, BCRAT</td>
<td>0.993</td>
</tr>
<tr>
<td>SCALL, SPKLTW, ACHNL, ASRAT, BCRAT</td>
<td>0.993</td>
</tr>
<tr>
<td>SCALL, ASRAT</td>
<td>0.993</td>
</tr>
<tr>
<td>SCALL, CIRAT</td>
<td>0.993</td>
</tr>
<tr>
<td>SCALL, BCRAT</td>
<td>0.993</td>
</tr>
<tr>
<td>SCALL, SPKLTW, ASRAT, CIRAT, BCRAT</td>
<td>0.986</td>
</tr>
<tr>
<td>SCALL, SPKLTW, ACHNL, BCRAT</td>
<td>0.986</td>
</tr>
<tr>
<td>SCALL, SPKLTW, ACHNL, CIRAT</td>
<td>0.986</td>
</tr>
<tr>
<td>BCRAT, CIRAT, BRACTW, INFLW, BRACNL, RAYL</td>
<td>0.981</td>
</tr>
<tr>
<td>SPKLTW, CIRAT</td>
<td>0.981</td>
</tr>
<tr>
<td>SPKLTW, BCRAT</td>
<td>0.980</td>
</tr>
</tbody>
</table>

Additionally, the qualitative character, scale shape, was observed to be markedly and consistently different between the two taxa and is included in the dichotomous key.

In summary, of the six key characters used by Denton (1978), we found three (SCALL, SPKLTW, ASRAT) to be highly reliable and concur with their relative placement in Denton’s dichotomous key. Because of substantial overlap between the two taxa, Denton’s remaining three key characters (PPEDN, RAYL, LEAFW) proved to be of limited use in our study. Additionally, we have identified four other taxonomically useful characters: ACHNL, BCRAT, CIRAT, and floral scale outline.

CONCLUSIONS

Results of PCA and DA show six characters are taxonomically useful in separating *Cyperus drummondii* and *C. virens*. These in ranked order as determined by PCA and DA are SCALL, SPKLTW, ACHNL, ASRAT, BCRAT, and CIRAT. Additionally, we have determined that the qualitative character, scale outline, is useful in separating the two taxa. Further, the discrete clusters obtained in PCA indicate *C. virens* and *C. drummondii* are distinct in the southeastern United States and support recognition of *C. drummondii* at the rank of species as follows.
TAXONOMIC TREATMENT

Key to *Cyperus virens* and *Cyperus drummondii*

1. Floral scales oblancoolate, at least 1.7 mm long; spikelets at least 2.25 mm wide; achenes less than 0.7 times as long as subtending floral scale; achenes 1.2–1.5 mm long; longest primary inflorescence bract length at least 0.45 times as long as culm; culm less than 8 times longer than inflorescence width; primary peduncles 5–10. ................................................................. 1. *C. virens*

1. Floral scales ovate, less than 1.7 mm long; spikelets less than 2.25 mm wide; achenes at least 0.7 times as long as subtending floral scale; achenes 1.1–1.2 mm long; longest primary inflorescence bract less than 0.45 times as long as culm; culm (8-)10–33 times longer than inflorescence width; primary peduncles 3–5. ........................................................................... 2. *C. drummondii*

1. *Cyperus virens* Michx., Fl. Bor.-Amer. 1:28. 1803. (Fig. 2). Type: "Carolina," Herb. A. Michaux (holotype: P, microfiche).

Cespitose perennial herb. Roots fibrous, reddish brown. Culms 16–100 cm high, 3–13 times longer than inflorescence width, 2.4–6.9 mm wide, triquetrous, scabrid. Leaves basal, blades 3.5–13.2 mm wide. Primary inflorescence bracts 4–8, longest 17–75 cm long, up to 0.3–1.5 times as long as culm, 2.7–13.2 mm wide. Inflorescence usually diffuse, (4.2–)7–18.4 cm wide, rays 5–10, longest 2.4–12 cm long. Spikes globose, 1.2–7.3 cm wide. Spikelets flattened, 1.7–3.2 mm wide. Floral scales 12–38, distichous, spreading to ascending, bincarinatate, oblancoolate, (1.35–)1.9–2.4 mm long, pale grayish-green, turning brown. Stamens 1–2, anthers 0.8–1.3 mm long. Style 3-branched, exserted, deciduous. Achene oblong-ellipsoidal, 2.7–4.1 times as long as wide, (0.9–)1.2–1.5 × 0.3–0.4 mm, trigonous, stipitate, brown.

*Distribution and habitat:*—Widely distributed in the New World: southeastern United States, Caribbean, Mexico, Central America, and South America (Denton 1978; Kükenthal 1935–1936). In the coastal plain of the southeastern United States, from Texas through Florida into North Carolina (Fig. 3). Common in a variety of disturbed, low, intermittently wet habitats, such as ditches, stream bottoms, edges of ponds and lakes.

*Phenology:*—Flowering and fruiting April through December.

Fig. 2. *Cyperus drummondii*: A. Inflorescence. B. Floral scale and achene. C. Spikelet. Drawn from Carter 10738 (ctb). *Cyperus viridius*: D. Inflorescence. E. Floral scale and achene. F. Spikelet. Drawn from Carter 6964 (ctb). G. Habit: *C. viridius* (left) and *C. drummondii* (right).
Distribution of *Cyperus virens* in the United States.


Cespitose perennial herb. Roots fibrous, reddish brown. Culms 35–170 cm high, (8–)10–35 times longer than inflorescence width, 2–4.7 mm wide, triquetrous, scabrid. Leaves basal, blades 2.4–11.2 mm wide. Primary inflorescence bracts 3–5, longest 11.3–47.9 cm, up to 0.523 times as long as culm, 1.9–6.7 mm wide. Inflorescence usually tight, 2.1–8(–11.9) cm wide, rays 3–5, longest 0.9–7.7 cm long. Spikes globose, 1.1–7 cm wide. Spikelets flattened, 1.5–2.2 mm wide. Floral scales 18–42, distichous, spreading to ascending, bicarinate, ovate, 1.4–1.6 mm long, pale grayish-green, turning brown. Stamens 1–2, anthers 0.8–1.2 mm long. Style 3-branched, exserted, deciduous. Achene trigonous, oblong-ellipsoidal, 2.4–3.9 times as long as wide, 1.0–1.2 × 0.3–0.5 mm, stipitate, brown. Fig. 2.

Distribution and habitat.—Southern Georgia and northern Florida westward through southern Mississippi and southern Louisiana into southeastern Texas (Fig. 4). Also, known from Nicaragua, Jamaica, Surinam, Ecuador (Galapagos Islands), and Brazil (Kükenthal 1935–1936; Denton 1978). In the southeastern United States, found in the lower coastal plain along the margins of flatwoods ponds, seepage slopes, and coastal prairies.

Phenology.—Flowering and fruiting May through October.

Because of its greater height and tighter inflorescence Cyperus drummondii has a strikingly different habit from C. virens; this is best observed in the field. Cyperus drummondii does not appear to be as weedy as C. virens. Cyperus
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*virens* is much more common and widely distributed in the southeastern United States, occurring in a variety of low wet disturbed habitats, especially ditches. In contrast, *C. drummondii* is less common and tends more to be restricted to less disturbed systems such as margins of flatwoods ponds, seepage slopes, and coastal prairies. Also, as summarized in the key, *C. drummondii* differs from *C. virens* in its narrower spikelets, greater achene length to scale length ratio, ovate scales, and fewer primary inflorescence bracts.


ACKNOWLEDGMENTS

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REFERENCES


Carter et al., Taxonomy of Cyperus virens and drummondii


BOOK NOTICE


This text is a comprehensive resource for the study of population genetics and population ecology. Now in its 15th year, it has been reorganized into three parts that explore I) Basic principles of genetics, II) Population biology, and III) The interrelationship between these two fields. In each chapter you will find theoretical explanations, case studies, examples for relevant models, and graphics selected to highlight important topics. Short problem sets at the end of each chapter provide students the opportunity to practice using the models presented in the text. Part one provides students with a solid foundation in the field of genetics, with discussions covering major topics such as chromosomal variation, the Hardy-Weinberg Principle, and gene flow. The section on Population Biology begins with a discussion of factors influencing species distribution and abundance, and of population density and dispersion before entering into a discussion of demography. This provides a useful context for understanding growth models and population dynamics. A thorough presentation of interspecific competition, predator-prey interactions, and the theoretical models used to describe these processes concludes part two. Part three builds on lessons from the first parts of the book to explore major topics in the fields of evolutionary ecology, ecological genetics, and applied population biology. The text illustrates the combined use of established theories and models with modern technologies to solve current problems in ecology or applied biology. It is a useful resource for students of genetics, ecology, and evolutionary ecology alike.

STRIKING SEXUAL DIMORPHISM IN *LINDERA SUBCORIACEA* (LAURACEAE)

LORAN C. ANDERSON

Department of Biological Science
Florida State University
Tallahassee, FL 32306-1100, U.S.A.

ABSTRACT

Male and female flower morphology is documented for Florida plants, augmenting the original floral analysis of this rare, dioecious species (*Lindera subcoriacea*). Sexual dimorphism is readily apparent; leaves on male plants are much larger than those on female plants. Leaf surfaces of the two sexes also contrast strongly in features of trichome size, epicuticular wax (abundance and pattern), and development of peristomatal rims. Such dimorphism has not been previously reported for the Lauraceae.

RESUMEN

Se documenta la morfología de flores masculinas y femeninas de *Lindera subcoriacea* en plantas de Florida, aumentando el análisis floral de esta especie rara y dioica. El dimorfismo sexual es muy aparente; las hojas de las plantas masculinas son mucho mayores que las de las plantas femeninas. Las superficies foliares de los dos sexos también contrastan fuertemente en cuanto a las características del tamaño de los tricomas, ceras epicuticulares (abundancia y patrón), y desarrollo de los bordes peristomáticos. Este dimorfismo no había sido citado previamente en las Lauraceae.

INTRODUCTION

Wofford described *Lindera subcoriacea*, the bog spice bush, in 1983. This species is now known to occur in at least eight states, ranging in coastal states from Louisiana to Florida north to Virginia (Bridges & Orzell 1989; Bryson et al. 1988; McCartney et al. 1989; Sorrie 1993). Although the range appears extensive, the plant is nowhere common. Most occurrences consist of one or a few plants. McCartney et al. (1989) signaled its possible presence in Florida by listing some peninsular populations as “*Lindera affin. subcoriacea*.” Sorrie (1993) stated they have proven to be *L. benzoin* (L.) Blume, but these problematic peninsular plants need further study. Unequivocal *L. subcoriacea* was reported by Anderson (1995) from a population in the Florida panhandle.

More attention to the Florida panhandle plants is warranted because Wunderlin (1998) did not list the species for Florida, and additional field surveys since the initial report (Anderson 1995) have revealed new dimensions in the species’ morphology.
MATERIALS AND METHODS

The original plant upon which the Florida panhandle record was based (Anderson 1995) was destroyed by brush removal under the Cliftonia canopy along Metts Creek in Okaloosa County shortly after the collection was made. Intensive survey along Metts Creek and nine similarly nearly pristine clearwater streams in the general area (on Eglin Air Force Base) for additional bog spice bushes yielded a count of 12 plants (six of each sex, restricted to Metts Creek). James R. Burkhalter collected a sample (originally identified only as Lindera) from a presumably male shrub (sterile) on the campus of the University of West Florida in Escambia County. After being alerted to its identity, he searched the area thoroughly and reported (pers. comm.) that the plants were no longer extant as a result of habitat alteration.

Flowering materials were preserved in FPA (5 pts formalin, 5 pts propionic acid, 90 pts 70% ethanol). Living plants were tagged at blooming time so that they could be more easily located later in the season. Samples with mature leaves were taken from only a few plants because of the species' rareness. Vouchers are at FSU unless otherwise noted. Leaf morphology (of the largest leaf per specimen) was studied from samples representing the geographical range of the species. Leaf samples were cleared in NaOH and stained in safranin for study of venation and trichomes. Other samples were sputter coated with gold palladium, and micrographs were taken on a Joel JSM-840 scanning microscope operated at 10KV.

RESULTS

Wofford (1983) reported the plants were up to 2 m tall (his original description was based solely on specimens from Mississippi and Louisiana as this species was not known to occur elsewhere at that time), whereas Sorrie (1993) said that in North Carolina the plants grew up to 4 m tall and were multistemmed. At Metts Creek (Florida) the blooming shrubs were 1.5–4.2 m tall with only 2–4 stems per clump. These deciduous shrubs bloom in mid-March (as they do in Mississippi) before leaf development.

Florida flowers of this diocious species differ in several aspects from Wofford's description. Some of the differences in size may have arisen because his measurements came from restored (boiled) flowers, whereas mine came from preserved flowers. Wofford (1983) stated flower buds were ca. 2.5 mm wide and tepals were 2.2 by 1.8 mm. Further, in staminate flowers, stamens were 2.5 mm long, and the pistillodium was 1.2 mm long (Wofford 1983). In our plants, staminate flowers were generally larger (2.8–3.2 mm long by 3.8–4.5 mm wide at anthesis); outer tepals were 2.4–2.8 by 1.8–2.0 mm, whereas inner tepals were slightly smaller (2.2–2.5 by 1.5–1.7 mm). The nine stamens were 2.7–2.9 mm long; the innermost series of three had a
pair of stalked (1 mm) glandular outgrowths. The glandular heads were 0.8 mm wide and had 3–4 irregular lobes.

The original description (Wofford 1983) stated pistillate flowers were on pedicels 1.5 mm long, with tepals slightly smaller that those of staminate flowers, and stamens (staminodes) variously developed, often reduced to glands. The style was 1 mm long, and the ovary elliptic and 1.0 by 0.6 mm. In our plants, pistillate flowers were on pedicels 1.5–2.5 mm long. Flowers were 1.8–2.2 mm long (style excluded) by 2.2–2.6 mm wide. The outer tepals were 2.0–2.2 by 1.1–1.4 mm, and the inner tepals were 2.0 by 1.4–1.5 mm (relatively wider than the outer tepals). The six outer staminodes (in two series) were reduced to naked filaments 1.4 mm long (no vestige of anthers), whereas the three innermost staminodes (also filaments 1.4 mm long) had a pair of flattened, stalked glands fused basally to the filament. The glands differed from those of the staminate flowers in that the heads (0.8 mm wide) were broadly cordate and lacked irregular lobes. Styles were 1.4–1.8 mm long and often curved. The elliptic ovaries were 1.6–1.8 mm long by 0.9–1.0 mm wide. Mature fruits were scarlet, elliptical, and 10 mm by 6 mm.

Wofford and Sorrie both gave the same range of 4–7.5 cm long by 2–3.5 cm wide for leaves of L. subcoriacea (Fig. 1). Leaves of female shrubs in the Metts Creek population fall in that size range; the largest leaves per sample (usually the penultimate on any given branch) measured 5.6–6.8 cm long by 2.4–2.8 cm wide (Figs. 2–4). This dioecious species exhibits sexual dimorphism, however; leaves on the male shrubs are 9.0–10.5 cm long by 3.5–4.6 cm wide (Figs. 5–7). The ranges in leaf size of the two sexes are almost completely nonoverlapping, if one discounts the very small broadly obovate leaves that occur basally on the branches (they are 1–2 cm long on female shrubs and 3.3–5 cm long on male shrubs). Incidentally, female plants of L. benzoin var. pubescens from Florida have leaves larger than any seen in L. subcoriacea.

Mature leaves were dark green adaxially, whereas the abaxial (undersurface) area was generally pale, grayish, glaucescent, and moderately appressed pubescent. Venation is brochidodromous (Figs. 1–7; Hickey 1979), and the areoles are well developed. Trichomes were nonglandular and unicellular (Figs. 8–9), as is typical for the Lauraceae (Metcalfe & Chalk 1979). Average trichome length on leaves of four Florida female shrubs ranged from 0.19 to 0.22 mm long [and 0.23 on Wofford 82–121 (TENN), an isotype], whereas trichomes on Florida male shrubs averaged 0.29–0.32 mm long. The longer trichomes on male shrubs also appear to be somewhat thicker than those on female shrubs (Figs. 11–13).

Stained, partially cleared leaves showed the epidermal cells were thin-walled; stomatal guard cells were 24–26 μm long, and the stomata were paracytic (similar to those of fossil forms of Lindera illustrated by Bandulska
The two subsidiary cells tended to be unequal in size on female leaves; one cell was somewhat rectangular and lay parallel to the guard cell, whereas the other subsidiary cell was more triangular in outline. Conversely, stomata on male leaves had more evenly shaped, triangular subsidiary cells.

The grayish appearance of the leaf undersurface was due to wax accumulation more than to indumentum (Figs. 10–16) as demonstrated by scanning electron microscopy (SEM). The thick layer of cuticular wax obscures epidermal cell outlines. A papillose abaxial leaf surface is characteristic of the Lauraceae (Metcalfe & Chalk 1979). The stomata on L. subcoriacea leaves are sunken and surrounded by prominent stomatal rims; peristomatal rims are also evident—see Wilkinson (1979) for overview of these stomatal structures. Stomatal rims and peristomatal rims may prove to be frequent among woody taxa that have relatively firm (subcoriaceous) leaves in the southeastern United States flora; elaborate rims have also been reported for Gordonia (Anderson 1983) and Sideroxylon (Anderson 1996).

Sexual dimorphism is also evident at the micromorphological level. Leaves of female plants have extensive epicuticular wax papillae over the epidermal cells and the massive peristomatal rims (Figs. 10–12, 14–15). Leaves of male plants have scattered epicuticular flecks of wax that do not hide the cuticle, and peristomatal rims are not massive, but are present as 1–3 ridges lying parallel to the long axis of the stomatal rim (Figs. 13, 16).

Unisexual flowers are, by definition, dimorphic, but in L. subcoriacea the
Fig. 8–16. Electron micrographs of leaf surfaces in *Lindera subcoriacea*. Figs. 8–9. Venation and trichomes, × = 100. Fig. 10–13. Leaf surfaces showing cuticle and stomatal features, × = 500. Fig. 8. Leaf from female plant, *Anderson 14452*. Fig. 9. Leaf from male plant, *Anderson 14921* showing trichomes slightly longer and thicker than those on female leaf (Fig. 8). Fig. 10. Female from George Co., MS, Wofford 82-121 (TENN, isotype). Fig. 11. Female from Hoke Co., NC, *Carter s.n.* Figs. 12. Female from Okaloosa Co., FL, *Anderson 14452*, showing nearly continuous layer of epicuticular papillae and large peristomatal rims (as in Fig. 10–11). Fig. 13. Male from Okaloosa Co., FL, *Anderson 14921* showing scattered epicuticular flecks, reduced development of peristomatal rims, and thicker trichomes (than female leaves, Fig. 10–12). Fig. 14. Leaf surfaces of *Anderson 14452* (female plant) showing massive peristomatal rims covered with epicuticular papillae with stomatal rim barely visible, × = 1500. Fig. 15. Portion of Fig. 14 showing detail of epicuticular papillae and part of stomatal rim with the peristomatal rim, × = 3500. Fig. 16. Leaf surface of *Anderson 14921* (male plant) showing sparse epicuticular flecks of wax and partial development of peristomatal rim (forming brackets or ridges parallel to the stomatal rim), × = 1500.
dimorphism extends to nonsexual parts of the flower with the different shapes of glandular heads on staminodes. Sexual dimorphism in the Florida plants is expressed vegetatively in leaf size, trichome length, epicuticular wax patterns, stomata (subsidiary cells), and peristomatal rim development. Vegetative sexual dimorphism has been reported for *L. benzoin* (Cipollini & Whigham 1994), in which leaves on male shrubs averaged 1.3 times longer than those on female shrubs. In *L. subcoriacea* the dimorphism is more pronounced; male leaves average 1.7 times longer than those on female shrubs. Apparently, vegetative sexual dimorphism at the microscopic level has not been previously reported for *Lindera* or any other dioecious members of the Lauraceae (Wood 1958; van der Werff 1991).

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REFERENCES


NEW PLANTS FROM PAPUASIA. NOVELTIES FROM THE LAKEKAMU AND BISMARCK-RAMU EXPEDITIONS

W. TAKEUCHI

Botanical Research Institute of Texas
c/o Lae National Herbarium and
Papua New Guinea Forest Research Institute
P.O. Box 314, Lae, PAPUA NEW GUINEA

ABSTRACT

Two species are formally described from the 1996 survey of the Lakekamu basin. The new plants are Medinilla sapo-riverensis (Melastomataceae) and Trichospermum stevensii (Tiliaceae). Medinilla bismarck-ramuensis is described from the 1995 biological survey of the Bismarck-Ramu tract. Taxonomic and ecological notes are provided with the diagnoses.

INTRODUCTION

The Lakekamu basin was botanically surveyed between October 14 and November 12, 1996, as part of a general biological assessment organized by Conservation International and the Foundation for People and Community Development. The survey territory is regarded as one of Papua New Guinea's 16 terrestrial unknown areas (Sekhram & Miller 1995: 114) and is also ranked among the highest value sites for biodiversity preservation in Papuasia (ibid: 121). A synopsis of scientific results from the expedition was previously published (Mack 1998). The present paper provides a formal description for two of the plants listed as new species in the earlier publication (Takeuchi & Kuluang in Mack 1998).

A third species (Medinilla bismarck-ramuensis) is described from an expedition reviewed by Hedemark et al. (1997) and Takeuchi (1999).

DESCRIPTION OF NEW SPECIES

MELASTOMATACEAE

Medinilla bismarck-ramuensis Takeuchi, sp. nov. (Fig. 1). TYPE: PAPUA NEW GUINEA. WESTERN HIGHLANDS PROVINCE: Bismarck Range, Mt. Oibo, ridgeline
Fig. 1. Medinilla bismarck-ramuensis Takeuchi. A. Vegetative habit. B. Leaf and petiolar auricles. C. Inflorescence: flowers obscured by bracts. D. Cyme. E. Major stamen; perspectives from the bud. Drawn from the type by N.H.S. Howcroft.
near 'Camp 1,' GPS 05° 35.513' S, 144° 47.252' E, elev. 2,357 m, 4 Oct 1995 (fl), W. Takeuchi 10,408 (holotype: LAE; isotypes: A, K, L).

Medinillae schlchteri Mansf. et al. mansfeldiana Merrill & Perry affinis sed abica petiolis auriculatis differt.

Erect epiphytic shrub to 2 m in height. Branchlets robust, terete, obliquely ascending, indumentum setiform, spreading or subpressured, ± dense; nodal innovations crowded, setose, acroscopic, 10 mm long, glabrous and smooth or at most obscurely plumulose near the base. Leaves isomorphic; blades fleshy or coriaceous, elliptic or broadly lanceolate, 13.8–20.0 cm × 4.3–9.0 cm, apex acute or gradually acuminate, base equal, cuneate to obtuse, margin entire, not or hardly reflexed, lamina epunctate, bichromatic, adaxial surface dark opaque green, abaxially pale purple-suffused, bifacially alveolate in sicco; venation 5–7 plinerved, ventrally prominulous, more or less channelled, raised dorsally and distinctly purple, the lateral pairs of veins diverging from at most 22 mm above the base, at first subsericeous, progressively setose towards the petiole, later glabrate on the mature lamina, reticulating nerves invisible; petioles to 25 mm long, setose, proximally alate, the wings paired, auriculiform, to 31 mm × 15 mm, foliaceous, the margins usually entire, rarely erulose, surfaces purple and glabrous. Inflorescence dichasial, 2–12 cm long, solitary or fascicled, variably inserted, infrafoliolar and lateral to cauline, occasionally from the axils of attached leaves, all parts dark reddish-purple except for the corolla, rachises cernuous, terete, not or only sparingly branched, setulose at nodes, glabrous in between, conspicuously and persistently bracteate; bracts geminate, orbicular, ca. 8 mm broad, involute, infrequently with margins distantly fimbriate, surfaces glabrous, venulose, nervation anastomosing; pedicels 3–4 mm, subtended by paired bracteoles. Flowers (measurements from spirit-preserved material) acute in bud; hypanthium setose, cupuliform-ovoid, typically 5 mm × 4–5 mm, margin denticulate or irregularly notched; corolla 5-merous, choripetalous, white, imbricate, petals 13 mm × 9 mm, asymmetric; stamens 10, glabrous, isomorphic but of differing lengths, 5 long stamens alternating with 5 short ones, the longer outer stamens: filament ca. 2.3 mm, anthers ca. 4.1 mm; shorter inner stamens: filament ca. 1.9 mm, anthers ca. 3.0 mm; all stamens with anthers at first inwardly retrorse and contiguous with the filament, dorsally ecalcarate or nearly so, ventral appendages minute; style 7–8 mm long, glabrous, cylindric, apically tapering, stigma discolorous and punctiform. Fruits not seen.

Distribution and ecology.—Medinilla bismarck-ramuensis is known only from montane forests in Western Highlands and Morobe Provinces. The type was found as scattered plants in fog-swept clearings, growing on mossy stumps and logs.

Etymology.—The new species commemorates the 1995 Bismarck-Ramu expedition.
Medinilla is comparable to Cystandra in its pattern of endemic diversification. Even at the time of the first revision of Papuan taxa (Mansfeld 1925), Medinilla was already one of the larger woody genera, with a conspectus of 53 species. Merrill and Perry (1943) later added 16 species using a key patterned on Mansfeld. Baker (1916), Ohwi (1943), and Bakhuizen (1943) also contributed species from the Wollaston expedition, the Kanchira-Hatusima collections, and Dutch New Guinea, respectively. Numerous contemporary gatherings cannot be accommodated by these earlier contributions, suggesting that the number of undescribed species is substantial.

In Mansfeld (1925: 115–18) the new species will key to M. schlechteri Mansfeld. Unlike most treatments from the ‘Beiträge zur Flora von Papuasien’ series, Mansfeld's key is written in Latin rather than German. Although outdated, Mansfeld's treatment still stands as the most comprehensive available account. Medinilla bismarck-ramuensis can be inserted into the couplet train at species 50, in the following manner:

Folia supra glabra, subitus nervis pilis nonnullis vestitis
Petiolus auriculatus: ........................................ Medinilla bismarck-ramuensis Takeuchi
Petiolus non auriculatus: ........................................ Medinilla schlechteri Mansfeld

In Merrill and Perry (1943: 427–28), M. mansfeldiana Merrill & Perry is the closest match to the new species, but the longer and manifestly auricled petioles on M. bismarck-ramuensis are distinctive. The novelty's affinity is actually to a group consisting of four species (fork G, ibid: 427).

Medinilla bismarck-ramuensis may be connected to the complex characterized by persistent bracts and bracteoles, and regarded by Merrill and Perry (ibid: 422) as comprising a distinct section. In Papuaasia, this alliance is characteristic of the archipelagic stations from New Britain to the Solomons and (unlike the new species) is usually markedly anisophyllous. It was not previously thought to occur on the New Guinea mainland.

Medinilla sapoi-riverensis Takeuchi, sp. nov. (Fig. 2). Type: PAPUA NEW GUINEA, Gulf Province: Lakekamu, near Sapoi River, first ravine on the track above Ivimka Research Station, 07° 44' S, 146° 30' E, elev. 183 m, 22 Oct 1996 (fr, lfr), W. Takeuchi & J. Kulang 11,398 (holotype: LAE; isotypes: A, BISH, BRIT, CANB, K, L).

Medinilla warica Mansfeld similis sed inflorescentis non terminalibus.

Epiphytic shrub, ascending or with branches extended and hanging. Stems quadrangulate, tetramerous, weak, hollow, surfaces green, minutely and distantly stellate-furfuraceous on apical intervals, older parts glabrous and pustulate, nodal innovations light-brown setose, 15–25 mm long, the youngest ones
Fig. 2. Medinilla sapoi-riverensis Takeuchi. A. Vegetative habit. B. Immature infructescence. C. Mature infructescence. D. Flower, showing 3 petals, 2 stamens, and the style; other parts removed for clarity. E. Fruit. Drawn from the type by N.H.S. Howcroft.
somewhat plumulose but with the hairs fugacious. *Leaves* equal, obliquely diverging; blades linear-elliptic or narrowly lanceolate, subcoriaceous, 23–33 cm × 5.2–8.0 cm, adaxial surfaces opaque green, abaxially pale green; apex attenuate, prolonged into a filiform cauda or not, margins reflexed, base cuneate to obtuse, lamina reddish-purple in flush, initially stellate-pubescent on veins, glabrous when mature; venation 5-plinerved, the lateral pairs diverging from less than 12 mm above the petiole, raised on both sides, tertiary nervation transversal, scalariform, ventrally prominent; petiole 8–15 mm long, glabrescent. *Inflorescence* ramigerous, paniculiform, ultimately cymose, lax, pendulous, 10–18 cm long, ternate or quaternate on the first order ramification, lateral branches to 4 cm long, all axes nitid, red, flaccid, delicate, inconspicuously and stellately pubescent, eventually glabrate; floral bracts linear, persisting, hardly visible; pedicels 1–3 mm long. *Flowers* (measurements from spirit-preserved material): hypantherium cylindrical to narrowly ovoid, 3.0–3.5 mm × 2.5–2.8 mm, margin truncate or 4-denticulate, exterior surfaces light green, at first very sparsely lepidote like the pedicel, glabrate at anthesis; corolla 4-parted, acute in bud, petals pink, reflexed, ecoscate, asymmetric, distally oblique, apiculate, 4.0 mm × 2.5–2.8 mm; stamens 8, equal, glabrous, filaments 2.3–2.6 mm long, apically attenuate, anthers 1.9–2.0 mm long, distinctly calcarate and bi-appendiculate, dorsal spur ca. 0.4 mm long, linear, basally directed, ventral appendages lobulate, introrsely projecting, deltoid, ca. 0.2 mm long; style 6.5–6.9 mm long, stigma discolorous and punctiform, receptive surface obscurely papillate. *Fruit* globose, 5–6 mm in diameter, baccate, polyspermous, exocarp green turning black when ripe; seeds oblongoid, 1.0–1.2 mm × 0.5 mm, testa pale, verruculose.

**Distribution and ecology.**—Known with certainty only from the type locality. *Medinilla* *spai-riverensis* is infrequent in natural growth foothill forest, favoring mainly the wetter sites afforded by dark draws and gullies, especially near flowing creeks with closed overstories. It is shade-loving and does not occur in sewer situations. A collection from Western Province (*Henty et al. in NGF* 42788) may be *M. spai-riverensis*, extending its range further west towards the border with Irian Jaya. The vegetative characters are consistent with the new species, but the specimen lacks the fertile structures required for reliable identification.

**Etymology.**—*Medinilla* *spai-riverensis* is named after the type locality in the Lakekamu basin.

*Medinilla* *spai-riverensis* is distinguished by its elongate leaves and quadrangular-aleate branchlets. Other salient characters are the lax, pendulous inflorescences with verticellate branching. Innovations are setose at older nodes and only caducously plumulose in the apical tufts.

*Medinilla* *spai-riverensis* keys to *M. warica* Mansfeld (Mansfeld 1925) but
the latter species has a terminal inflorescence. There is also an apparent affinity to *M. mansfeldiana* Merrill & Perry, and *M. schlechteri* Mansfeld. The new species differs from *M. mansfeldiana* by the nature and density of the indumentum, length of the inflorescence, and size of the bracts. From *M. schlechteri*, it differs in having clearly petiolate leaves, smaller bracts, and escose calyces.

**TILIACEAE**

*Trichospermum stevensii* Takeuchi, sp. nov. (Fig. 3). **Type:** PAPUA NEW GUINEA

Gulf Province: Lakekamu, Sapoi River, streambanks near base camp, 07° 44' S, 146° 29.5'E, elev. 105 m, 7 Nov 1996 (fl bud, fr, xylarium collection), W. Takeuchi & J. Tak'ucbi<br>

Folia subter consperce stellato-pilosa et costa media nervisque minute stellato-lepidotis differt.

Small tree to 8 m tall. **Stem** without buttress or basal swell, exterior surfaces pale grayish-brown, un fissured, not lenticellate; bark thick, fibrous, extractable in flexible strips or plates; wood white, weak, very light in weight. **Branchlets** flexuous, terete, sparingly mucilaginous from cut surfaces, pithy, indumentum stellate, squamulate, scales dark brown, at most 0.3 mm diameter, coarsely-armed, crowded, occasionally accompanied by larger ascending hairs especially at the stem apices. **Stipules** caducous or persisting through several nodes, oblong-ovate, typically 10 mm × 4 mm, rarely to 14 mm × 10 mm, foliaceous, yellow-green, cordately-based or auriculate, proximally and laxly provided with indumentum like the branchlets, otherwise glabrescent. **Leaves** distichous, membranaceous, adaxially dark dull green, abaxially medium green and marked by opaque punctations, ventral surfaces puberulous, the hairs simple or stellate, following veins, dor sal surfaces stellate-pilosulous, hairs 4–8 armed, ascending, processes short, ca. 0.2 mm long, the midrib also provided with a secondary indumentum of smaller appressedly stellate scales; mature blades oblong, weakly con stricted near the middle, 22–32 cm × 10.5–14 cm; apex long-acuminate, more or less abruptly developed, the acumen 2.0–3.5 cm long; leaf margins entire to the naked eye, remotely and minutely toothed under magnification, serrations glandular-thickened from excurrent nervules; leaf base truncate or more commonly broadly cordate, the sinus when present to 1.5 cm deep, basal glands marginal, occurring as linear callosities flanking the petiole insertion; lateral veins 7–9 above a basal nervation, often in opposite pairs, acutely diverging (ca. 45° from the midrib), generally straight, ending in commissural looping nerves or not, major veins plane or hardly raised ventrally, dorsally prominulous and with primary axils stellately comose, higher order axils clear, intercostals obliquely scalariform, tertiary venation lax; petiole 14–25 mm long, unchannelled, indumentum as the branchlets. **Inflorescence** axillary, to 8.5 cm length, axes texturally scabrid, variably covered by stel late scales and occasional interspersed hairs, rachides unequal, often fractiflex,
Fig. 3. Trichospermum stevensii Takeuchi. A. Flowering branchlet. B. Mature leaf. C. Vegetative branchlet and stipules. D. Infructescence. E. Dehisced fruits. F. Detail of capsule from side. G. Capsule hairs, showing the 2 stellate types discussed in the text. Drawn from the type by N.H.S. Howcroft.
bifurcate or ternate at the first branch, ultimately cymose, peduncle 5–30 mm long; bracts deciduous, free, linear-acuminate or ligulate, usually 2–3 mm long, sparsely stellate-hairy, the cymes subtended by 6 bracteoles. Flowers not seen at anthesis, immature buds (all measurements from rehydrated material) ovoid to subglobose, 4.5–5.5 mm × 5.5–6.0 mm, yellow-green; sepals 5, valvate, fleshy, ovate, 5 mm × 3 mm, outer surfaces coarsely and minutely stellate-hairy, inside non-stellately pilosulous with submoniliform hairs; corolla included, imbricate, 5-choripetalous, chartaceous, reticulately venose, elliptic to oblong, ca. 4 mm × 2 mm, dorsally with indumentum like the contiguous calycine surface, ventrally glabrate; androecium polyandrous, congested, glabrous, anthers medifixed, arcuate; ovary compressed, pulverulent, style 4-lobulate; receptacle pilose; pedicels ca. 1.5 mm long. Capsules 2-celled, loculicidal, polyspermy, distinctly broader than long, 13–15 mm × 20–23 mm, compressed but with otherwise weakly inflated lobes, summit retuse, style persisting, capsular base obscurely stipitate, androecium residue present on the fruit, valves 2, thin-crustaceous, marginate, brownish-green turning black after seed dispersal, persistently and basally connate, inside glabrous, smooth or intermittently striate, outside somewhat harshly tomentulose, the indumentum stellate, dimorphous, bilayered, the larger hairs lax, 4–8 armed, processes 0.5–1.0 mm long, radiate, underneath with a congested layer of coarse scales 0.3 mm diameter. Seeds obovate or oblanceolate, dorsally convex and ventrally ± cotylid, ca. 1.4 mm × 1.0 mm, testa brown, shaggy-fimbriate on equatorial margins, fimbriate fulvous, 3–4 mm long.

Distribution and ecology.—Trichospermum stevensii is thus far known only from lowland rainforests of Gulf Province. The new species is characteristic of regrowth environments such as gaps, landslides, forest margins, and surge zones along open streambeds. It is most commonly seen in association with various species of Macaranga, or as a co-dominant in early riverine successions. Nearly all sightings were in sterile condition during the survey.

Etymology.—The new species is named after Professor P.F. Stevens, an authority on the Malesian flora and a specialist in Eriaceae and Clusiaceae.


In Kostermans’ (1972) revision of Trichospermum, T. stevensii arguably keys closest to the extra-Papuasian T. morotatensis Kosterm. and T. fosbergii Kosterm. Although Kostermans’ reliance on underleaf indumentum is useful for primary separations, Trichospermum stevensii falls between the cracks on the first order couplets. It is nearest to fork 1c (ibid: 405–406) but the combination of dorsal scales with scattered, erect hairs is not covered by any of the prin-
principal leads. The strictest solution for integration into the existing key is to introduce another descriptor for the new species, as follows:

1f. Lower leaf surface squamulate on costae, and with scattered, erect stellate
   hairs on intervagina and higher order nervation ....................... T. stevensii Takeuchi

If the underleaf hairs on the new species are generously interpreted, it can be forced into Kostermans’ conspectus, in which case an apparent connection to T. morotatensis and T. fosbergii will emerge. Substantive distinctions in leaf and capsule size would still provide separation against the preceding taxa. Among Papuasian representatives, T. stevensii appears close to T. tripyxis (K. Schum.) Kosterm., but the latter species has trivalved capsules. The compressed bivalved fruits of T. stevensii also suggest affinity to T. pekelii Burret, but the indumentum is clearly inconsistent with that species. The type collection has branchlets with appressed stellate scales rather than the erecto-patent vestiture on most Papuasian taxa.

The bast of Trichospermum stevensii is very resilient; the entire bark is stripped in sheets from the trunk and the resulting mats applied as flooring by Lakekamu villagers. Other species of Trichospermum are noted for their fiber value (ibid: 403).

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REFERENCES


BOOK NOTICES


From dustjacket: "Wonders and the Order of Nature is about the ways in which European naturalists from the High Middle Ages through the enlightenment used wonder and wonders, the passion and its objects, to envision themselves and the natural world. Monsters, gems that shone in the dark, petrifying springs, celestial apparitions—these were the marvels that adorned romances, puzzled philosophers, lured collectors, and frightened the devout. Drawing on the histories of art, science, philosophy, and literature, Lorraine Daston and Katharine Park explore and explain how wonder and wonders fortified princely power, rewove the texture of scientific experience, and shaped the sensibility of intellectuals. This is a history of the passions of inquiry, of how wonder sometimes inflamed, sometimes dampened curiosity about nature's best-kept secrets. Refracted through the prism of wonders, the order of nature splinters into a spectrum of orders, a tour of possible worlds."


Iran supports a total of around 8,000 plant species, and is one of the major centers of endemism (1,727 endemic in Iran) in that part of the world. The total number of listed taxa based on defined IUCN categories, endemics, vulnerable, and endangered is 2,405. For the category Vulnerable, 132 taxa are listed and 21 listed for Endangered. Contents for Red Data Book of Iran. A Preliminary Survey of Endemic, Rare & Endangered Plant Species in Iran: List of Figures, Introduction, The Phytogeographical Regions of Iran, Data Collection and Analysis, Results and Discussion, Concluding Remarks, Species Description, Appendix I, References, and Index. For each species, the following information is provided: Status (Endangered, Vulnerable, Lower Risk, Data Deficient; Life Form; Distribution; and Habitat. The book is printed on quality paper and the color paintings and photos are very nice.
A NEW VARIETY OF PINUS GREGGII
(PINACEAE) IN MEXICO

JEFFREY K. DONAHUE
Boise Cascade Corporation
P.O. Box 1060
DeRidder, LA 70634, U.S.A

JAVIER LOPEZ UPTON
Especialidad Forestal, IRENAT
Colegio de Postgraduados en Ciencias Agrícolas
Montecillo, Mex. 56230, MEXICO

ABSTRACT

A new variety of Pinus greggii is described. Variety australis is endemic to east central Mexico and represents the southern disjunct region of the natural range of the species. Variety greggii represents the northern population of the species. Characters that segregate the varieties are presented.

RESUMEN

Se describe una nueva variedad de Pinus greggii. La variedad australis es endémica del centro-este de México, y abarca la distribución natural austral de la especie. La variedad greggii representa la población localizada en el norte de su distribución natural. Se incluyen características que distinguen las dos variedades.

Pinus greggii Engelm. occurs in two disjunct regions in Mexico (Fig. 1) separated by approximately 300 km, or four degrees latitude. Northern and southern populations of P. greggii grow in distinct environments. Northern populations occur in the northern Mexico states of Coahuila and Nuevo Leon, at elevations ranging from 1900 to 2600 meters above sea level. The average annual temperature at the northern sites is 14॰ C, and they receive an average annual precipitation of 650 mm (Donahue & Lopez Upton 1996). Topsoils at northern P. greggii sites are predominately neutral or slightly alkaline (Donahue 1993).

Southern populations of P. greggii occur in the central Mexico states of Hidalgo, Puebla, Queretaro, San Luis Potosi and Veracruz at elevations ranging from 1100 to 2400 meters above sea level. The average annual temperature at the southern sites is 17॰ C, and they receive an average annual precipitation of 800–1600 mm (Donahue & Lopez Upton 1996). Topsoils at the southern P. greggii sites are predominately acidic (Donahue 1993).

A comprehensive study of the species began after differences in growth rate, needle length and needle color became apparent in genetic trials planted
in Brazil, Chile, Colombia, South Africa (Dvorak et al. 1996) and Mexico (Lopez Ayala 1998; Alba Landa et al. 1998), where trees from northern and southern populations were planted side-by-side. The differences observed in these field trials suggested that two distinct, unrelated taxa had been planted by mistake. Studies of geographic variation in leaf, cone and seed morphology, seed production and terpene chemistry were performed to determine what differences existed, and to quantify them. Results from our comprehensive study indicated that only P. greggii was included in the trials, but several character differences exist between northern and southern populations suggesting recognition taxonomically.

MATERIALS AND METHODS

Field sampling was done in six northern populations and six southern populations from a wide range of geographic locations and elevations (Table 1). Leaf specimens were collected from 172 trees, and cones from 177 trees of Pinus greggii. The samples were collected from the upper 1/3 of the crown from healthy dominant and co-dominant trees in the stands, at least 100 meters apart. Leaf and cone specimens were collected from five distinct as-
Table 1. Summary of the sampling of *Pinus greggii* sites included in the leaf, cone and seed morphology, seed production and terpene chemistry studies.

<table>
<thead>
<tr>
<th>Southern populations</th>
<th>Latitude-Longitude</th>
<th>Elevation (m)</th>
<th>Number of trees sampled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerro Perico, Hidalgo</td>
<td>20°44' N - 99°02' W</td>
<td>1830-1970</td>
<td>14 15 24</td>
</tr>
<tr>
<td>Laguna Atezca, Hidalgo</td>
<td>20°39' N - 98°36' W</td>
<td>1250-1420</td>
<td>15 15 16</td>
</tr>
<tr>
<td>Laguna Seca, Hidalgo</td>
<td>21°02' N - 99°10' W</td>
<td>1670-1830</td>
<td>12 12 0</td>
</tr>
<tr>
<td>El Madroño, Queretaro</td>
<td>21°16' N - 99°10' W</td>
<td>1650-1730</td>
<td>15 15 17</td>
</tr>
<tr>
<td>San Joaquin, Queretaro</td>
<td>20°56' N - 99°34' W</td>
<td>2310-2380</td>
<td>15 15 15</td>
</tr>
<tr>
<td>Valle Verde, Queretaro</td>
<td>21°29' N - 99°12' W</td>
<td>1150-1250</td>
<td>15 15 0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>86 87 72</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Northern populations</th>
<th>Latitude-Longitude</th>
<th>Elevation (m)</th>
<th>Number of trees sampled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerro Perico, Hidalgo</td>
<td>20°44' N - 99°02' W</td>
<td>1830-1970</td>
<td>14 15 24</td>
</tr>
<tr>
<td>Cañon Los Lirios, Coahuila</td>
<td>25°22' N - 100°29' W</td>
<td>2260-2460</td>
<td>11 15 0</td>
</tr>
<tr>
<td>Mesa del Rosario, Coahuila</td>
<td>25°26' N - 100°28' W</td>
<td>1920-2325</td>
<td>12 12 13</td>
</tr>
<tr>
<td>Santa Anita, Coahuila</td>
<td>25°27' N - 100°34' W</td>
<td>2515-2620</td>
<td>18 18 20</td>
</tr>
<tr>
<td>La Tapona, Nuevo Leon</td>
<td>24°13' N - 100°10' W</td>
<td>2090-2350</td>
<td>15 15 24</td>
</tr>
<tr>
<td>Las Placetas, Nuevo Leon</td>
<td>24°55' N - 100°11' W</td>
<td>2370-2520</td>
<td>13 15 22</td>
</tr>
<tr>
<td>Loma El Oregano, Coahuila</td>
<td>25°22' N - 100°55' W</td>
<td>2310-2350</td>
<td>14 15 19</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>86 90 98</td>
<td></td>
</tr>
</tbody>
</table>

| a = leaf characters b = cone & seed characters c = terpene analysis |

pects in the crown, and leaves were sampled only from first-order branches, prior to elongation. The five cones collected per tree were used in both the morphology and seed production studies. Stem-xylem oleoresin was collected from 170 trees for analysis of terpene chemistry using standard procedures. Details of the sampling procedure and chemical analysis for the terpene study are given in Donahue et al. (1995).

Leaf and Cone Morphology

For the morphology study ten leaf characters were analyzed: number of needles per fascicle, fascicle sheath length, needle length and width, number of ventral and dorsal surface stomatal lines, number of stomata per 3 mm length on dorsal surface, number of medial and internal resin canals and total number of resin canals. Ten needles per tree were measured for length, width and number per fascicle (1720 needles total). Five needles per tree were analyzed for the resin canal and stomata information (860 needles total). Five fascicle sheaths per tree were measured for length (860 sheaths total). Leaf width and stomatal counts were taken at the mid-point of the leaf, as well as the resin canal assessment, using standard microtechniques.

The ten cone characters measured were cone length and width, cone scale apophysis height and width, seed length and width, seed wing length and width, seed coat thickness and seed weight. Five cones per tree were mea-
sured for length and width. Cone length was measured in a straight line from the base to the top; cone curvature was excluded. Cone width was the average of two perpendicular measurements taken at the widest point of the cone. Cone scale apophysis height and width were measured on four sides, perpendicular to each other, located at the widest part of the cone. Seed wing width was measured at the widest point of the wing.

The leaf and cone data were analyzed using statistical procedures of the Statistical Analysis System (Donahue & Lopez Upton 1996). First a multivariate stepwise discriminant analysis was performed on the data to determine which traits would be most useful in separating trees from the two regions. A canonical discriminant analysis was conducted on the variables selected by the stepwise discriminant analysis to look at patterns of differentiation among populations, and calculate spatial Mahalanobis distances.

Analyses of variation by region were done on each individual variable to determine which varied significantly between the northern and southern groups of populations. Next a multivariate analysis of variation was conducted on the subset of variables that were significantly different between the two regions. Means and coefficients of variation were calculated and a correlation analysis was conducted on all morphological traits.

Seed Production
For the seed production study, five cones per tree were assessed (885 cones total). The extracted seeds were counted and classified as filled, empty, first-year aborted, second-year aborted, or insect-damaged. The number of fertile cone scales was counted to calculate seed potential and determine seed efficiency. Of the seed production criteria, the number of fertile cone scales is least affected by environmental variation. Population and individual tree means and coefficients of variation were computed for each seed-yield trait (Lopez Upton & Donahue 1995). An analysis of variance was conducted on the individual tree means with a nested model: trees, populations and populations within region (north and south regions). Waller-Duncan comparisons were performed on population means to detect differences among them, and to look for trends across regions.

Terpene Chemistry
The terpene chemistry analysis was performed on one resin sample from each of 170 trees by gas chromatography (Donahue et al. 1995). The chemical components were identified by comparison with known chemical standards, and also compared to results from gas chromatography/mass spectrometry analyses run on one sample from each of nine populations in the study. The chemical compositions were reported as “percent of terpenes.” This included all the monoterpenes and longifolene, a sesquiterpene, which was of particular interest. Since myrcene and carene were not separated, a combined
amount was reported for both. Population means were calculated for six terpenes. To characterize individual trees as “high” or “low” types for specific terpenes, frequency distributions were examined to help establish threshold values as criteria for determining the point of separation for the concentration classes. Threshold values were established at points where the trees’ frequency distributions might be separated into two modes.

Herbarium specimens examined
Of the specimens collected for and examined in the comprehensive study, the following vouchers, which are now considered variety *australis*, are located in the indicated herbaria:


The following vouchers from the comprehensive study, are considered variety *greggii*, and are located in the indicated herbaria:


In addition to the 860 specimens from the comprehensive study, the authors have also examined the following additional herbarium material:


During the course of several years of field study, the authors visited a number of sites and examined material that was not archived in herbaria.
Table 2 summarizes details of those additional sites where trees of Pinus greggii were observed and information gathered for this work.

RESULTS AND DISCUSSION

The results from the morphology study given in Table 3 showed that based on population means, the southern populations had significantly longer needles, more stomata per unit of leaf length, lighter seeds and five times greater frequency of internal resin canals than northern populations (Donahue & Lopez Upton 1996). Although the number of leaves per fascicle did not differ significantly between northern and southern trees, four-needle fascicles did occur more frequently in the north. The total number of resin canals did not differ between north and south, however trees from southern populations had five times more internal resin canals. The values shown for the northern and southern “regions” in Table 3 are means of the six individual population means that were part of that region. The values shown for (range) indicate the range of those six population means.

While both the northern and southern populations had the same number of lines of stomata on ventral and dorsal surfaces, the number of stomata per 3 mm length of leaf was greater in southern trees. On average, southern trees had narrower needles and wider seed wings. Northern trees had thicker seedcoats and heavier seeds. In the morphology study, northern and southern population means for needle length were significantly different, without overlapping values.

In the seed production study, no traits were significantly different between north and south, however the number of fertile cones scales showed a clear trend. Cones from southern trees had 28% more fertile cone scales than those from northern trees. The number of fertile cone scales is considered to be under more genetic control than the other criteria.

Table 4 gives a summary of the terpene chemistry results. β-phellandrene was found to be the single most abundant terpene in the chemistry analysis of *Pinus greggii* (51%) (Donahue et al. 1995). Southern populations had significantly higher proportions of α-pinene and myrcene and lower proportions of limonene and longifolene than northern populations. Northern populations had almost no variation in the frequency of high and low concentration types of trees; all trees within a population were either “high” or “low”. In this respect, trees from southern populations had varying numbers of high and low concentrations of α-pinene, myrcene and limonene. Results of this study indicated that genes that control these terpenes appear to be fixed in the northern populations. Longifolene is the sole terpene that distinguishes trees from northern and southern populations. Southern trees had a near-zero content of longifolene, while northern trees had an average content of 5%.
Table 2. List of additional sites observed but not included in the comprehensive study.

<table>
<thead>
<tr>
<th>State</th>
<th>Locality</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coahuila</td>
<td>Agua Fria</td>
<td>25° 26' N</td>
<td>100° 30' W</td>
<td>2400</td>
</tr>
<tr>
<td>Coahuila</td>
<td>Cañon de Caballos</td>
<td>25° 15' N</td>
<td>100° 55' W</td>
<td>2410</td>
</tr>
<tr>
<td>Coahuila</td>
<td>Cerro El Patosi</td>
<td>23° 53' N</td>
<td>100° 13' W</td>
<td>2430-2500</td>
</tr>
<tr>
<td>Coahuila</td>
<td>Jame</td>
<td>25° 21' N</td>
<td>100° 35' W</td>
<td>2450</td>
</tr>
<tr>
<td>Coahuila</td>
<td>Puerto Chapultepec</td>
<td>25° 15' N</td>
<td>100° 56' W</td>
<td>2410</td>
</tr>
<tr>
<td>Coahuila</td>
<td>Puerto Los Conejos</td>
<td>25° 28' N</td>
<td>100° 34' W</td>
<td>2380-2700</td>
</tr>
<tr>
<td>Coahuila</td>
<td>Puerto San Juan</td>
<td>25° 5' N</td>
<td>100° 53' W</td>
<td>2630-2680</td>
</tr>
<tr>
<td>Nuevo Leon</td>
<td>La Chona</td>
<td>24° 17' N</td>
<td>99° 58' W</td>
<td>2300</td>
</tr>
<tr>
<td>Nuevo Leon</td>
<td>Ojo de Agua</td>
<td>24° 54' N</td>
<td>100° 12' W</td>
<td>2200</td>
</tr>
</tbody>
</table>

Table 3. Means by region and (ranges of means within region) and p-values for the characteristics which varied significantly by geographic location.

<table>
<thead>
<tr>
<th>Population (region)</th>
<th>Needle Length (cm)</th>
<th>Needle Width (mm)</th>
<th># of Stomata</th>
<th># of Internal Resin Canals</th>
<th>Wing Width (mm)</th>
<th>Seed Weight</th>
<th>Seed Coat Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>11.3</td>
<td>1.28</td>
<td>35.6</td>
<td>0.09</td>
<td>5.95</td>
<td>1.73</td>
<td>0.146</td>
</tr>
<tr>
<td>(10.4-11.8)</td>
<td>(1.19-1.35)</td>
<td>(34.1-36.8)</td>
<td>(0.0-0.18)</td>
<td>(5.55-6.37)</td>
<td>(1.61-1.87)</td>
<td>(0.138-0.156)</td>
<td></td>
</tr>
<tr>
<td>Southern</td>
<td>12.5</td>
<td>1.18</td>
<td>38.8</td>
<td>0.48</td>
<td>6.4</td>
<td>1.47</td>
<td>0.138</td>
</tr>
<tr>
<td>(12.0-13.3)</td>
<td>(1.09-1.24)</td>
<td>(36.2-41.3)</td>
<td>(0.28-0.91)</td>
<td>(6.06-6.65)</td>
<td>(1.18-1.58)</td>
<td>(0.128-0.145)</td>
<td></td>
</tr>
<tr>
<td>Significance level</td>
<td>0.002</td>
<td>0.016</td>
<td>0.01</td>
<td>0.002</td>
<td>0.012</td>
<td>0.005</td>
<td>0.037</td>
</tr>
</tbody>
</table>

1 weight of 100 seeds (gms)

Table 4. A comparison of terpene composition (%) of southern and northern populations of Pinus greggii.

<table>
<thead>
<tr>
<th>Pinus greggii</th>
<th>α-pinene</th>
<th>β-pinene</th>
<th>Myrcene/ Limonene</th>
<th>β-phellandrene</th>
<th>Longifolene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern</td>
<td>17</td>
<td>0.8</td>
<td>15</td>
<td>10</td>
<td>58</td>
</tr>
<tr>
<td>Northern</td>
<td>5</td>
<td>0.7</td>
<td>3</td>
<td>41</td>
<td>54</td>
</tr>
</tbody>
</table>
In summary, trees from northern populations of *P. greggii* can be distinguished from southern ones using needle length, number of stomata, number of internal resin canals, seed wing width, seed weight, seed coat thickness, number of fertile cone scales and terpene composition. Of these, needle length, number of stomata, number of internal resin canals and percent content of longifolene had non-overlapping population means in the studies.

**Leaf Characteristics**

Subsequent to the comprehensive study, the authors and colleagues made informal observations of leaf color in native stands in Mexico, and trials planted outside the species natural distribution both within and outside of Mexico. Differences in leaf color were reported in exotic trials (Dvorak et al. 1996), where color was noted as dark green for northern populations and pale green for southern. Using Munsell® color charts for plant tissues, which assign a code based on the hue, value and chroma of an object, an attempt was made to characterize the differences seen on live trees in native stands in Coahuila and Queretaro, Mexico, and planted trials in Veracruz, Mexico, and Louisiana, USA. Leaf color was found to be variable both within and among trees, but variation could be generalized as differences between hue classes. Northern populations were predominately hue class “5 GY”, value & chroma combinations 4/6, 4/8 and 5/6, while southern populations were predominately hue class “7.5 GY”, value & chroma combinations 4/4, 4/6 and 5/6 (light green vs yellowish green). In addition to color differences it was observed that needles of northern trees are stiffer, more erect than those of southern trees. Figure 2 is a photograph of two branches that illustrate the differences in leaf color, length and rigidity between var. *greggii* and var. *australis*. The eighteen-inch long branches were collected from the lower third portion of the crown of three-year-old trees planted in Singer, Louisiana, USA. The trees were planted in field plots located adjacent to each other, and are typical of the rest of the trees (approximately 400) planted in the same plots. They are also representative of the differences in foliage characteristics seen in the twelve native populations cited in this study.

Distinguishing characters for the two varieties are summarized in Table 5. Most of the quantitative characters reflect the statistical results presented in Table 3, except for leaf length. Table 3 shows mean leaf lengths, whereas Table 5 gives a range of values that takes into consideration individual leaves and trees from our study.

Other characteristics distinguish southern from northern populations of *P. greggii*. In genetic field trials planted in Brazil, Colombia and South Africa, progeny from southern populations grew significantly taller than northern progeny, and maintained their differences in foliage color and stiffness. Southern trees planted in Brazil and Colombia were 100% taller than northern trees at
Table 5. Summary of the characters that distinguish northern and southern populations of Pinus greggii.

<table>
<thead>
<tr>
<th>CHARACTER</th>
<th>var. greggii</th>
<th>var. australis</th>
</tr>
</thead>
<tbody>
<tr>
<td>position</td>
<td>erect</td>
<td>frequently drooping</td>
</tr>
<tr>
<td>rigidness</td>
<td>stiff</td>
<td>flexible</td>
</tr>
<tr>
<td>color</td>
<td>light green</td>
<td>yellowish green</td>
</tr>
<tr>
<td>length (cm)</td>
<td>7–12</td>
<td>10–15</td>
</tr>
<tr>
<td>stomata number¹</td>
<td>34–36</td>
<td>36–41</td>
</tr>
<tr>
<td>internal resin canals</td>
<td>lacking</td>
<td>sometimes 1 or 2</td>
</tr>
<tr>
<td>Seeds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>wing width (mm)</td>
<td>5.5–6.1</td>
<td>6.0–6.7</td>
</tr>
<tr>
<td>Terpenes (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a-pinene</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>limonene</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>longifolene</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>myrcene</td>
<td>low</td>
<td>high</td>
</tr>
</tbody>
</table>

¹per 3 mm leaf length

Donahue and Lopez Upton, A new variety of Pinus greggii

CONCLUSION

Based on the results of the aforementioned studies and observations, the authors believe that trees from southern populations located in the states of Hidalgo, Puebla, Queretaro, San Luis Potosi and Veracruz constitute a separate taxon treated as follows:

三三年龄，且在南非它们是17到30%比北部树木高。相似的结果在墨西哥的田间试验中观察到，其中南部群体在两年龄时高106%高于北部群体（Alba Landa et al. 1998）和118%比近三年龄时（Lopez Ayala et al. 1999）。树木从南部群体显示比北部树木对松材病菌病（Fusarium subglutinans f.sp. pini）具有更大抵抗性于P. greggii在墨西哥发生于四月–五月在南部群体，和在五月–六月在北部群体（Lopez Upton & Donahue 1995）。

Pinus greggii Engelm. ex Parl. var. australis Donahue & Lopez, var. nov. (Figs. 1, 2). Type: MEXICO. QUERETARO: Mpio. Landa de Matamoros, El Madroño, 21° 16' N, 99° 10' W, 1690 m, 19 May 1993, Donahue & Lopez Upton B30 (MICH- TYPE: MO).

Varietas *australis* ab *Pinus greggii* var. *greggii* distinguibilib est foliis elongatis, flavovirentibus, cum stomatibus plus per 3 mm longitudione, interdum canalisibus resiniferis internis uno vel duobus, et terpene compositis myrcene altis et longifolone demissis, et endemicis ad Mexico centralis.

The variety *australis* has leaves in fascicles of 3, 10–15 cm long, 1.0–1.3 mm wide, with 36–41 stomata per 3–mm leaf length. Resin canals are 3–4(–6) in number, predominantly medial, and occasionally 1–2 internal. Cone length is 8–13(–14) cm and cone widths are 3–5 cm. Seeds are 5–7 mm in length and 3–4 mm wide. Seed wing length is 11–16 mm, and width is 6–8 mm.


The variety *greggii* has leaves in fascicles of 3, 7–12 cm long, 1.2–1.4 mm wide, with 34–37 stomata per 3 mm leaf length. Resin canals are (2–)3–4(–6) in number, medial. Cone length is 8–12 cm and cone widths are 3–5 cm. Seeds are 5–8 mm in length and 3–4 mm wide. Seed wing length is 13–16 mm, and width is 5–7 mm.

ACKNOWLEDGMENTS

The research conducted in conjunction with this work was supported by the CAMCORE Cooperative, North Carolina State University, USA, and Colegio de Postgraduados en Ciencias Agrícolas, Mexico. Thanks to James Hardin (NCSC), Bill Dvorak (North Carolina State University, USA) and Carlos Ramirez Herrera (Colegio de Postgraduados en Ciencias Agrícolas, Mexico) for their assistance with the research. Paul Fantz (North Carolina State University, USA) gave generous assistance with the manuscript review and Latin diagnosis. Special recognition is given to Jesse Parker Perry, Jr., to whom the taxon is dedicated, for his assistance during many years of fieldwork and research. Perry’s great enthusiasm and many years of accomplishments in the area has encouraged and influenced many others to research and conserve the pine species of Mexico and Central America.

REFERENCES


Fig. 2. A comparison of leaf characteristics of (A) *Pinus greggii* var. *greggii* from La Tapona, Nuevo Leon, and (B) *Pinus greggii* var. *australis* from El Madroño, Queretaro. The trees are growing in Louisiana, USA, produced from seed from the corresponding native stands in Mexico.


BOOKS RECEIVED


A collection of 30 agricultural and technological papers intended to document the status of tobacco and its products today. The fourteen subject chapters include: 1) seed to smoke, 2) breeding and genetics, 3) biotechnology: uses and applications in tobacco improvement, 4) agronomy and physiology, 5) production practices, 6) major tobacco diseases, 7) tobacco insect pests, 8) leaf chemistry, 9) physical properties of leaf tobacco, 10) marketing, processing and storage, 11) cigarette manufacturing, 12) smoke chemistry, 13) cigars and cigarillos, 14) smokeless tobacco.


A horticultural guide to ornamental bulbs and their cultivation, including chapters on: 1) main growing areas, 2) cultivation, 3) bulbs from A to Z (alphabetically arranged by genus), 4) glossary, 5) bibliography, 6) classification of genera in terms of cultivation difficulty, 7) classification of genera and species in terms of ornamental value, 8) useful addresses.


"This comprehensive list also includes crops, persistent perennials, and naturalized plants." The table of contents includes: Preface, Acknowledgments, Introduction, Format, Scientific Names: Species and Infraspecific Rank, Authors of Taxa, Common Names, Abbreviations and Special Designations, Conserved Names, Cultivated Plants, Endangered and Threatened Taxa, Federal Noxious Weeds, Hybrid Taxa, Misapplied Names, Orthography, State Symbols, Synonyms, Unpublished Names, Summary of Taxa, Summary Table, Checklist, Bibliography, and Index. A full review is forthcoming.
A synopsis of the genus Myrsine in Venezuela is provided. The generic description is updated, along with discussions of its morphology and ecology in Venezuela. A key to the species and subspecies is provided, along with descriptions, discussions of distribution, ecology and conservation, and etymology for all species. Each of the 12 species known for the country (one with two subspecies) is newly illustrated and its distribution is mapped. Four binomials: Rapanea ambigua Mez in Engl. (=Myrsine coriacea R. Br. ex Roem. & Schult. subsp. coriacea), Rapanea andina Mez (Myrsine andina (Mez) Pipoly), Rapanea nitida Mez (Myrsine nitida (Mez) Pipoly), and Rapanea guianensis Aubl. (=M. guianensis (Aubl.) Kuntze) are lectotypified. Three additional binomials are relegsted to synonymy.

INTRODUCTION

The genus Myrsine L. contains about 300 species, of which nearly one fourth remain undescribed. C. Chen and Pipoly (1996), Pipoly (1991, 1992a, 1992b, 1996), Pipoly and C. Chen (1995), and Rickenton & Pipoly (1997) have provided summaries of evidence for broader circumscription of the genus, especially to include Rapanea Aubl. This circumscription has most recently been accepted by Otegui (1998a) in her treatment of Myrsine for the Southern Cone of South America, and tentatively by Anderberg and Ståhl (1995).
in their preliminary analysis of phylogeny in the entire order Primulales. While Anderberg and Ståhl (1995) were relatively noncommittal regarding the circumscription of Myrsine, later work by Ståhl (1996) in determining the systematic position of species formerly placed in Heberdenia Banks ex DC., revealed that the genus would be paraphyletic if taxa formerly assigned to Rapanea were removed from it, so the best circumscription of the group is in its broadest sense. The conclusion was based on a cladogram using three species from morphological extremes within the genus. Otegui (1998b) constructed another cladogram in a paper discussing anemophily in the genus, in which Myrsine was most closely related to the Papuan endemic genus Fittingia Mez. However, it should be noted that Fittingia is a group whose species have been described from very incomplete material, and that there has not been any analysis to include all genera in the family, so these cladograms should be considered very tentative.

Myrsine is pantropically distributed, occurring in diverse vegetation types, from mangroves to subalpine scrub, but always in moist, wet or pluvial habitats. The genus is defined by lateral (axillary), fasciculate or umbellate inflorescences, sessile or on short, perennating peduncles girdled by persistent floral bracts, thus forming "short shoots." In preparation for our treatment of the genus for Flora of the Venezuelan Guyana, it became necessary to assemble specimens from the entire country with complete synonymies and bibliographic references, and to lectotypify several species. Because of the somewhat abbreviated format of that flora, the present synopsis is intended to provide a complete nomenclator and a preliminary treatment for Flora de Venezuela for this often misunderstood and nomenclaturally complex genus.

**MORPHOLOGY**

**Habit and Architecture**

The majority of Myrsine species in Venezuela are shrubs to small trees to 10 m tall, but occasional individuals of _M. dependens_ (Ruiz & Pav.) Spreng., _M. coriacea_ (Sw.) R. Br. ex Roem. & Schult. subsp. coriacea, and _M. guianensis_ (Aubl.) Kuntze, have been known to reach heights of 15 m, 30 m, and 15 m, respectively. All species of Myrsine are terrestrial, with positively geotropic roots, although those in cloud forests occasionally occur on deep humus formed by decaying organic matter over large boulders.

All Venezuelan species of Myrsine, with the notable exception of _M. dependens_, exhibit Rauh’s Model of architecture (Hallé et al. 1978), characterized by a polyaxial, monopodial, rhythmically growing, readily distinguishable trunk, that develops tiers of branches morphogenetically identical to itself. All branches are orthotropic and monopodial, with spiral phyllotaxy and lateral (axillary) inflorescences that do not affect shoot development. As was found for
Myrsine cubana A. DC. (called M. floridana A. DC. in the paper), all branches are sylleptic (Wheat 1980) producing two prophylls followed by adult leaves.

Myrsine dependens exhibits Massart’s Model of architecture (Hallé et al. 1978), characterized by a polyaxial, monopodial, rhythmically growing, readily distinguishable trunk, that develops regular tiers of branches at levels established by the growth of the trunk meristem. Branches are plagiotropic by leaf symmetry (distichous in this case), but never by apposition. The position of the inflorescence is not significant in the definition of the model. Like branching in Rauh’s Model, the branching is sylleptic. This model is typical of many Myristicaceae, and is also known in Ardisia crenata Sims and A. polycephala Wall. in the Myrsinaceae. Most species of the genus Embelia Burm. f. also exhibit Massart’s Model. Symmetry of the entire plant is striking, and allows immediate recognition of Myrsine dependens among the other species in its subpáramo thicket and páramo margin habitat, even though most branches will fall due to lack of light in the compact canopy of the thicket. With long-lived branches (when light conditions permit), Massart’s Model is most often confused with Roux’s Model, differing only by its rhythmic (and not continuous or diffuse) branching. Field work conducted in Venezuela, Colombia, and Ecuador has shown that the branch tiers consist of pseudoverticels, most often comprised of three branch units. It is notable that Massart’s Model is typical in extreme environments, where wind-shearing of orthotropic trunk axes produce the characteristic “Krummholz Effect” in taxa such as Abies balsamea Mill. (Hallé et al. 1978). That resilience inherent in Massart’s Model may be significant in the species’ ability to withstand extreme conditions of high winds, extreme diurnal temperature fluctuations, soil compaction from overgrazing, and lack of oxygen due to high altitude, all typical of the páramo margin and subpáramo thicket habitats.

Branchlets
A branchlet is here defined as the distal 10 cm of any branch. Branchlets in Venezuelan Myrsine are straight, terete, smooth, glabrous, rufous or ferrugineous villous- or floccose-tomentose, or rufous glandular-papillose, lenticellate or not. Most species have thin outer bark, but in Myrsine guianensis, an extremely active cork cambium results in significant cork accumulation, linked to dryness of the habitat.

Leaves
Species of Myrsine, like all Myrsinaceae, are extipulate and have simple leaves. The leaves are mostly spiral, except in Myrsine dependens, where they are distichous. In Venezuela, all species have petiolate leaves. A study of ptyxis (Cullen 1978) showed that four Asian and Pacific species of Myrsine surveyed had supervolute ptyxis, but a survey among the Venezuelan species has not as
yet been conducted, nor has the vernation been studied thus far. The leaf blade texture may be chartaceous, coriaceous, thickly coriaceous or cartilaginous. The difference between thickly coriaceous and cartilaginous is that the leaf is rubbery and will not snap on bending perpendicular to the plane of the midrib in the former, while it will easily snap with application of moderate bending perpendicular to the plane of the midrib in the latter. The shape is most often obovate, oblanceolate, elliptic or oblong, but may rarely be ovate (*Alyrsina maguireana* Pipoly), or linear-lanceolate, narrowly elliptic or lorate (*Al. resinosa* (A. C. Sm.) Pipoly). The apex may be attenuate, acuminated, acute, obtuse, rounded, broadly rounded, or emarginate, with or without a short, often blunt, bulbous, mucron formed by an extension of the midrib, while the base may be acute, cuneate, obtuse, or broadly rounded, usually decurrent on the petiole. The adaxial surface may be glabrous, smooth or scrobiculate, with or without a villous-tomentum of uniseriate hairs or glandular-papillae along the length of the midrib above; the secondary venation may be conspicuous, inconspicuous or not visible, and on the lower surface, the punctation may be black or pellucid punctate or black punctate and punctate-lineate; the margin is usually entire, and may be flat, merely inrolled, or revolute at least basally. The petioles may be flat on the adaxial surface, canaliculate, marginate or canaliculate and marginate distally, near the leaf blade base.

**Inflorescence, Flowers and Fruit**

The inflorescence in *Alyrsina* consists of a sessile to subsessile umbel, or a fascicle. The inflorescence bract is very early caducous and is rarely seen on herbarium specimens. The "peduncle" consists of an accrescent, perennating rachis that mimics a shoot, gradually built up by persistent, girdling floral bracts to form a "short shoot." The floral bracts may be early caducous or persistent, chartaceous or coriaceous, orbicular, ovate, widely ovate, deltate, obovate, apically acute, rounded or obtuse, inconspicuously pellucid punctate, brown punctate, black or red punctate and/or punctate-lineate, the margin most often entire, but may be erose and usually with glandular cilia, but sometimes glabrous. In Venezuela, all pedicels are terete, and vary mostly by their length and relative thickness. In most species the pedicel is accrescent in fruit, but not exceeding approximately 5% of its original length.

The flowers are 4–5(–6)-merous, perfect and normally functionally unisexual. When they are bisexual, the androecium is smaller than that of a staminate flower and the gynoecium is smaller than that of the pistillate flower of the same species. Flower texture is chartaceous for all species in Venezuela, except in *Mysrina picturata*, whose corolla is membranaceous. The calyx may be cotyliform, or rarely, campanulate or cupuliform, with valvate lobes nearly free to fused 1/3 their length. The lobes may be triangu-
lar-ovate, widely ovate, or deltate, apically rounded, obtuse, acute, acuminate, short-acuminate or long-attenuate, long-acuminate, flat or prominently keeled abaxially, inconspicuously pellucid punctate, brown punctate, or densely and prominently black punctate, and punctate-lineate, with margins entire or apically erose or roughly dentate, glabrous, villous-ciliate, long-glandular-ciliate, or glandular-ciliolate. The corolla may be cotyliform, campanulate or cupuliform, except for *Myrsine minima*, where the nearly free lobes erect in anthesis make it appear tubular. The lobes are valvate and may be linear-lanceolate, lanceolate, ovate, elliptic, or oblong, apically rounded, obtuse, subacute, sharply acute to attenuate, or acute. The ornamentation ranges from inconspicuously pellucid punctate and punctate-lineate, densely and prominently black punctate and punctate-lineate, or medially brown punctate. The margins are usually entire, and glandular-granulose along its length.

The stamens and staminodes are similar but the latter are reduced in size. The stamens are monodelphous (united into a tube by their filaments), and the tube developmentally fused to the corolla tube, the stamens thus appearing epipetalous, or rarely are visible (*M. maguireana*), or readily apparent (*M. minima*, *M. resinosa*). The anthers may be broadly ovate, elliptic, or oblong; apically acute to obtuse, and apiculate or not; basally cordate, subcordate, deeply cordate, or sagittate, and the connective punctate or epunctate dorsally. The antherodes may be lanceololate, obcordate, widely ovate, or ovate, apically acute or obtuse and apiculate or not, basally sagittate or deeply cordate, and the connective epunctate or punctate dorsally. The pistil may be obovate or ellipsoid, or rarely conical (*M. andina*) or globose (*M. resinosa*). The style in the Venezuelan species is obsolete. The stigma may be morchelliform, prismatic with 2–3 lobes, conic and spirally lobed with 4 lobes, or rarely umbraculiform (*M. resinosa*) with 4 vertically spirally twisted lobes, or laciniate (*M. nitida*) and 4-lobed. The pistilode is most often conic and hollow.

The fruits are usually globose to subglobose, or rarely ellipsoid (*M. dependens*) or obovoid (*M. picturata*), prominently black punctate and punctate-lineate, or obscurely pellucid punctate, not costate or with inconspicuous longitudinal costae.

ECOLOGY AND BIOGEOGRAPHY

*Myrsine* species, throughout their range, are most often associated with moist or wet montane life zones. In Venezuela, one may find *Myrsine dependens* through the Andes, mostly in páramo along the margins, at the upper limit of the supáramo thicket habitat, but rarely also at the subpáramo-cloud forest transition zone as long as the site is open and exposed to wind. Where the cloud forest life zone is well-defined, one may expect *Myrsine andina* in the cloud forest just below the subparamo thicket, where *M. coriacea* subsp. *coriacea*
may also occur in gaps and more disturbed places, along with Myrsine pellucida. While Myrsine dependens and M. andina are less tolerant of disturbance, M. pellucida is more tolerant, and M. coriacea subsp. coriacea is essentially a “weed.”

Along the Atlantic coastal range and into the Guayana Region, Myrsine guianensis occurs mostly in primary and secondary riparian forests, but also rarely in premontane forests and upland tepui savannas. Below this life zone in the eastern portion of the Guayana Region (Pantepui Floristic Province sensu Huber 1995), Myrsine nitida is found in the same premontane forests, Clusia-Magnolia, or Mora riparian forests. At the upper limit of that same zone, Myrsine coriacea subsp. reticulata is found in the riparian formations. Immediately below these Guayana formations, but in the drier savannas, Al. reinosua occurs.

Among the endemic upland tepui taxa, two species are endemic to Cerro de la Neblina and vicinity, including Myrsine maguireana and M. perpaniclora, while two others also known from Neblina, M. minima and M. picturata, are also found in the easternmost area of Pantepui, near the border of Guyana. Myrsine macrocarpa is restricted to the area around Cerro Huachamacari, in Estado Amazonas, an area known for high numbers of endemics (Pipoly 1992c).

NOTES ON KEYS AND TERMINOLOGY

The keys are artificial and designed to expedite identification of herbarium specimens. An attempt has been made to emphasize vegetative characters to increase the keys’ usefulness with sterile material. The numbers appearing before the taxa refer to their respective position in the key; any correlations with phylogenetic relationships are coincidental. Quantitative and qualitative data presented in keys and descriptions for floral parts and bracts were taken from organs rehydrated from herbarium specimens by boiling in water. Measurements from these range from 10% to 15% greater than those measurements taken directly from dried material. Data regarding stem diameters, inflorescence rachises, pedicels, leaf and fruit shape were taken from dried herbarium specimens.


TAXONOMIC TREATMENT


Dubanemia Dombey ex lam., Encycl. 1:245. 1783.

Samara Sw., Prodr. 1:120. 1788, pro parte, non L.


Artrophyllyum Lour., Fl. Cochinch. 1:120. 1790.


Merista Banks & sol. ex A. Cunn. in A. DC. in DC., Prodr. 8:95. 1844.

Shrubs or small trees. Leaves alternate, estipulate. Inflorescences lateral (axillary), umbellate or fasciculate, sessile or on short, perennating, accrescent peduncles girdled by persistent floral bracts (thus forming “short shoots”). Flowers 4–5(–6)-merous, bisexual or unisexual (the plants then bisexual, monoecious, dioecious, or polygamous); sepals nearly free or united to 1/2 their length, imbricate or valvate, usually ciliate, punctate, persistent; petals nearly free or rarely united to 1/2 their length, usually ciliate, glandular-granulose at least along margin and often throughout within, punctate; stamens and staminodes similar, subequalling corolla length, the filaments free or con- nate basally to form a tube, the tube with or without sterile appendages alternating with the filaments, and all merely adnate to the corolla tube; or
developmentally fused throughout, the anthers or antherodes thus appearing epipetalous, the anthers and antherodes similar, ovate or reniform, elliptic or oblong, rarely sagittate, 2-celled, dehiscing by longitudinal slits, or rarely by subterminal pores opening later into wide longitudinal slits; pistil and pistillode similar; conic, ellipsoid, obturinate, obnapiform, or variably subglobose; ovary globose, costate or not, glabrous or glabrescent; ovules few, uniseriate, completely immersed in placenta or seated below apical pores in placenta or variably projecting; style obsolete to present, tapering into stigma; stigma morpheliform (morel-shaped), liguliform, sinuate to lobate, prismatic and 3 (–4)-lobed, or rarely conical. Fruit a globose, subglobose, ellipsoid, ovoid, or obovoid or subovoid drupe, with somewhat fleshy exocarp and crusty or leathery endocarp, 1-seeded; seed occupying cavity, the endosperm horny, ruminate; embryo cylindric, transverse.

*Myrsine*, as here defined, contains ca. 300 species and is pantropically distributed. In Venezuela, 12 species are known, separable by the following key.

**KEY TO MYRSINE OF VENEZUELA**

1. Branchlets, petioles and/or leaf midrib densely ferrugineous or Rufous villous-tomentose or floccose-tomentose, at times early glabrescent, the trichomes unicellular.

2. Branches plagiotropic; leaves distichous, the blades (0.6–)1.5–2(–3) cm long, apically mucronate, scrobiculate above, the secondary veins not visible; flowers 4 (very rarely 5-) merous; calyx widely ovate to deltate, glabrous without, the margins villous glandular-ciliate; fruit ellipsoid. .......... 1. *M. dependens*

2. Branches orthotropic; leaves spiral, the blades (1.5–)3.5–13 cm long, without apical mucron, smooth above, the secondary veins prominent to prominently raised at least adaxially; flowers 5 (rarely 4-) merous; calyx triangular-ovate, scattered papillose-puberulent or glabrate without, the margins ciliate, glandular-ciliate; fruit globose. ........................................... 2. *M. coriacea*.

3. Leaf blades 6–13 cm long; inflorescences (3–35–9(–11)-flowered; calyx lobes longer than wide .......................... 2a. *M. coriacea subsp. coriacea*.

3. Leaf blades (1.5–)3.5–5.5 (–5.8) cm long; inflorescences 2(–3)-flowered; calyx lobes deltate ........................................... 2b. *M. coriacea subsp. reticulata*

1. Branchlets, petioles and leaf midrib glabrous or reddish glandular-papillose.

4. Petioles obsolete to 5 mm long.

5. Leaf blades cartilaginous, (2.3–)5–(5.5) cm wide; petioles thick, 2–3 mm diam.; calyx lobes prominently keeled, apically long-acuminate, the margins roughly dentate, ............................................ 3. *M. maguireana*.

5. Leaf blades coriaceous to thickly coriaceous, 1–2(–2.9) cm wide; petioles thinner, obsolete to 1.5 mm diam.; calyx lobes flat, apically obtuse or acute, the margins minutely ciliate or entire.

6. Leaf blades (1.7–)2–5 cm long, 1–1.5 cm wide; calyx lobes obtuse apically, the margins minutely cleft toward the apex, glabrous. ........................................... 4. *M. minima*
6. Leaf blades (2.8−)3−5.5(−6) cm long, 1.5−2.5(−2.9) cm wide; calyx lobes acute apically, the margins entire, long glandular-ciliate toward apex or densely glandular-ciliate throughout.

7. Branchlets red glandular-papillose-tomentose apically; leaf blades emarginate apically; pedicels 0.5−0.8 mm long; calyx lobe margins long glandular-ciliate toward the apex. ............................... 5. M. andina

7. Branchlets glabrous apically; leaf blades acute or rounded apically; pedicels 1.2−2 mm long; calyx lobe margins densely glandular-ciliate throughout. ........................................... 6. M. perpauciflora

4. Pedioles 5−20 mm long.

8. Leaf blades 1−2(−3) cm wide.

9. Leaf blades (3−)4−5 times longer than wide, 4−15 cm long, 1−2(−2.7) cm wide, lower leaf surface sparsely but conspicuously black punctate-lineate, the lines (5−)20−40 mm long; pedioles flat above, marginate; pistillate pedicels 3.5−5 mm long; calyx lobes apically short-acuminate, the margins sparsely glandular-ciliolate; fruit subglobose, longer than broad. ......................................................... 7. M. resinosa

9. Leaf blades 2−3 times longer than wide, (3−)4−6 cm long, 1.8−2(−3) cm wide, lower leaf surface densely and prominently black punctate and very short punctate-lineate, the lines 5−1 mm long; pedioles canaliculate; pistillate pedicels 0.9−1 mm long; calyx lobes apically long-attenuate, the margins glabrous; fruit obovoid. ....................... 8. M. picturata

8. Leaf blades (2.7−)3−9.2 cm wide.

10. Pistillate pedicels obsolete to 1.4 mm long; secondary veins of the leaf blades inconspicuous.

11. Branchlets, petioles and leaf midrib glabrous or glandular-granulose; pedicels 1.1−1.4 mm long; calyx lobes 1.2−1.4 mm long, wider than long; fruits 8−12 mm in diam., obscurely pellucid punctate. ...................................................... 9. M. macrocarpa

11. Branchlets, petioles and midrib of leaf blade reddish glandular-papillose; pedicels obsolete to 1 mm long; calyx lobes 1 mm long, longer than wide; fruits 3−3.5 mm in diam., obscurely punctate and punctate-lineate. ........................................... 10. M. pellucida

10. Pedicels 1.5−3 mm long; secondary veins of the leaf blades conspicuous.

12. Leaf apices acute, rarely obtuse; lower leaf surfaces conspicuously reddish punctate and punctate-lineate; calyx lobes deltate; fruit 3−3.5 mm diam., obscurely pellucid punctate; gallery, Alora and Clusia-Magnolia forests. ........................................... 11. M. nitida

12. Leaf apices obtuse to broadly rounded; lower leaf surfaces inconspicuously black punctate to punctate-lineate; calyx lobes ovate; fruit 3.5−5 mm diam., prominently black punctate; cloud forests to lowland savannas. ......................................... 12. M. guianensis

Fig. 1. A. Myrsine coriacea (Sw.) R. Br. ex Roem. & Schult. subsp. coriacea, detail of branchlet apex, petioles and midrib of leaf blades with dense tomentum, drawn from Pipoly 6486. B. Habit, flowering branch of same, drawn from E. Breteler 4580. C. Fruit of same, drawn from E. Breteler 4580. D. Habit, flowering branch of Myrsine coriacea (Sw.) R. Br. ex Roem. & Schult. subsp. reticulata (Steyerm.) Pipoly, drawn from B. Maguire 33465. E. Fruit of same, drawn from B. Maguire 33465. F. Abaxial leaf of same, drawn from B. Maguire 33465. G. Abaxial leaf of same, showing variation, drawn from J. Steyermark 58983 (NY isotype). H. Habit, flowering branch of Myrsine dependens (Ruiz & Pav.) Spreng., drawn from L. Marciano-Berti 804. I. Fruit of same, drawn from L. Marciano-Berti 804. J. Abaxial leaf of same, drawn from L. Marciano-Berti 804.

**Samara myrtifolia** Willd. ex Schult. & J.H. Schult. in Roem. & Schult., Mant. 3:220. 1827. *Myrsine myrtifolia* (Schult. & J.H. Schult.) A. DC. in DC., Prodr. 8:103. 1844. **Type**: COLOMBIA. Without locality, without elev., without date, A. von Humboldt & A. Bonpland s.n. (holotype: P). According to TL-2, the third volume of Mantissa was co-authored by Julius Herman Schultes, son of Josef August Schultes, in their revision of the Syst. Veg. that Josef and Johann Jakob Roemer had written earlier. Therefore, we have changed the literature citation customarily used for the basionym accordingly.


Shrubs or small trees to 15 m tall and 16 cm DBH; trunk orthotropic, the branches plagiotropic. Branchlets terete, rufous puberulent or short villous to densely villous-tomentose apically, at least when young, usually glabrescent, nodes congested, lenticels generally small and obscure. Leaves distichous; blades coriaceous to cartilaginous, ovate to elliptic, obovate or suborbicular, (0.6–)1.5–2.0(–3.5) cm long, 0.5–2 cm wide, apically rounded or emarginate, with a short, often blunt, bulbous, mucron formed by an extension of the midrib, basally obtuse to rounded, the midrib impressed and puberulent to short-villous toward base above, prominently raised below, the secondary venation not visible, nitid and scrobiculate above, bearing numerous hydropotes, punctate and punctate-lineate below, the margin entire, densely punctate flat to inrolled; petioles canaliculate, 0.1–0.3(–0.4) cm long, puberulent to short villous within, extending up the midrib of the blade, outside often puberulent to short villous, usually glabrescent. Stamineate inflorescence fasciculate, 1–3(–4)-flowered; peduncles forming short shoots 1–1.5 mm long, 1–1.2 mm diam., floral bracts chartaceous, oblate, 0.8–1 mm long, 1–1.5 mm wide, apically rounded, densely short-villous above, glabrous below, the margins entire, densely glandular-ciliate; pedicels 1–1.8 mm long, glabrous. Stamineate flowers 4(tetragonous).
merous, chartaceous, 3–3.5 mm long; calyx coryliform, 1–1.2 mm, long, the tube ca. 0.2 mm long, the lobes widely ovate to deltate, 0.8–1 mm long and wide, apically acute, prominently black punctate and punctate-linear, the margin entire, villous-ciliate, especially toward apex; corolla campanulate, 2.5–3 mm long, the tube ca. 0.5 mm long, the lobes lanceolate to ovate, 2–2.5 mm long, 0.8–1 mm wide, apically subacute to obtuse, inconspicuously punctate and punctate-linear, the margins entire, minutely glandular-granulose; stamens 1.9–2.3 mm long, the filaments obsolete, the anthers broadly ovate to elliptic, 1.4–1.8 mm long, 0.4–0.6 mm wide, attached dorsally at apex of corolla tube and thus appearing epipetalous, apically apiculate, basally cordate, the connective epunculate dorsally; pistil glabrous, hollow, glabrous, the style obsolete, the stigma morchelliform, 0.1–0.2 mm long. *Pistillate inflorescence* as in staminate but 1–3-flowered; peduncle 1–1.2 mm long, 0.8–1 mm diam.; floral bracts 0.8–1 mm long and wide, densely ciliate along the margins; pedicels 1.7–2.2 mm, glabrous. *Pistillate flowers* as in staminate but corolla 2.4–2.6 mm long, the tube 0.2–0.4 mm long, the lobes lanceolate, 2–2.2 mm long, 0.6–0.7 mm wide; staminodes resembling stamens but abortive, the filaments obsolete, the antherodes lanceolate, 1–1.4 mm long, 0.3–0.4 mm wide, apically apiculate, basally sagittate; pistil obnapiform, the ovary subglobose to conical, glabrous the style obsolete. The stigma morchelliform, 0.8–1 mm long, the placenta globose, the ovules 2–4, uniseriate. *Fruit* ellipsoid, 3–3.5 mm long, 2.5–3 mm diam., densely and prominently black punctate and punctate-linear, with inconspicuous longitudinal costae.

**Distribution.**—*Myrsine dependens* is known from Costa Rica and Panama, and in the Andes from Venezuela to Bolivia, from 2,500–3,800 m elevation. In Venezuela, it is found in the Andean states of Mérida, Táchira, and Trujillo, and along the coastal cordillera in and north of Caracas, in the Distrito Federal and Miranda states. We expect it should also occur in the Serranía de Turumiquire, in the states of Anzoátegui, Monagas and Sucre.

**Ecology and conservation status.**—*Myrsine dependens* is known from subpáramo, páramo margins, and subpáramo-cloud forest transition areas, and withstands moderate to heavy disturbance. The principal obstacle to successful seedling establishment appears to be compaction of the soil from overgrazing by sheep and goats. The species is locally common, often forming dense thickets, and is not threatened at this time.

**Etymology.**—The specific epithet comes from the Latin 'dependens', meaning suspended or hanging down, and refers to the often lax, narrow branchlets that hang due to weight with age.

Specimens examined. VENEZUELA. Distrito Federal: Caracas, without elev., 1843 (fl), H. Funak 481 (P); “crescit in declivitate meridionali montis Silla de Caracas, 800 hex, without date (fr), A. von Humboldt & A. Bonpland s.n. (P); Caracas, without elev., without
date (fl), J. *Linden* 958 (K); Parque Nacional El Avila, Pico Naiguatá, without elev., 5 Jan 1976 (fr), B. *Manara* s.n. (MO, NY, VEN); Cordillera del Avila, between Los Venados and Pico Oriental, 1,675–2,640 m, 27–28 Feb 1944 (fl), J. *Steyermark* 55646 (F, NY); Silla de Caracas, without elev., 1891–1892 (fr), J. *Warwings* s.n. (C). *Mérida*: Páramo de Mucuquí, 3,100 m, 7 Dec 1952 (fr), L. *Bernardi* 214 (G, NY, VEN); Near Alto del Aguada, 3,300–3,500 m, 4 Nov 1976 (fr), L. *Bernardi* et al. 17136 (NY, VEN), 17144 (NY, VEN); Distrito Libertador, Páramo El Escorial, vicinity of El Valle, NE of Mérida, ca. 2,800 m, 9 Sep 1982 (fl), S. *Clements* & J. *Dugarte* 2411 (F, NY, VEN); Distrito Miranda, road from Páramo La Aguila to Piñango, at bridge, 3,400 m, 16 Sep 1982 (fr), S. *Clements* & D. *Díaz* M. 2435 (MERF, NY); Quebrada de Saisay, 3,220 m, 5 Apr 1930 (fr), H. *Gebriger* 28 (F, MO, NY, VEN); Páramo near Hotel Los Frailes, N of the Mérida-Barinas Hwy, 08° 49' N, 70° 47' O, 3,000–3,300 m, 29 Dec 1991 (fl), W. *Meier* 1097 (MO, VEN n.v.); Distrito Libertador, Sierra de Culata, 20 kms NE of Mérida, 2,800–3,800 m, 19 Dec 1983 (fr), J. *Pipoly* et al. 6466 (MER, MO, NY); Distrito Libertador, Sierra de Culata, 18 kms NE of Mérida, 2,800–3,800 m, 19 Dec 1983 (fr), J. *Pipoly* et al. 6512 (MER, MO, NY); Distrito Libertador, Parque Nacional Simón Bolívar, La Mucuy, Laguna del Coroñome, 3,400 m, 22 Dec 1983 (fr), J. *Pipoly* & G. *Aymard* 6566 (MER, MO, NY); Distrito Libertador, Municipio Táchira, near Laguna de la Coromota, Parque Nacional Simón Bolívar, 3,100–3,400 m, 19 Jun 1963 (fl), L. *Ruiz Terán* 1609 (MERF, MO). *Miranda*: Ascent of Pico de Naiguatá, above Los Chorros, 2,200–2,865 m, 16–17 Jun 1945 (fl), J. *Steyermark* 63007 (F, MO); Táchira-Mérida border: Páramo, La Negra, 3,000 m, 7 Oct 1965 (fr), J. *Breteler* 4629 (F, NY); Páramo La Negra, ca. 3,080 m, 7 Oct 1965 (fl, fr), L. *Marcano-Berti* 804 (MER, MO). *Trujillo*: Páramo Guariguay, toward Peña Blanca, 3,400 m, Aug 1958 (fl), L. *Aristeguieta* 3606 (NY, VEN); Arriba de Jají, Paramito, toward Tuñame, rocky mountains, 3,100–3,200 m, 29 Oct 1969 (fr), J. *Cuatreras* et al. 28185 (F); Along highway between Flor de Patria and Boconó, 64 km from Boconó, 500 m, 24 Feb 1971 (fl, fr), J. *Steyermark* 104785 (MO, NY). Without location: Venezuela, without elev., 1842–1843 (fl), H. *Funck* 550 (BM); 1845 (fl), H. *Funck* & L. *Schlim* 58 (BM).

As here interpreted, *Myrsine dependens* includes a wide range of growth forms, all restricted to Andean subpáramo and páramo habitats, extending to the Caribbean coastal cordillera. The *Myrsine ciliata* growth form is the most striking variant, chiefly because of its cartilaginous leaf blades with a plicate habit. Further study is needed through the subpáramos and jalca habitat margins, from Colombia to Peru, to determine whether this variant deserves subspecific recognition.

Among all Venezuelan species, *Myrsine dependens* is easily distinguished because it exhibits architecture corresponding to Massart’s Model (Hallé et al. 1978), characterized by an orthotropic trunk and plagiotropic branches bearing distichous leaves. Fieldwork has shown it forms large populations with high densities. The ellipsoid fruit is also distinctive. At this time, its relationships are not certain, but the small-leaved taxa, including, *M. microadonta* Pipoly, *M. fosteri* Pipoly, and *M. brevis* (J. F. Macbr.) Pipoly of Peru; *M. lehmannii* (Standl.) Pipoly, and *Myrsine paramensis* (Cuatrec.) Pipoly of Colombia, seem to form a monophyletic group defined by mucronulate to mucronate leaf apices and Massart’s Model of architecture. All are high-altitude taxa growing in harsh environments.
2. **Myrsine coriacea** (Sw.) R. Br. ex Roem. & Schult.

*Shrubs or small trees to 8(–30) m tall; trunk and branches orthotropic. Branchlets terete, ferrugineous to Rufous villous tomentose to floccose tomentose, at least apically, usually persistent, the trichomes uniseriate; lenticels small and obscure to large and conspicuous. Leaves spiral; blades membranaceous, chartaceous or coriaceous, lanceolate, oblanceolate, obovate, elliptic or oblanceolate, (1.5–)6–13 cm long, (0.8–)1–3 cm wide, apically acute or acuminate, rarely obtuse to emarginate, basally acute, cuneate to obtuse or rarely rounded, decurrent on the petiole, nitid and smooth above, pallid below, the midrib flat or impressed above, prominently raised below, the secondary veins prominently raised above and/or below, conspicuously but not prominently punctate and punctate-lineate below, villous at first, at least along the midrib, glabrescent, the margins entire, flat or rarely revolute basally; petioles canaliculate or marginate at least distally, 0.1–2 cm long, thick, densely to sparsely ferrugineous or Rufous villous tomentose, often glabrescent with age. Stamine inflorescence fasciculate, 5–12-flowered; peduncles forming short shoots 1–4 mm long, 1–2 mm diam., glabrous or pilose; floral bracts deltate to very widely ovate, 0.4–0.8 mm long and wide, apically obtuse to rounded, the margin glandular-ciliate; pedicels obsolete to 1.5 mm long, papillose-puberulent at first, glabrescent. Stamine flowers 5-merous, very rarely with a few, scattered 4-merous ones on some inflorescences, 2.5–4 mm long; calyx chartaceous, cotyliform, 0.4–1.5 mm long, the tube 0.1–0.3 mm long, the lobes triangular-ovate, 0.4–1.2 mm long, 0.3–0.6 mm wide, apically acute to obtuse, densely and prominently black punctate or rarely epunctate, scattered papillose-puberulent without or glabrate, the margins subentire to erose, glandular-ciliate; corolla chartaceous, campanulate, 2.5–4 mm long, the tube 0.5–1 mm long, the lobes lanceolate, 2.5–3.5 mm long, 0.8–1.1 mm wide, apically subacute to obtuse, prominently black punctate-lineate, the margin entire, glandular-granulose; stamens 2–2.8 mm long; filaments obsolete and anthers attached at the apex of corolla tube, thus appearing epipetalous; anthers oblong, 1.5–1.8 mm long, 0.9–1 mm wide, apically acute to obtuse, basally deeply cordate to subsagittate, the connective epuncate dorsally; pistillode conic, hollow. Pistillate inflorescence as in stamine but 3–9-flowered. Pistillate flowers as in stamine but 1.8–4 mm long; corolla 1.7–3.3(–3.9) mm; staminodes similar to stamens but anthers obvate, 0.5–1 mm, apically acuminate, basally slightly sagittate, the connective epuncate; pistil obturate, the ovary 0.5–1 mm, globose to subglobose; the style obsolete, the stigma morchelliform, (1–)1.2–1.4 mm long; ovules 3, uniseriate. Fruit globose, 2.5–3.5(–4) mm diam., punctate to punctate-lineate, glabrous, costa not prominent, brown or black at maturity.

As here circumscribed, *Myrsine coriacea* is the most widespread neotropical species and perhaps the only "weedy" neotropical member of the Myrsinaceae.
It is the most polymorphic of the ochlospecies (sensu White 1962; Prance 1982; Pipoly 1983) found in any myrsinaceous genus. While vegetative plasticity is greater in this species than in any other in the family, the morchelliform stigma is shared only with *M. dependens*. It is not certain whether the morchelliform stigmas of both species are identical, or two states of what could be a transformation series, and more study of this is needed. Among the other distinguishing features of *Myrsine coriacea* are the few-flowered, sessile, faciculate inflorescences, subsagittate anther and antherode bases, the persistent furigineous tomentum of the vegetative organs and pedicels, and the small, globose fruits.


Without locality, without elev., without date, O. Swartz s.n. (holotype: BM).


*Samara saligna* Willd. ex Schltr. & J.H. Schult. in Roem. & Schult., Mant. 3:220. 1827. *Myrsine saligna* (Schult. & J.H. Schult.) A. DC., Prodr. 8:103. 1844. Type: Herb. Willd. 1039 (holotype: B-WILLD, n.v.). According to TL-2, the third volume of Mantissa was co-authored by Julius Herman Schultes, son of Josef August Schultes, in their revision of the Syst. Veg. that Josef and Johann Jakob Roemer had written earlier. Therefore, we have changed the literature citation customarily used for the basionym accordingly.


Fig. 2. Distribution of *Myrsine coriacea* subsp. *coriacea* (●) in Venezuela.
**Altura Verapaz**: Coban, 1350 m, Dec 1906, H. von Türkheim 1001 (holotype: P; isotypes: F, G, LL-TEX, MICH, MO).


** Shrubs or small trees to 5–30 m tall, 15–50 cm DBH. Branchlets rufous or ferrugineous villous- or floccose- tomentose, persistent at least apically, rarely glabrescent. Leaf blades membranaceous, chartaceous or subcoriaceous, 6–13 cm long, 1–3 cm wide, the secondary veins prominulous to prominently raised above, often conspicuously but rarely prominently punctate and punctate-lineate, sometimes villous at first, especially along the mid-rib on both surfaces, usually glabrescent with age the margins flat to revolute; petioles 0.1–2 cm, thick, punctate, usually puberulent or short villous to densely villous-tomentose with reddish trichomes, often glabrescent. Fruit globose, 2.5–3.5(–4) mm diam.

**Distribution.** — *Myrsine coriacea* subsp. *coriacea* is known from Mexico and the West Indies through Central America, through the Andes from Venezuela to Argentina, and in montane or premontane areas in the Atlantic coastal forest of Brazil, from 700–3,000 m elevation. In Venezuela (Fig. 2), the species is known from the Guayana Region (Bolívar), the eastern states of Anzoátegui, Monagas and Sucre, the Coastal Range north of Caracas, including Aragua, Carabobo, Distrito Federal and Miranda, and the entire Andean region from Falcón to the Colombian border.

**Ecology.** — *Myrsine coriacea* subsp. *coriacea* occurs in primary and secondary elfin, cloud, and wet montane (including montane tepui savanna), and subpáramo thickets. While no statistical analyses have been carried out, fieldwork has shown that within a range from slight to heavy disturbance (mostly from sheep grazing), *Myrsine coriacea* subsp. *coriacea* seems to increase in population density with disturbance.

The subspecies’ range overlaps with that of subsp. *reticulata* only in the state of Bolívar, where subsp. *coriacea* occurs in the talus slope forests, while subsp. *reticulata* occurs in riparian gallery forests on the tepui summits. Given its ability to thrive in disturbed habitats, subsp. *coriacea* it is not subject to threat at this time.
Etymology.—The subspecific epithet, 'coriaceae' refers to the coriaceous nature of the leaf blades, an especially common feature in Caribbean populations.

Specimens examined. VENEZUELA. Amazonas: Departamento Río Negro, Cerro de La Neblina, Expedition Camp VII, 00° 50' N, 65° 58' W, 1,850 m, 2 Dec 1984 (il), W. Anderson 13461 (F, NY, US). Anzoátegui: Distrito Libertad, summit of Montaúnas Negras, along the Sucre and Anzoátegui border, 20 airline km NE of Bergantín, NE of Buenos Aires, Serranía de Turimiquire, 10° 04' 30" N, 64° 11' W, 2,000–2,350 m, 28 Nov 1981 (fr), G. Davide & A. González 19540 (F, MO, NY, VEN); (il, fr), 19606 (MO, NY, VEN); Cerro Corona, near radio installation, 2,000–2,200 m, 7 Jan 1987 (il), W. Habu & E. Grifo 3460 (MO, US); Distrito Freites, Serranía de Turimiquire, Cerro Peñón, ca. 10° 06' N, 64° 06' W, 2,200–2,400 m, 8 Dec 1983 (fr), J. Pujol 6450 (NY, VEN); (il, fr), J. Steyermark 61615 (F). Aragua: Distrito Girardot, near Alto de Choroní, 1,400 m, 11 May 1977 (fr), V. Badillo 7339 (MY, NY); Carretera las Tejerías-La Tiara, highest point of Carretera, 11–15 km S of junction to Carretera Las Tejerías-Los Teques, 1,150–1,200 m, 4 Jan 1978 (fr), G. Bunting & M. Finoc 6050 (NY); Summit, Pico Guacamaya, Parque Nacional Henri Pittier, 1,850 m, 25 Jan 1990 (il), A. Cardozo & H. Rodríguez 1218 (MO); Summit, Cerro Chimborazo, Parque Nacional Henri Pittier, 2,230 m, 23 Feb 1990 (il), A. Cardozo et al. 1278 (MO); On steep slope, N slope of Pico Guacamaya, Parque Nacional Henri Pittier, 1,800 m, 23 Mar 1990 (fr), A. Cardozo et al. 1344 (MO); Parque Nacional Henri Pittier, without elev., 26 May 1990 (fr), A. Cardozo & H. Menees 1421 (MO); Near Colonia Tovar, without elev., 1854–1855 (fr), A. Feudler 738 (MO, NY); Distrito Ricurute, after arch toward Colonia Tovar, without elev., 22 Jul 1987 (fr), C. de Rojas y F. Rojas 3682 (NY, n.v., NY). Aragua: Laguna de Colonia Tovar, without elev., without date (fr), J. Moritz 1175 (BM); Vicinity of Tovar, 1,200 m, 31 Jan 1928 (il), H. Pittier 12793 (NY); Sabanas de Agua Negra, 1,500–1,600 m, 18 Dec 1936 (il), H. Pittier 3793 (US); S-facing slopes of Cordillera del Avila, just above Caracas, along trail towards Los Venados, 1,520–1,675 m, 27 Dec 1943 (il), J. Steyermark 55202 (F). Barinas: Distrito Pedraza, SW of Carrizal, "La Escasa" on the S bank of the Río Canaguá, Parque Nacional Sierra Nevada, 08° 39' N, 70° 36' W, 26 Jun 1988 (fr), L. Dorr et al. 5693 (NY, PORT). Bolívar: Distrito Pirá, Macizo del Chimantá, wide valley in the SE sector of Apacará-tepui, in contact zone between Roraima Sandstone and extensive metamorphic (diabase) intrusions, in the N sector of the Macizo 05° 19' N, 62° 07' W, 2,150 m, 7 Feb 1984 (il), A. Colella & O. Hakes 451 (MYF, NY); Distrito Pirá, Kuapia Min. Pedro Cova, 05° 37' N, 61° 46' W, ca. 1,000 m, 14 Apr 1986 (fr), S. Eleora y N. Vera 225 (MYF, NY); Distrito Sifontes, Mun. Urdaneta, Cuencas del Caroní, "Sabana" 11 km E of San Ignacio, 05° 00' 00" N, 61° 00' 30" W, 1,120 m, 30 Jan 1985 (fr), L. Hernández y N. Deza 114 (MYF, NY); Distrito Pirá, ca. 6 km NE of Kavanayén, 05° 38' N, 61° 40' W, 1,300 m, 6 Mar 1983 (fr), O. Hakes & C. Alarcón 7375 (MYF, NY); Distrito Roscio, montane savannas above "Piedra de Canaimé", ca. 5 km SE of Santa Elena de Uairén, 01° 35' N, 61° 06' W, 1,100–1,200 m, 28 Jul 1983 (fr), O. Hakes & C. Alarcón 7937 (MYF, NY); Distrito Pirá, Macizo del Chimantá, wide valley located in SE section of Apacará-tepui, in the contact zone between Roraima Sandstones and extensive metamorphic (diabase) in the N sector of the Macizo, 05° 19' N, 62° 07' W, 2,150 m, 6–9 Feb 1984 (il), O. Hakes et
al. 8786 (MYF, NY 2-sheets); 11 kms E of Kavanayén, ca. 1,200 m, 26 Jul 1983 (fr), R. Kral & A. González 70455 (MO, VDB); Entre Estación y Aeroporto CVG de Parupa, 1,250 m, 14 Sep 1983 (fr), G. Morillo et al. 9606 (VEN); Gran Sabana, Vía Kavanayén, El Jardín, between Campamento Parupa and Kavanayén, ca. 55 km E of Fuerte Lueca, without elev., 25 Jun 1983 (fl), N. Ramírez 796 (VEN); Gran Sabana, Rastrojo, behind Campamento Río Parupa at junction with Río Parupa, Parque Nacional Canaima, without elev., 23 Nov 1993 (fr), N. Ramírez et al. 4666 (MO); Ptari-tepui, steep forested slopes at base of first line of sandstone bluffs, on S-facing part, E of “Cave Rock”, 2,130 m, 4 Nov 1944 (fl), J. Steyermark 59826 (E, MO, NY, US); Río Karauí bordering savanna between base of Ptari-tepui and Soro-tepui, 1,220 m, 28 Nov 1944 (bud), J. Steyermark 60737 (F); Ridge above La Laja at base of Soro-tepui, 1,375–1,460 m, 30 Nov 1944 (bud), J. Steyermark 60808 (F). Carabobo: Above Hacienda Curu, between Valencia and Maracay, 1,400 m, 8 Jan 1939 (fl), A. Alston 6172 (BM). **Distrito Federal:** Las Flores, Sierra de El Avila, 1,600 m, 15 Dec 1938 (fl), A. Alston 5515 (BM); Ecological study site, Silla de Caracas, without elev., 29 Jan 1969 (fl), Z. Baruch 95 (NY); Bajo Seco, Facultad de Agronomía Station, 2,000 m, 26 Jan 1983 (fl), L. C. de Guzmán 3261 (BM); Parque Nacional El Avila, trail from end of road to La Silla de Caracas, ca. 10° 35’ N, 66° 50’ W, 1,951–2,316 m, 29 Jan 1984 (fl), J. Lateyn et al. 9386 (NY, VEN), (ster.), 9387; Fila del Avila, 10° 32’ 8” N, 66° 53’ W, 2,060 m, 11 Jun 1991 (fr), W. Meier 14 (MO); Cerro El Avila, S slope, along ridge to Hotel Humboldt-Papelón, 10° 32’ 0” N, 66° 52’ 05” W, 1,930 m, 10 Jan 1992 (fl), W. Meier 1317 (MO); Fila del Avila, 10° 32’ 07” N, 66° 53’ W, 2,050–2,100 m, 7 Jan 1992 (fr), W. Meier 1414 (MO); Headwaters of Quebrada Chacaito, 10° 33’ 8N, 66° 52’ O, 2,090 m, 5 Feb 1992 (fr), W. Meier 1603 (MO); Colinas W of Río Macarao Basin, 1,200 m, 4 Mar 1971 (fl), G. Morillo 392 (NY, VEN); 6 km ENE of Colonia Tovar, 1,900 m, 21 May 1960 (fl), J. Steyermark 86192 (NY, VEN); Fila de Aguas Negras, without elev., Feb 1938 (fl), T. Tamayo 436 (US, VEN); Carretera de El Junquito, 1,700 m, May 1950 (fr), VEN Herb. No. 3879 (MO); Caracas, without elev., 1891–1892 (fl), J. Warming 553 (C); along Carretera de Los Flores y Boca del Tigre, 1,600 m, without date (fl), L. Williams & A. Alston 3144 (BM); Agua Negra, 1,400 m, 18 Mar 1938 (fl), L. Williams 9938 (F, US); Along road to Las Flores a Caligan, 1,700 m, 16 Dec 1938 (fl), L. Williams & A. Alston 10940 (F). **Falcón:** Cerro Santa Ana, Península Paraguana, near top, 800 m, 15 Dec 1964 (fl), F. Breteler 4289 (NY); Cerro Santa Ana, Península Paraguana, 800–840 m, Dec 1953 (fl), T. Laser y L. Aristeiñeta 3418 (E, VEN); Península de Paraguana, Cerro Santa Ana, isolated mountain, without elev., 17 Feb 1980 (fl), G. Sobel et al. 2021 (NY); Sierra de San Luís, La Chapa y Uria, 1,400 m, 19 Jul 1967 (fl), J. Steyermark 199182 (F, MO, VEN). **Falcón and Lara:** Disputed area between Falcón and Lara, Cerro Cerrón, W part, 1,800–2,000 m, 27 Jun 1979 (fr), R. Liese et al. 8202 (MO, VEN); (fl), 8232 (MO, VEN); Cerro Socopo, 1,400–1,560 m, 29 Jun 1979 (fr), R. Liese et al. 8389 (MO, NY, VEN). **Lara:** Distrito Morán, Carretera de Humacao Bajo via Buenos Aires, 09° 35’ N, 70° 03’ W, 1,600 m, 13 Nov 1985 (fl, fr), H. van der Werff & R. Rivero 7838 (MO, NY); (fl), 7839 (MO, NY); Distrito Morán, Carretera de Humacao Bajo, via Las Palmitas, without elev., 16 Nov 1985 (fl), H. van der Werff & R. Rivero 8009 (MO, NY). **Mérida:** 10 km NE of Mérida, near village of Tabay, native coffee plantation, 1,900 m, 28 Oct 1963 (fl), F. Breteler 3218 (NY); 19 km W of Mérida, 1,700 m, 31 Oct 1963 (fl), F. Breteler 3242 (NY); 5 km NW of Mérida along road to El Valle, 1,920 m, 27 Feb 1964 (fl), F. Breteler 3365 (NY); 10 km NE of Mérida, near village Tabay, 1,900 m, 9 Sep 1965 (fr), F. Breteler 4380 (MO, NY); NW of Mérida, on slope near Barrio Los Chorros, 1,950 m, 16 Jul 1966 (fr), J. de Britiñ 988 (MO); Valle Grande from the stream to the páramo, 3,100–3,200 m, 8 Nov 1976 (fr), A. Chargin & F. Jacquesmoud 13136 (NY); Vicinity of Mérida, Río Chama, without elev., 14 Jul 1951 (fr), H. Currall 2114 (NY); Distrito
Rangel, Cuenca del Quebrada de La Mitisús, Parque Nacional Sierra Nevada, ca. 08º 51'–52' N, 70º 39' W, 2,300–2,750 m, 19 Jun 1988 (fl, fr), L. Dorn & L. Barnett 5602 (NY); Tabay, 2,200–2,300 m, 2 Sep 1930 (fr), H. Gebriger 401 (F, MO, NY); Parque Nacional Sierra Nevada, de La Mucuy, 13 km air miles NNE of Mérida, 08º 38' N, 71º 2' W, 2,400–2,600 m, 9 May 1991 (fl), W. Meier & O. Carrero 869 (MO); Galipán, Manteco Fac., without elev., without date (fl), J. Moritz 153 (BM); Distrito Libertador, Sierra de Culata, 18 km al NE of Mérida, 2,000–2,500 m, 19 Dec 1983 (fr), J. Pipoly et al. 6486 (MO, NY, VEN); Distrito Campo Elias, Municipio Zerpa, Bosque Experimental de San Eusebio, 2,100–2,400 m, 23 Jan 1963 (fl), L. Ruiz Terán 1297 (MERE, MO); Distrito Campo Elias, Municipio Zerpa, El Molinillo-San Luis, between El Salado and the village of La Azulita, ca. 1,680 m, 18 Mar 1963 (fl), L. Ruiz Terán 1436 (MERE, MO); Distrito Sucre, Municipio Estanques, along Quebrada de Quirorá, unos 4 km E of Quirorá, 700–1,000 m, 21 Feb 1970 (fl), L. Ruiz-Terán & M. Lopez-Figuereas 126 (MERE, MO, NY); Estanques-Páramos of the Cordillera road, Mérida, 1,750 m, 12 Mar 1980 (fr), G. Sobel & J. Stridwick 2151 (NY); NW-NE-facing slopes above “La Isla”, above Tabay, 2,285–2,745 m, 18 May 1944 (fl), J. Steyermark 56588 (F); Distrito Montecarpa, valley above La Hichiceta Mérida, 2,000–3,000 m, 4 Sep 1985 (fr), E. Tanner & V. Kapos 107 (MO); Ridge behind la Montaña teleférico station, ca. 2,600 m, 24 Nov 1985 (fr), E. Tanner & V. Kapos 246 (MO), 251 (MO); Spur ridge behind Estación La Montaña del Teleférico de Mérida, Tanner sites, 2,600–2,750 m, 15 Jul 1986 (ster.), E. Tanner & V. Kapos 402 (MO); La Trampa, Carretera San Juan-Azulita, 2,500 m, 2 Feb 1987 (fl), H. van der Werff et al. 8779 (MO, VEN); Distrito Sucre, along the road from Santa Cruz de Mora to Canaguá, along road 11.5 km from turn off paved road to Guayabal, 08º 20' N, 71º 36' W, 1,660 m, 15 Dec 1984 (ster.), A. Weitzman & N. Hoolbrook 183 (MO, NY). Miranda: Altos de Pipe, 10º 23.7' N, 67º 0.1' W, 1,500 m, 10 May 1965 (fl), G. Agustini 174 (F, NY, VEN); Open sites near de San Antonio de los Altos, without elev., Feb 1965 (fl), L. Aristegüeta 5498 (MO, VEN); Reserva Biológica, Instituto Venezolano de Investigaciones Científicas (IVIC), Interior Branch of Cordillera de la Costa NE of Venezuela, 10º 00' 2' N, 66º 00' W, 1,700 m, 7 Jan 1987 (fr), N. Ramírez 2084 (NY, VEN). Monagas: Summit of Cerro de la Cueva de Doña Anita, S & bordering valley of Caripu, 1,300 m, 7 Apr 1945 (fr), J. Steyermark 61927 (F). Sucre: Península de Paria, trail from Los Pocitos de Santa Isabel to Cerro Humo, 25 km NW of Irapa, 10º 41' N, 62º 36' W, 900–1,250 m, 12 Jul 1972 (fr), K. Dumont et al. 7611 (NY); Cerro Turumiquiare, 10º 07' N, 63º 53' W, 2,000–2,150 m, 14–16 Mar 1993 (fl, fr), W. Meier & G. Bronner 3523 (MO); Península de Paria, trail to Los Pocitos de Santa Isabel to Cerro Humo, 25 km NW of Irapa, 10º 41' N, 62º 36' W, 900–1,250 m, 12 Jul 1972 (fr), G. Morillo 2626 (F, VEN); Valley between base of Cerro de Diablo (W extension of S peak of Cerro Turumiquiare), and Cerro de Neverí, along headwaters of Río de Amana, 2,000 m, 11 May 1945 (fl), J. Steyermark 62721 (F, NY); Península de Paria, Cerro de Humo, NW of Irapa, between Roma and Santa Isabel, ca. 12 kms N of Río Grande Arriba, 1,273 m, 2 Mar 1966 (fr), J. Steyermark 94902 (NY, VEN); Distrito Marino and Distrito Arismendi, Península de Paria, trail between crossing of Río Tacarigua to summit of slopes E of Cerro Humo, descending to Las Melena N of Río Grande Arriba, 10º 41' N, 62º 36–37' W, 760–1,000 m, 24 Feb 1980 (fl), J. Steyermark et al. 121737 (MO, NY). Táchira: Distrito Junín, entre Villa Paúl y Betania, near Colombian border, 2,000–2,400 m, 15 Nov 1975 (fr), G. Bunting 4915 (NY); to above the right bank of Río Táchira on the Colombian border, ca. 2,300 m, 13 Nov 1976 (fr), A. Chabrín & F. Jaconmond 13296 (NY); 7 km W of Rubio, 07º 42' N, 72º 25' W, 900–1,000 m 18 Mar 1981 (fl), R. Lister & A. González 10713 (NY, VEN); Slopes at base of Páramo de Tamá, 2,475–2,550 m, 19 May 1967 (fl), J. Steyermark 98431 (MO, NY, VEN); Forest of the small párano of the Universidad Nacional Experimental del Táchira, San Cristóbal, without elev., 10 Jun 1988 (fl), L. Valverde & I. Peña 1021 (MO); Distrito
Uribante, ca. 5 km outside Siberia along old road to Pregonero, ca. 1,300 m, 20 Nov 1985 (fl), H. von der Wett & F. Ortega 8082 (MO, NY, PORT). Trujillo: Distrito Boconó, Guaramacal, 20 km al E de Boconó, 09° 14' N, 70° 11' W, 1,900–2,300 m, 7 Feb 1987 (fl), G. Aymard et al. 5190 (F, MER, MO); Distrito Boconó, Parque Nacional Guaramacal, 09° 15' 07'' N, 70° 13' 34'' W, 1,950 m, 2–4 Jun 1995 (fl, b), N. Cuello et al. 931 (MO, PORT); S slopes, 09° 14' 48'' N, 70° 12' 15'' W, 1–3 Jul 1995 (ster.), N. Cuello 1107 (MO, PORT); S slopes, 09° 13' 32'' N, 70° 10' 01'' W, 2,400 m, 13–15 Dec 1995 (ster.), N. Cuello et al. 1256 (MO, PORT); 09° 12' 45'' N, 70° 09' 51'' W, 2,300 m, 03–05 Jan 1996 (ster.), N. Cuello et al. 1335 (MO, PORT), 1348 (MO, PORT); Distrito Carache, above Mesa Arriba, between Pico de Jabón and Páramo de Turmál, SE of Laguna de Turmál, 12 km SE of Carache, 09° 35' N, 70° 09' W, 2,550–2,600 m, 12 May 1988 (fl), L. Dorr & L. Barnett 5157 (NY, PORT), 5162 (NY, PORT); Distrito Boconó and Distrito Trujillo border, Quebrada La Honda, SW of Arbol Redondo on the Boconó-Flor de Patria road, 09° 25' N, 70° 20' W, 1,800–2,200 m, 2 Nov 1990 (fl), L. Dorr & L. Barnett 7598 (MO, VEN); Mpio. Boconó, Parque Nacional Guaramacal, S slopes, 09° 13' N, 70° 07' W, 2,100 m, 20–22 Jan 1996 (ster.), A. Licatta et al. 650 (MO, PORT); Distrito Boconó, Páramo Guaramacal, 4.4–4.8 kms beyond jcr. NE of Boconó, 09° 15' N, 70° 14' W, 1,860 m, 19 Jan 1984 (fl), J. Lateyn & J. Pipoly 9280 (F, MER, MO, NY); Distrito Boconó, vicinity Páramo Arbol Redondo, ca. 40 km N of Boconó, 09° 24' N, 70° 18' W, 2,073 m, 20 Jan 1984 (fl), J. Lateyn & J. Pipoly 9328 (MER, MO, NY), 9330 (MER, MO, NY); Distrito Carache, ca. 9 km NE of Carache on Hwy, 2° 09' 38'' N, 70° 09' W, 1,890 m, 21 Jan 1984 (fl), J. Lateyn & J. Pipoly 9335 (MO, NY, VEN). Yaracuy: Distrito Nigruga-Distrito San Felipe border, Cerro La Chapa, 7 km N of Nigruga by road, 10° 12' N, 68° 35' W, 1,200–1,300 m, 21 Oct 1982 (fl), G. Davids et al. 20813 (F, MO, NY, VEN); Sierra de Aroa, Cerro Negro, forest 8 km SW of San Felipe, 10° 17' N, 69° 01' W, 1,200–1,800 m, 1–2 Apr 1980 (fr), R. Liesner & A. Gonzalez 9933 (MO, VEN); El Amparo hacia Candelaria, a 7 km al N de Salom, 1,220–1,250 m, 17–19 Jun 1972 (fr), J. Steyermark 106283 (NY, VEN). Without Location: Venezuela, without elev., 1845 (fl), H. Funk & L. Siblin 140 (BM); Venezuela, without elev., without date (fl), J. Moritz 360 (BM); Venezuela, 1,400 m, without date (fl), P. Vogel 177 (F); Venezuela, 1,400 m, 17 Mar 1946 (fr), P. Vogel 309 (F).

As noted above, this highly variable species exhibits great variation in quantitative features of its vegetative parts, and also in such features as the degree of curvature of the leaf base (obtuse, rounded or acute), leaf shape, vestiture thickness and trichome length, number of flowers and internode length. All of these factors are responsible for the various segregates that have been recognized in the past, including the new one synonymized above.

We believe we have assembled material from throughout subsp. coriacea's range for the first time since Mez's work in 1902 and only for that reason have we been able to appreciate how broadly variation occurs within and among populations. Given this broad plasticity, we have adopted a very broad species concept. One of the synonyms, Myrsine microcalyx, is a bisexual growth form with consequent quantitative floral variation, but with qualitative features of the vegetative organs within the normal range of variation for the subspecies.

Roraima, SW-facing forested slopes between Rondón Camp and base of sandstone bluffs, 2,040–2,255 m, 30 Sep (fl), J. Steyermark 58983 (holotype: F (NY neg. no. 12122); isotypes: NY, US, VEN).

_Shrubs_ or small trees to 3 m tall. Branchlets densely rufous villous-tomentose, often glabrescent. Leaf blades coriaceous, obovate to oblongate, (1.5–3.5–5.5 (–5.8) cm long, (0.8–1)–2.5 cm wide, apically emarginate or obtuse, basally acute, decurrent on the petiole, nitid above, pallid below, essentially glabrous or with a few scattered hairs over the midrib above the petiole, the margin revolute toward the base; petioles marginate, 4–5 (–8) mm long, densely villous along the margin, early glabrescent. Fruit globose, 3–3.5 mm diam.

_Distribution._—Myrsine coriacea subsp. reticulata (Fig. 6) is endemic to the Guayana Region, Pantepui Floristic Province in the state of Bolívar, Venezuela, growing at 2,000–2,750 m elevation.

_Ecology and conservation status._—Subsp. reticulata occurs in gallery forests along streams on the summits of tepuis, where it forms considerable stands with several species of _Terustroemia, Bonnetia, Clusia, Gleasonia_ and _Cyananthus quelchii_. Given the protection afforded the tepuis in the state of Bolívar, the only threat to it is occasional fire. Therefore, it is not considered threatened.

_Etymology._—The subspecific epithet, ‘reticulata’ refers to the prominent secondary veins of the leaf.

Specimens examined. VENEZUELA. Bolívar: Distrito Par, Macizo del Chimantá, wide valley in the SE section of Apacará-tepui, 05° 19' N, 62° 07' W, 2,150 m, 7 Feb 1984 (fl), M. Coello & O. Huber 465 (MYF, NY); Distrito Cedeño, Sierra de Maigualeida, NW sector, tepui plateau over dissected granite, at the headwaters of the Río Chajura, W branch of the Río Erebato, ca. 100 km directly SW of the Campamento Enterríos, 05° 33' N, 65° 13' W, 2,100 m, 18 Nov 1988 (fl), O. Huber & L. Izquierdo 12802 (MYF, US); Hú-tepui, Gran Sabana, 7,000–8,000 ft [2,134–2,438 m], 17 Mar 1952 (fr), B. Maguire 33465 (F, NY, US); Gran Sabana, Sororopán-tepui, near the C. V. G. Antenna, Parque Nacional Canaima, without elev., 17 Aug 1993 (fr), N. Ramírez et al. 4452 (MO, VEN); Chimantá Massif, E branch of headwaters of Río Tírico, 2,150–2,200 m, 12 Feb 1955 (fr), J. Steyermark & J. Woodack 806 (BRIT, F, NY); Chimantá Massif, Toronó-tepui, NW-facing forested slope between Summit Camp and base of escarpment, 1,880–1,970 m, 27 Feb 1955 (fl), J. Steyermark & J. Woodack 1194 (F, MO, NY).

Subspecies reticulata is poorly known, but easily distinguished from subsp. coriacea by its shorter leaf blades, fewer-flowered inflorescences, deltate calyx lobes, and riparian gallery forest habitat.


_Type._ VENEZUELA. AMAZONAS: Cerro de La Neblina, Río Yatua, Bonnetia forest NE of Cañón Grande, 1,200–2,200 m, 8–9 Dec 1957 (fr), B. Maguire, J. Woodack & C. Maguire 42318 (holotype: VEN; isotypes: MO, NY 3-sheets, US).
Fig. 3. Distribution of Myrsine picturata (Y), M. dependens (●), M. andina (▲) and M. maguireana (○) in Venezuela.
Shrubs to 1.5(-2) m tall; trunk and branches orthotropic. Branchlets terete, 5–7 mm diam., glabrous. Leaves spiral; blades cartilaginous, elliptic to ovate, (4–)5–9 cm long, (2.3–)3–5.4 cm wide, apically and basally obtuse, decurrent on the petiole, nitid above, pallid and scrobiculate below, the midrib impressed above, prominently raised below, the secondary venation obscure, conspicuously black punctate and punctate-lineate, the margin membranous, hyaline, revolute, prominently black punctate, glandular-ciliate at first when young, glabrescent, entire; petiole canaliculate, 0.4–0.9 cm long, 2–3 mm diam., glabrous. Staminate inflorescence: unknown. Pistillate inflorescence: an umbelliform glomerule, 4–9-flowered, the peduncle glabrous, epunctate, 1.7–2.5 mm long, built up by a series of floral bract bases; floral bracts obovate, 0.5–0.6 mm long, 0.9–1 mm wide, apically obtuse, the margins entire, densely glandular-ciliate; pedicels cylindrical, 1–1.5 mm long, accrescent in fruit to 2 (–2.5) mm long, glabrous, brown punctate. Pistillate flowers 5-merous; calyx chartaceous, cupuliform, erect, translucent, unequally divided, 1.6–1.8 mm long, the tube 0.6–0.8 mm long, the lobes ovate, 1.1–1.3 mm long, 0.4–0.5 mm wide, apically long-acuminate, glabrous, mediably brown punctate, and prominently keeled, the margins hyaline, roughly dentate, highly irregular, glabrous; corolla chartaceous, campanulate, 2.8–3.2 mm long, translucent, the tube 0.8–1 mm long, the lobes linear-lanceolate, 2–2.4 mm long, 1.2–1.4 mm wide, asymmetric, apically acute, mediably brown punctate, the margin glandular-granulose; staminodes 1.9–2 mm long, the anthers appearing epipetalous, filaments thin, hyaline, 0.1–0.3 mm long, the antherodes widely ovate, 1.2–1.5 mm long, 0.9–1.0 mm wide, the apically apiculate, basally deeply cordate, the connective epunctate; pistil obnapiform, ca. 1.5 mm long, 1 mm diam., the ovary 0.8 mm long, costate, densely pellucid punctate, glabrous, the style 0.2 mm long, costate, the stigma prismatic, 0.5 mm long, 2–3-lobed, the placenta hemispherical, the ovules 3, completely imbedded. Fruit globose, 3–5 mm long and diam., densely pellucid punctate.

Distribution.—Myrsine maguireana (Fig. 3) is known from Cerro de la Neblina and Sierra de Maigualida, Amazonas, Venezuela, growing at 1,200–2,200 m elevation.

Ecology and conservation status.—Myrsine maguireana is restricted to dense, open marshy scrub plateaus and on open tepui summits. While it has a highly restricted distribution and narrow ecological tolerance, the remoteness of these areas has thus far ensured that it is not threatened.

Etymology.—The specific epithet honors the late Basset Maguire, indefatigable explorer, collector and student of the Guayana Region’s flora.

Specimens examined. VENEZUELA. Amazonas: Departamento Río Negro, Cerro de La Neblina, camp 9, 1.2 km NE of waterfall on E headwaters of Río Mawarinuma, 35 km E of Base Camp, 01° 00’ N, 65° 53’ W, 1,780–1,820 m, 2 Feb 1985 (fr), B. Boom et al.
Myrsine maguireana appears to be most closely related to *M. glazioviana* Warm., a taxon known from the Planalto of Brazil. However, *Myrsine maguireana* is easily recognized by the glabrous leaves, glandular-ciliate leaf bud margins, longer, glabrous pedicels, costate ovary and glabrous corolla lobe margins.


*Shrubs* 1.8–2.8 m tall; trunk and branches orthotropic. *Branchlets* terete, glabrous. *Leaves* spiral; blades thickly coriaceous, obovate, widely oblong or suborbicular, (1.7–)2–3 cm long, 1–1.5 cm wide, apically obtuse to broadly rounded, basally obtuse to broadly rounded, nitid above, pallid below, the secondary veins not visible, bearing numerous hydropotes in pits and conspicuously black punctate below, the margins scarious, flat, decurrent on the petiole; petiole marginate, 3–6 mm long, essentially glabrous. *Staminate inflorescence* a fascicle (3–)5-flowered; pedicels 0.9–1.2 mm long. *Staminate flowers* chartaceous, 3–3.2 mm long; calyx cotyliform, chartaceous, 0.9–1.1 mm long and wide, the tube ca. 0.1 mm long, the lobes very widely ovate to suborbicular, 0.9–1.1 mm long and wide, apically obtuse, prominently black punctate, the margins entire except minutely erose apically, hyaline, glabrous; corolla cotyliform, 3–3.2 mm long, the tube 0.2–0.3 mm long, the lobes oblong, 2.8–3 mm long, 1.2–1.3 mm wide, apically acute to obtuse, cuculate, prominently black punctate abaxially, the margins densely glandular-granulose throughout; stamens 2–2.2 mm long, the filaments 0.5–0.6 mm long, the anthers oblong, 1.3–1.5 mm long, 0.7–0.8 mm wide, apically apiculate, basally cordate, dehiscet by extremely wide longitudinal slits, connective epuncate dorsally; pistillode lageniform, hollow, not differentiated into ovary and style, 1.3–1.5 mm long, 0.3–0.4 mm wide. *Pistillate inflorescence* as in staminate but (2–)3–5-flowered, pedicels 0.7–1 mm long. *Pistillate flowers* as in staminate but 2–2.2 mm long; calyx cotyliform, hyaline, 0.8–1.1 mm long, the tube ca. 0.1 mm long, the lobes very widely ovate to suborbicular, 0.9–1 mm long and wide, apically obtuse, prominently black punctate, the margin entire except minutely erose apically, hyaline, glabrous; corolla appearing tubular, but lobes nearly free, 2.0–2.2 mm long, the tube 0.1–0.2 mm long, the lobes oblong, 1.8–1.9 mm long, 0.5–0.6
mm wide, apically obtuse to broadly rounded, densely and prominently black punctate and punctate-lineate abaxially, densely glandular-granulose along entire margin; staminodes 1–1.2 mm long, the filaments 0.7–0.8 mm long, the antherodes obcordate, 0.8–0.9 mm long, 0.5–0.6 mm long, sterile, apically acute, basally deeply cordate, the connective prominently brown punctate apically; pistil ellipsoid, 1.7–1.8 mm long, the ovary 1.2–1.3 mm long, 0.6–0.7 mm wide, opaque beige in color when dried, the stigma conic and spirally lobed, 0.5–0.6 mm long, with 4 slight lobes; placenta ellipsoid, 0.4–0.5 mm long, 0.2–0.3 mm diam., bearing 3 uniseriate ovules, fully exposed on the side of the placenta. *Fruit* globose, (2.5–)3–4.5 mm long and in diam.

**Distribution.**—*Myrsine minima* (Figs. 6, 9) is endemic to the Guayana Region, and is known from eastern Bolívar and adjacent Guayana, and from the Brazilian side of Cerro de la Nebelina, growing from 1,900–2,800 m elevation.

**Ecology and conservation status.**—*Myrsine minima* is known only from extremely remote and well-protected areas. It occurs in scrub forest and exposed areas in upland tepui savannas. Therefore the species is not under threat at this time.

**Etymology.**—The epithet “minima” refers to the diminutive size of the leaf blades.

Specimens examined. BRAZIL. Amazonas: Parque Nacional do Pico da Nebelina, rocky formation of Pico da Nebelina, 2,600 m, 21 Aug 1985 (fl), C. Farney et al. 905 (MO); Serra da Nebelina, summit to Pico Phelps, 9,000 ft [2,743 m], 2 Dec 1965 (fr), B. Maguire et al. 60450 (BRIT, NY, US). GUYANA. Mazaruni-Potaro: Roraima, summit, La Prúa camp, E of border, near Lake Gladys, 05° 15' 36" N, 60° 13' W, 2,800 m, 14 Apr 1988 (fr), R. Lienier 23296 (MO, US). VENEZUELA. Bolívar: Distrito Piar, Macizo del Chimatá, north mesa of Abacapá-tepui, located in the SW sector of the massif, 05° 10' N, 62° 16' W, 2,200 m, 31 Jan–2 Feb 1984 (bud), O. Huber & N. Dezeo 8590 (MYF, NY); Distrito Piar Macizo del Chimatá, sector SE, central SE section of Churí-tepui, 05° 15' N, 61° 58' W, 2,250 m, 28 Mar 1984 (fl), O. Huber 9269 (MYF, NY); Distrito Piar, Macizo del Chimatá, sector SE, mesa slightly sloping toward the SSE, in the central-SE portion of Churí-tepui, 05° 15' N, 61° 58' W, 2,250 m, 6–8 Feb 1985 (fr), O. Huber et al. 10100 (MYF, NY); Distrito Piar, Macizo del Chimatá, NW sector, superposed mesa on the summit of the central part of Maréy-(Eruoda-) tepui, 05° 22' N, 62° 05' W, 2,600 m, 15–17 Mar 1986 (fl), O. Huber 11593 (MO, MYF, NY 2-sheets); Distrito Piar, W summit of Angasima-(Adanta-) tepui, 10 km SSE from the W limit of Amurí-tepui (Macizo del Chimatá) and ca. 40 km NWN of the Mission de Wonkén, 05° 05' N, 62° 07' W, 2,100 m, 9 Aug 1986 (fl), O. Huber 11698 (MYF, NY); Kukenán-tepui, summit, 05° 13' N, 60° 18' W, 2,550 m, 11 Apr 1988 (fr), R. Lienier 23107 (BRIT, MO, NY, US, VEN); (fl, fr), 23210 (MO, US, VEN); Ilu-tepui, lower plateau, 05°, 25° 36" N, 60° 29' W, 2,500 m, 16 Apr 1988 (fr), R. Lienier 23426 (BRIT, MO, US, VEN); Distrito Piar, Macizo del Chimatá, sector SE, mesa slightly sloping toward the SSE, in the central SW section of Churí-tepui, 05° 15' N, 61° 58' W, 2,250 m, 6–8 Feb 1985 (fr), J. Pipoly et al. 7141 (MO, MYF, NY, US); Chimatá Massif, E-central portion of summit of Apacara-tepui, 2,450–2,500 m, 21–22 Jun 1953 (fr), J. Steyermark 75931 (F, NY); Chimatá Massif, along tributary valley of E branch of headwaters of Río Tírica, 2,120 m, 13 Feb 1955 (fl), J. Steyermark & J. Wurdack 843 (BRIT, F,
NY); Meseta de Jauá, Cerro Jauá, summit of the Central-Western portion of the Meseta, 36 nautical miles or 60 kms NW of the mission at the medical camp of Río Kanarákuni, 1,922–2,100 m, 22–27 Mar 1967 (fl), J. Steyermark 97985 (MO, NY, VEN); Distrito Sucre, Meseta de Jauá, 0°45’ 35’ N, 61° 15’ W, 2,020 m, 14 Feb 1981 (fl), J. Steyermark et al. 124328 (BRIT, MO, NY, VEN); Distrito Piar, Macizo del Chimaná, mesa at the southern base of the upper walls of Aparatá-tepui, N sector of Macizo, exposed knolls near stream, 05° 20’ N, 62° 12’ W, 2,200 m, 30 Jan–1 Feb 1983 (fl), J. Steyermark et al. 128268 (MO, NY, VEN); Roraima, 2,500 m, Jul 1910 (fl), E. Ule 8721 (US).

Myrsine minima appears to be closely related to Myrsine andina, but is easily separated by its glabrous branchlets, shorter leaves and longer pedicels.


Mez’ description clearly indicates that the branchlets of Myrsine andina are ferrugineous-pilose tomentose, although they are often glabrous. Also, the floral description matches those of all sheets except C. von Feldi 12 (W). Given that Mez saw all the duplicates of the Spruce collection, that they are the most numerous, and include staminate and pistillate individuals, we designate its duplicate at Kew (K) as the lectotype.

Shrubs or trees to 5 m tall; trunk and branches orthotropic. Branchlets terete, rufous glandular papillose-tomentose at first, glabrescent. Leaves spiral; blades coriaceous, elliptic to oblaimginal, (2.8–3)–5.2(–5.5) cm long, 1.5–2.5(–2.9) cm wide, apically emarginate, basally obtuse to subacute, nitid, the midrib impressed above, prominently raised below, the secondary venation not visible, densely and prominently black punctate above and below, sparsely red-papillate along midrib above at first, early glabrescent, the margin densely black punctate below, inrolled, entire, decurrent on the petiole; petioles marginate, 5–7 mm long. Staminate inflorescence fasciculate, (3–)5–8-flowered, on short perrennating shoots girdled by floral bracts, 1–1.5 mm long; floral bracts ovate, 1–1.3 mm long, 0.5–0.7 mm wide, apically acute, the margins somewhat erose, long glandular-ciliate; pedicels 0.5 mm long. Staminate flowers 2–2.2 mm long; calyx chartaceous, cotyliform, the tube ca. 0.1 mm long, the lobes ovate, 0.8–1 mm long, 0.5–0.7 mm wide, apically acute, minutely and prominently black punctate, the margin entire, long glandular-ciliate apically, glabrescent; corolla campanulate, 2–2.2 mm long, the tube 0.2 mm long, the lobes ovate, 1.8–2 mm long, 0.6–0.7 mm wide, apically acute, densely and prominently black punctate and punctate-lineate without, glabrous within, the margin entire, densely glandular-ciliate apically; stamens 1.8–2 mm long, the filaments not discernible, developmentally fused to corolla tube, the anthers appearing epipetalous, broadly ovate, 1.5–1.6 mm long, 0.6–0.8 mm wide, apically apiculate, basally
cordate, the connective slightly dark brownish dorsally; pistillode conic, hollow or absent. *Pistillate inflorescence* as in staminate but on shoots to 1.5 mm long; pedicels 0.7–0.8 mm long. *Pistillate flowers* as in staminate but 2.8–3 mm long; calyx cupuliform, 1.3–1.5 mm long, the tube ca. 0.3 mm long, the lobes ovate, 0.9–1 mm long, 0.7–0.8 mm wide; corolla campanulate, 2.6–2.9 mm long, the tube ca. 0.5 mm long, the lobes 2.1–2.3 cm long, 0.6–0.8 mm wide; staminodes like the stamens but 1–1.3 mm long; pistil conical, 0.8–1.0 mm long; 0.7–0.8 mm diam., the stigma sessile, conical, prismatic, with 4 lobes; placenta globose; ovules 2–3, uniseriate. *Fruit* globose, 3.5–5 mm diam, the stigma persistent, prominently punctate.

**Distribution.**—In Venezuela, *Myrsine andina* (Fig. 3) is only known from secondary and dry forests in Estado Táchira, but is well known otherwise from Venezuela, southward through Colombia, Ecuador, and Peru to Bolivia, growing at (400–)1,200–2,500 m elevation.

**Ecology and conservation status.**—*Myrsine andina* is restricted to primary cloud forest margins just below the subpáramo thicket transition throughout its range. Because many montane roads through the Andes follow the páramo-cloud forest contour, it should be considered threatened.

**Etymology.**—The specific epithet refers to its place of description and range, throughout the Andes.

Specimens examined. VENEZUELA. Táchira: 5 km E of San Antonio del Táchira, 07° 50' N, 72° 25' W, 1,400 m, 5 Jan 1989 (fl), W. Habb & F. Grifo 4971 (MO, NY, US); Parque Cazadero, Quebrada Cazadero, 16 km NW of San Cristóbal, 400–650 m, 2 May 1981 (fr), R. Liesner & M. Guariglia 11655 (MO, VEN); Paramito between Quebrada de Palmar & Quebrada de Paramito, at base of Páramo de Tamá, 2 kms above Betania & 7 kms above Villa Paéz, 2,500 m, 14 Jun 1944 (fl), J. Steyermark 57205 (F, NY); Along path between “Las Copas” and peak of Fila de Tierra Negra, toward Cerro de Segeta and Fundación Bélgica, on the narrow range that divides the headwaters of Río Quinimarí, Río Frío and Uribante and Río Talcó (Oiró), 20–25 km S of San Vicente de la Revancha, 35–40 km S of Alquiriana, SW of Santa Ana, 2,870–2,880 m, 16 Jan 1968 (fr), J. Steyermark et al. 100998 (NY, VEN).** Without Locality: Without locality, without elev., 1848 (fl), J. Linden 108 (P).

*Myrsine andina* appears to be closely related to *M. minima*, but is easily separated by its glandular-papillate branchlets, emarginate leaf blades and sub sessile flowers.


**Type.** VENEZUELA. AMAZONAS: Cerro de La Nebina, Camp VII, 5 km NE of Pico Phelps, vicinity of heliport on rock outcrop, 00° 50' 40" N, 65° 58' 10" W, 1,850 m, 1 Feb 1985 (fr), M. Nee 30697 (holotype: VEN; isotypes: F, NY, US).

*Trees* to 4 m tall; trunk and branches orthotropic. *Branchlets* terete, 2.5–3 mm diam., glabrous. *Leaves* spiral; blades chartaceous, oblanceolate to elliptic, (4–)4.8–5.5(–6) cm long, (1.5–)1.8–2 cm wide, apically acute, basally cu-
neate to rounded, decurrent on the petiole, asymmetric, somewhat nitid above, pallid and black punctate-lineate below, the midrib impressed above, prominently raised and brown punctate-lineate below, the secondary veins prominent above and below, the margin revolute, translucent but not hyaline, entire, brown punctate, glandular-ciliate at first, early glabrescent; petiole marginate, 0.3–0.5 mm long. *Staminate inflorescence* unknown. *Pistillate inflorescence* unknown. *Inflorescence*: glomerulate, apparently 1–3-flowered, the peduncle glabrous, epunctate, (1.2–)1.6–2.4 mm long; floral bracts orbicular, 0.8–1 mm long, 0.8–1 mm wide, apicily obtuse, densely pellucid punctate, the margins densely erose-ciliate; pedicels cylindrical, 1.2–2 mm long, glabrous, sparsely pellucid punctate-lineate. *Pistillate flowers*: unknown. *Fruiting calyx*: chartaceous, cotyliform, unequally divided, 1.2–1.3 mm long, translucent, densely and prominently brown punctate and punctate-lineate, with darkened glandular areas at the calyx lobe/tube sinus, the tube 0.2–0.3 mm long, the lobes very widely ovate to deltate, 1–1.2 mm long, 0.8–1 mm wide, apiciy acute, prominently brown punctate and punctate-lineate, flat, the margin hyaline, entire, densely glandular-ciliate. *Fruit* globose, 3–5 mm long and in diam., when dried, densely pellucid punctate and punctate-lineate.

*Distribution.*—*Myrsine perpunctiflora* (Fig. 9) is endemic to the Cerro de La Neblina, 1,500–1,730 m elevation.

*Ecology and conservation status.*—*Myrsine perpunctiflora* is restricted to low shrubland on saturated soils. Because Cerro de la Neblina is extremely remote and protected, the species is not threatened.

*Etymology.*—The specific epithet refers to the fact that the inflorescences are infrequent and very few-flowered.

Specimens examined. **VENEZUELA. Amazonas**: Departamento Río Negro, Cerro de La Neblina, Camp VII, 00° 52' N, 65° 58' W, 1,730–1,850 m, 10 Feb 1985 (fr), S. Renner 2096 (US); Cerro de La Neblina, Camp 2, Neblina massif, 2.8 km NE of Pico Phelps, 00° 49' 40" N, 65° 59' W, 2,100 m, 15 Apr 1984 (fr), B. Stein & A. Gentry 1525 (MO, NY, VEN).

*Myrsine perpunctiflora* is most closely related to *M. lanicifolia* Mart., but is separated by the smooth upper leaf blade surface, the prominent brown punctations of the calyx, and inflorescences with 1–3 flowers. Within the Guayana Region, it may be confused with *Myrsine picturata*, but is easily recognized by the abaxial leaf surface less conspicuously (not densely and prominently) black punctate-lineate, 1–3 (not 3–5)–flowered inflorescence, calyx lobes brown (not black) punctate, and globose (not obovoid) fruit.

Shrubs 1–1.5(–3) m tall; trunk and branches orthotropic. Branchlets terete, glabrous. Leaves spiral; blades chartaceous to thinly coriaceous, linear-oblancoolate, lorate or narrowly elliptic, (4–)6–12(–15) cm long, (1–)1.7–2(–2.7) mm wide, apically acute to attenuate, basally acute to attenuate, midrib prominulous above, prominently raised below, the secondary venation prominulous above.
and below, nidid above, pallid below, with conspicuous black punctate-lineations (5—)20—40 mm long below, the margins entire, inrolled and revolute at least basally; petioles flat above, marginate, 6—9 mm long. Stami-nate inflorescence a sessile, 4—8-flowered umbel; floral bracts ovate, 0.8—1 mm long, 0.6—0.7 mm wide, apically acute, inconspicuously red punctate, the margins entire, densely glandular-ciliolate; pedicels 2.5—3.5 mm long. Stami-nate flowers 5(—7)-merous, chartaceous; 2.5—3 mm long; calyx corymiform, 1.2—1.4 mm long, the tube ca. 0.2 mm the lobes ovate, 1—1.2 mm long, 0.9—1 mm wide, apically short-acuminate, essentially epinate or with one or two scattered glands, the margin irregular, sparsely glandular-ciliolate; corolla campanulate, 2.6—2.7 mm long, the tube 0.4 mm long, the lobes ovate, 2.2—2.3 mm long, 1.6—1.7 mm wide, apically sharply acute to attenuate, sparsely brown punctate and punctate-lineate, the margins densely glandular-granulose; stamens 2—2.2 mm long, the filaments not visible, the anthers oblong, 2—2.2 mm long, apically apiculate, basally subcordate, the connective dark brownish punctate-lineate dorsally; pistillode conic, 0.9—1 mm long, hollow. Pistillate inflorescence a sessile 5—7-flowered umbel, as in stamine but pedicels 3.5—5 mm long. Pistillate flowers as in stamine but 2—2.2 mm long; calyx lobes ovate, 1.3—1.4 mm long, 0.9—1 mm wide; corolla 2—2.2 mm long, the tube, 0.2 mm long, the lobes 1.8—2 mm long, 0.7—0.9 mm wide; staminodes 1.3—1.5 mm long, the filaments 0.3 mm long, the antherodes 1.1—1.3 mm long, 0.5—0.6 mm wide, apically apiculate, basally sagittate; pistil globose, 2—2.2 mm long, the ovary 1—1.1 mm long, 1.2—1.4 mm wide, the stigma umbraculiform, with 4 vertical spirally twisted lobes, 1—1.2 mm long; placenta globose, 0.6—0.7 mm long, 0.5—0.6 mm wide; ovules 2—3, unicurate; immersed. Fruit subglobose, longer than broad, 3.5—5 mm long and broad, black at maturity, the exocarp thick, juicy, densely and conspicuously black punctate-lineate when dried.

Distribution.—Myrsine resinosa (Fig. 6) is known only from the eastern portion of Pantepui Floristic Province in the state of Bolívar in Venezuela, and the adjacent Mazaruni-Potaro region in Guyana, growing at 470—1,000 m elevation.

Ecology and conservation status.—This species is known from gallery forests along rivers in lowland dry savannas. Because these forests house the relatively scarce source of construction materials, M. resinosa should be considered threatened.

Specimens examined. GUYANA. Mazaruni-Potaro: Upper Mazaruni River basin, Kuku River between Mokay River and Sura-agu-puh River, 470 m, 11 Sep 1960 (fl), S. Tillett & C. Tillett 45380 (FDG, NY, US). VENEZUELA. Bolívar: Gran Sabana, ca. 10 km SW of Karaurin-tepui at junction of Río Karaurin and Río Asaon (Río Sampa), 05° 19’ N, 61° 03’ W, 900–1,000 m, 20 Apr 1988 (fr), R. Leiner 23465 (BRIT, MO, NY, US, VEN); 21 Apr 1988, 23534 (BRIT, MO, NY, US, VEN); Gran Sabana, orillas del Rio Aponguao,
without elev., 18 Jan 1973 (fl), G. Morillo et al. 2887 (VEN 2-sheets); Along Río Karuai, between base of Ptari-tepui and Sororopán-tepui, 1,220 m, 28 Nov 1944 (fr), J. Steyermark 60726 (F, NY, US).

Myrsine resinosa may be confused with M. picturata, but is easily separated by the linear-oblancoellate, lorate or narrowly elliptic leaf blades with long, conspicuous punctate-lineations, and the longer pedicels.


Trees to 8 m tall. Branchlets terete, 4–5 mm diam., glabrous; trunk and branches orthotropic. Leaves spiral; blades coriaceous, elliptic to oblanceolate, (3) 4–6 cm long, (1.5–)1.8–2(–3) cm wide, apically obtuse to slightly emarginate, basally cuneate, decurrent on the petiole, the midrib strongly impressed above, raised and ribbed below, the secondary veins prominent below, nitid above, pallid below, prominently and densely black punctate and short-fineate, translucent glandular-lepidote above in bud, glabrescent; the margin revolute, entire, hyaline, with prominently raised black punctations, densely red glandular-ciliate in bud, glabrescent; petiole canalicate, (0.7–)0.8–1 cm long, glabrous. Staminate inflorescence: unknown. Pistillate inflorescence glomerulate, 3–5-flowered, the peduncle glabrous, epunctate, 1.2–2.1 mm long; floral bracts membranaceous, very widely ovate to deltate, 0.7–1.0 mm long, 0.8–1.2 mm wide, apically obtuse, densely and prominently black punctate and punctate-lineate, the margin entire, glandular-ciliate; pedicels cylindrical, 0.9–1.0 mm long, glabrous, densely and prominently black punctate-lineate. Pistillate flowers 5-merous, translucent green; calyx chartaceous, cotyliform, 1.3–1.5 mm long, the tube 0.1–0.2 mm long, the lobes ovate, 1.1–1.2 mm long, 0.6–0.8 mm wide, apically long-attenuate, glabrous, densely and prominently black punctate-lineate, medially crassate, the margin hyaline, flat, irregular, glabrous; corolla membranaceous, campanulate, 1.8–2.0 mm long, the tube 0.5–0.6 mm long, the lobes ovate, 1.2–1.4 mm long, 0.6–0.7 mm wide, apically rounded to obtuse, densely and prominently black punctate and punctate-lineate, hyaline, the margin densely glandular-granulose, entire; staminodia 1.2–1.4 mm long, the filaments obsolete to 0.1 mm long, the antherodes ovate, 0.9–1 mm long, 0.3–0.4 mm wide, apically apiculate, basally sagittate, epunctate, but the connective darkened dorsally; pistil ellipsoid, 2.1–2.4 mm long, the ovary 1.5–1.8 mm long, 1.0–1.2 mm diam., densely and prominently black punctate and punctate-lineate, the stigma subsessile, conical, ca. 0.6 mm long, 2–3-lobed longitudinally, pellucid punctate, apically cuspidate, ovules 3, immersed in a globose placenta. Fruit obovoid, 4–5 mm long, 3–3.5 mm diam. when dried, densely and prominently black punctate and punctate-lineate.

Distribution.—Myrsine picturata (Figs. 3, 6) is endemic to Cerro de la Neblina
Fig. 6. Distribution of *Myrsine resinosa* (■), *M. minima* (•), *M. coriacea* subsp. *reticulata* (Ψ), *M. vitida* (Λ) and *M. picturata* (〇) in Venezuela and bordering Guyana region. Note that this map is essentially a close-up of the eastern portion of Figure 9, with *M. minima* repeated to eastern range more precisely.
of Amazonas and the Ilú-tepui on the Gran Sabana of Bolívar, growing at 1,200–2,450 m elevation.

Ecology and conservation status.—This species grows in low woodlands in cloud forests on saturated soil. Despite its restricted distribution, the protected status and remoteness of the Cerro provide it adequate protection.

Etymology.—The specific epithet refers to the dense and prominent black punctate lineations of the leaf blades, perianth parts and fruits.

Specimens examined. VENEZUELA. Amazonas: Departamento Río Negro, Cerro de La Neblina, Cumbre Camp Swale, 1,200–2,200 m, 19 Nov 1957 (fr), B. Maguire et al. 42090 (f, NY-2 sheets, US); Cerro de La Nebina, Río Yatua, S rim of upper basin of Cañon Grande, 1,200–2,200 m, 13 Dec 1957 (fr), B. Maguire et al. 42376 (NY 3-sheets). Bolívar: Gran Sabana, Ilú-tepui, slopes below upper most W-facing escarpment, 7,000–8,000 ft [2,134–2,438 m], 21 Mar 1952 (fl), B. Maguire 33535 (NY).

*Mysine picturata* may be confused with *M. perpusciflora*, but is separated by the more densely and prominently black punctate-lineate abaxial leaf surface, the 3–5 (not 1–3)-flowered inflorescences, calyx lobes black (not brown) punctate, and obovoid (not globose) fruit.


Type. VENEZUELA. Amazonas: Sierra Parú, Río Parú, Cerro Parú, valley above camp and valley draining eastward through cumbre, 2,000 m, 10 Feb 1951 (fr), R. Cowan & J. Wardock 31372 (HOLOTYPE: VEN; ISOTYPES: f, NY-2 sheets, US).

Tree to 7 m tall; trunk and branches orthotropic. Branchlets terete, 7–10 mm diam., glabrous. Leaves spiral; blades coriaceous, elliptic to obovate, 9.5–16 cm long, 6.5–9.2 cm wide, apically obtuse, basally acute, decurrent on the petiole, pallid and scrobiculate above and below, midrib impressed above, prominently raised below, the secondary vein pairs 13–26, mostly inconspicuous, but somewhat visible below, not evidently punctate, the margin opaque, highly revolute basally, glabrescent, entire; petioles marginate, 1.5–2 cm long, glabrous. Staminate inflorescence: unknown. Pistillate inflorescence: unknown. Inflorescence: glomerulate, apparently 4–8-flowered, the peduncle glabrous, epunctate, 1.2–4.2 mm long, made up of floral bract bases; floral bracts very widely ovate to oblate, 0.5–0.7 mm long, 1.0–1.2 mm wide, apically obtuse, densely pellucid punctate, the margin entire, densely glandular-ciliate; pedicels cylindrical, 1.1–1.4 mm long, glabrous, epunctate. Pistillate flowers unknown. Fruiting calyx cotyliform, coriaceous, 1.2–1.4 mm long, the tube 0.2–0.3 mm long, the lobes very widely ovate to oblate, 1.0–1.2 mm long, 1.1–1.3 mm wide, the apically acute, densely pellucid punctate, the margin irregular, opaque, entire, glabrous. Fruit globose, 0.8–1.2 cm long and diameter, purplish at maturity, inconspicuously pellucid punctate.

Distribution.—*Mysine macrocarpa* (Fig. 9) is endemic to the state of Amazonas, Venezuela, growing at 1,500–2,000 m elevation.
Fig. 7. A. Habit, flowering branch of *Myrsine macrocarpa* Pipoly, drawn from *R. Cowan & J. Wurdack* 31372 (NY isotype). B. Fruit of same, drawn from *R. Cowan & J. Wurdack* 31372 (NY isotype). C. Habit, flowering branch of *Myrsine pellicida* (Ruiz & Pav.) Spreng., drawn from *J. Lateyn & J. Pipoly* 9370. D. Fruit of same, drawn from *A. Gentry et al.* 11090. E. Detail of branchlet apex and partial petiole with reddish glandular-papilae of same, drawn from *A. Gentry et al.* 11090.
Ecology and conservation status.—Myrsine macrocarpa is a riparian species, occurring at the margins of gallery forests in upland, wet savannas. Because its known localities are so remote, and so wet, they are not particularly subject to dangers from human intervention nor fire. Therefore, the species should not be considered threatened.

Specimens examined. VENEZUELA. Amazonas: Cerro Huachamacari, Río Canacunnuma, below Camp II, 1,000 m, 20 Dec 1950 (fr), B. Maguire et al. 29969 (NY-2 sheets); In vicinity of Summit Camp, 1,800 m, 6 Dec 1950 (fr), B. Maguire et al. 30005 (NY); Along right fork of Caño de Dios in cumbre near Summit Camp, 13 Dec 1950 (fr), B. Maguire et al. 30180 (NY-2 sheets); Departamento Atraves, lomas graníticas, Caño Piedra, 115 km al SE de Puerto Ayacuchu, 04° 54' N, 66° 54' W, 1,500 m, Sep 1989 (ster.), E. Sanoja et al. 2988 (MO).

Myrsine macrocarpa is most closely related to the vicariant M. pellucida (Ruiz & Pav.) Spreng., but is easily separated by the prominent secondary veins and pellucid punctations of the leaf blades, shorter pedicels, glabrous calyx lobes margins, and the large fruits.


Trees to 5(−10) m tall; trunk and branches orthotropic. Branchlets terete, reddish glandular-papillose. Leaves spiral; blades coriaceous, elliptic, oblong, oblanceolate or obovate, (6.5−)7.5−18 cm long, (2.7−)3.3−7.9 cm wide, apically obtuse to subacute, basally acute, nitid above, densely reddish glandular-papillate along the midrib above, the midrib impressed above, prominently raised below, the secondary veins inconspicuous above and below, pellucid or black punctate and punctate-lineate below, the margin flat, slightly decurrent on the petiole; petiole marginate, 0.5−1.0 cm long, densely red glandular-papillate, glabrescent. Stamineate inflorescence sessile, 8−12-flowered; floral bracts coriaceous, ovate, ca. 1.3−1.5 mm long, 1.2−1.4 mm wide, apically broadly rounded, long reddish glandular-ciliolate; pedicels obsolete to 1 mm long. Stamineate flowers chartaceous, 2−2.2 mm long; calyx coryliform, ca. 1 mm long, the tube 0.2−0.3 mm long, the lobes ovate, unequally divided, longer than wide, 0.7−0.8 mm long. 0.5−0.7 mm wide, apically obtuse to subacute, densely and prominently black punctate and punctate-lineate, the margin sparsely glandular-ciliate, irregular, entire; corolla broadly campanulate, 2−2.2 mm long, the tube ca. 0.3 mm long, the lobes elliptic, 1.7−1.9 mm
long, 0.7–0.8 mm wide, apically acute, densely and prominently black punctate and punctate-lineate, the margin entire, densely glandular-granulose throughout; stamen 1.4–1.7 mm long, filaments not obvious, venation visible, ca. 0.3 mm long; anthers ovate to oblong, 1.5–1.7 mm long, apically apiculate, the apiculum darkened, recurved ventrally, basally subcordate, the connective black lineate; pistillode conic, hollow, ca. 1 mm long, 0.5 mm diam. Pistillate inflorescence as in staminate. Pistillate flowers as in staminate but antherodes 1–1.1 mm long; pistil 2–2.5 mm long, 1–1.3 mm diam., the ovary subglobose, 1.2–1.3 mm long and in diam., the stigma carnose, prismatic, 1–1.1 mm long and in diam., the placenta ellipsoid, 1 mm long, the ovules 3–4, uniseriate. Fruit globose, 3–3.5 mm diam., obscurely punctate and punctate-lineate.

Distribution.—Almyrine pellucida (Fig. 9) is known from the Venezuelan coastal range in the state of Falcón, south and westward through the Andes of Venezuela, Colombia, Ecuador, and Peru to Bolivia and adjacent Paraguay, growing at (400–)1,000–2,600 m elevation. There are a few disjunct populations in the western portion of the state of Bolivia, Venezuela, growing on diabasic intrusion areas in the tepuis.

Ecology and conservation status.—Almyrine pellucida is found along disturbed roadsides through cloud forest and subpáramo life zones, and along margins of cloud forests. The disjunct populations in the state of Bolivia are on diabasic intrusions in otherwise superimposed Roraima Sandstone formations.

Etymology.—The epithet ‘pellucida’ refers to the pellucid punctations of the abaxial leaf blades and fruits.

Specimens examined. VENEZUELA. Barinas: Distrito Pedraza, trail from Mesa de Canaguá (ca. 08° 34' N, 70° 37' W) to Pozo Negro (ca. 08° 32' N 70° 37' W), 400–600 m, 25 Nov 1990 (fr), L. Dorr et al. 7872 (MO, PORT); Ca. 32 km NE of Altamira & 3 km NE of Caldas, 08° 55' N, 70° 25' W, 1,000 m, 24 Jan 1984 (fr), J. Letey & J. Pipoly 9377 (BRIT, MO, NY, PORT). Bolívar: Distrito Cedeño, near Minería El Guaniamo, 06° 27' N, 65° 52' W, 300 m, May 1993 (ster.), F. Diaz 1756 (MO); near small Minería El Guaniamo, 06° 27' N, 65° 52' W, 500 m, May 1993 (ster.), W. Diaz 1759 (MO); Municipio Raul Leoni, 64 km al SE de Pijiguaos, 06° 09' N, 66° 23' W, 550 m, Jul 1989 (fr), L. Delgado 282 (MO). Falcón: Distrito Bolívar, mesa de Sierra de San Luis, ca. 1 km S of caserio Carrajalito, 11° 05' N, 69° 42' W, 1,100 m, 31 Aug 1985 (fr), O. Haber & W. Monaver 10823 (BRIT, MEF, MO, W); Cuatire, Sierra de San Luis, 3/4 km post, 11° 08' N, 69° 46' W, 1,000 m, 20 Jun 1979 (fr), R. Lioyer et al. 7661 (MO, VEN). Lara: Distrito Torres, Páramo Agua Linda, near television repeating towers and el Fundo Orion, above the village of Palmarito, along the Carretera Lara-Zulia ca. 33 km E of El Venedo, between Km 12–15, 10° 10' N, 70° 42' W, 6–7 Sep 1980 (fr), G. Bunting & A. Stodder 9743 (NY); Distrito Morán, trail from Humacoro to Buenas Aires, Caserio, below Páramo Los Rosas, 09° 40' N, 70° 05' W, 2,600 m, 25 Jun 1979 (fr), R. Lioyer et al. 7949 (MO); Distrito Morán, ca. 4.4 km W of Humacoro Alto, 09° 36' N, 70° 01' W, 1,400–1,500 m, 22 Jan 1984 (stam. fr.), J. Letey & J. Pipoly 9357 (MO, NY, PORT). Mérida: Mucurubá, without elev., 12 Nov 1952 (fr), L. Bernardi 11 (NY); Antes de la Palmira, 700 m, 4 Feb 1955 (fr), L. Bernardi 1881 (NY, VEN); Pueblos del Sur, 1,450 m, Jun 1955 (fr), L. Bernardi 2293 (NY, 2-sheets); 26 km NE of Mérida along road to Valencia, right bank of Chama River, 2,000 m, 18 Nov 1963.
Ricketson and Pipoly, Myrsine in Venezuela

Myrsine *pellucida* is a common plant throughout the Andes, particularly easy to distinguish because of the sessile umbels and reddish glandular papillae of the terminal bud and apical zone of the branchlets. This species, along with *Myrsine latifolia* (Ruiz et Pav.) Spreng. have been misidentified as *M. guianensis*, which does not occur in the Andes. Within Venezuela, it may be confused with *Myrsine macrocarpa*, but is easily distinguished by the red glandular-papillate branches petioles and leaf midrib, smaller fruits and shorter petioles. Another significant difference is that *Myrsine pellucida* is restricted to soils on metamorphic rock, while *M. macrocarpa* is a tepui species.


Fig. 8. A. Habit, flowering branch of Alyssium nitida (Mez) Pipoly, drawn from A. Pinkus 132 (NY, holotype of Rapumia ramosensis A.C. Sm). B. Fruit of same, drawn from J. Steyermark 75834. C. Habit, flowering branch of Alyssium gianzenis (Aubl.) Kuntze, drawn from J. Aublet s.n. (BM islectotype). D. Fruit of same, drawn from L. Delgado 2145.
Shrub or tree to 10 m tall; trunk and branches orthotropic. Branchlets terete, glabrous. Leaves spiral; blades coriaceous, elliptic or oblanceolate, (5.5)12–17 cm long (2.7–3.5–5.7 cm wide, apically acute or rarely, obtuse, basally acute to obtuse, slightly decurrent on the petiole, the secondary veins prominulous above; obviously brochidodromous, the loop connections visible dull to somewhat nitid above, conspicuously reddish punctate and punctate-lineate below, the margin entire, flat; petioles marginate, 0.7–1.5 cm long, glabrous. Staminate inflorescence fasciculate, 5–9-flowered, the short shoots sessile to 3 mm long; floral bracts ovate, 1–1.2 mm long, 0.7–0.8 mm wide, apically acute, densely and prominently black punctate-lineate; pedicels 1–1.3 mm long. Staminate flowers 5-merous, chartaceous, 3.4–3.6 mm long; calyx clytiform, 1.2–1.4 mm long, the tube 0.2–0.3 mm long, the lobes ovate to deltate, 1–1.2 mm long, and wide, prominently black punctate-lineate medially, apically acute, the margin entire, minutely glandular-ciliolate; corolla campanulate, 3.4–3.6 mm long, the tube 0.7–0.9 mm long, the lobes oblong to elliptic, 2.5–2.7 mm long, 1.2–1.3 mm wide, apically acute to obtuse, densely and prominently black punctate and punctate-lineate, the margin entire, glandular-granulose throughout; stamens 2.9–3.1 mm long; filaments not obvious, ca. 0.7–0.9 mm long, the anthers ovate to oblong, 2–2.1 mm long, 1.1–1.3 mm wide, apically apiculate, basally subcordate, the connectives black punctate-lineate dorsally; pistillode conic, 2 mm long, 1 mm wide, the sterile stigma conic, 4-lobed, hollow. Pistillate inflorescence as in staminate but pedicels 1–1.5 mm long. Pistillate flowers as in staminate but 2.5–2.9 mm long; calyx 1.5–1.7 mm long, the tube ca. 0.5 mm long, the lobes ovate to deltate, 0.9–1 mm long and wide, apically acute; corolla 1.8–2 mm long, the tube 0.7–0.8 mm long, the lobes elliptic, 1.1–1.3 mm long, ca. 0.5 mm wide; staminodes ca. 1.5 mm long, the filaments not obvious but venation visible, ca. 0.7–0.8 mm long, the antherodes malformed, 0.5–0.8 mm long, ca. 0.5 mm wide, apically acute, basally subsagittate; pistil 2.5–2.7 mm long, the ovary globose, 1.1–1.3 mm long and diam., the stigma lacinate, 4-lobed, translucent, carnose, 1.5–1.7 mm long, 1–1.2 mm diam, the placenta ellipsoid; ovules 3–4, uniseriate. Fruit globose, 3–3.5 mm long and in diam., obscurely pellucid punctate.

Distribution.—Myrsine nitida (Fig. 6) is known from the state of Bolívar in Venezuela, and adjacent Guyana, growing at (830–)1,800–2,450 m elevation.

Ecology and conservation status.—Myrsine nitida occurs in rocky knolls in savannas, along the margins of premontane forests, Clusia-Magnolia riparian forests, and in Mora forests. Because these forests produce more timber than any of those surrounding them, this species should be considered threatened.

Etymology.—The specific epithet refers to the shiny nature of the adaxial leaf surface.
Specimens examined. GUYANA. Cuyuni-Mazaruni: Pakaraima Mts., NE plateau of Ayanganna, 05°23'N, 59°58'W, 1,500–1,650 m, 3 Nov 1992 (ster.), B. Hoffman 3230 (BRIT, US). VENEZUELA. Bolívar: 0–1 km NE of El Pauji, 04°30'N, 61°35'W, 850–900 m, 5 Nov 1985 (fl), R. Luescher 19543 (MO, NY, VEN); Gran Sabana, Ilú-tepui, W-facing slopes below low escarpment, 7,000–8,000 ft [2,134–2,438 m], 17 Mar 1952 (fl), B. Maguire 33468 (BRIT, NY), slopes below upper most W-facing escarpment, 21 Mar 1952 (fr), 334497 (NY); Mount Roraima, SW-facing slopes between Rondón Camp and base of bluffs, 2,040–2,255 m, 30 Sep 1944 (fr), J. Steyermark 58948 (F, NY); Patur-tepui, along base of E-facing bluff, 2,410–2,450 m, 7 Nov 1944 (fl), J. Steyermark 59948 (F, NY); Sororopán-tepui, crest of cerro between E & W end, 2,255 m, 14 Nov 1944 (fl), J. Steyermark 60108 (F, NY, US); Chimantá Massif, above SE-facing upper shoulder on slope leading to summit of Apicara-tepui, 2,200–2,300 m, 20 Jun 1953 (fl), J. Steyermark 75834 (F, MO, NY); Chimantá Massif, Agaramán-tepui, SE-facing forested slopes below escarpment, 1,880–1,955 m, J. Wordock & J. Steyermark 1160 (NY).

**Myrsine nitida** appears to be most closely related to *M. guianensis*, but is separated by the conspicuously reddish punctate-lineate abaxial leaf surface, the acute or rarely, obtuse leaf apices and habitat.


*Rapana oblonga* Pohl ex Miq. in Mart., Fl. Bras. 10:308. 1856. **Type.** BRAZIL. Without locality, without elev., without date (fl, fr), Pohl 4384, 6077 (SYNTYPES W; photo SI). We defer lectotypification of this binomial until all material cited in the protologue and their duplicates can be assembled.


**Trees** to 6–(15) m tall; trunk and branches orthotropic. **Branchlets** terete, glabrous, the bark of lower branches thick and corky. **Leaves** spiral; blades coriaceous, elliptic, oblong, oblanceolate or obovate, 7–18 cm long, (2.7–)3–7.5 cm wide, apically obtuse to broadly rounded, basally acute, the midrib impressed above, prominently raised below, the secondary veins prominent above, peninnerved, not obviously brochidodromous, nitid above, palisade below, inconspicuously black punctate or black punctate-lineate below, the margin entire, flat, somewhat revolute basally; petioles marginate, 0.5–1.5 cm long, glabrous. **Staminate inflorescence** fasciculate, 5–8-flowered, on short perrennating shoots accrescent by accumulating girdling floral bracts; floral bracts chartaceous, oblitate, 0.5–0.6 mm long, 0.9–1.0 mm wide, apically broadly rounded, the margin entire, densely long glandular-ciliate; pedicels 1.2–2 mm long. **Staminate flowers** 5-merous, chartaceous, hyaline, 3.5–3.8 mm long; calyx campanulate, 1–1.2 mm long, the tube ca. 0.3 mm long, the lobes widely ovate to deltate, 0.7–0.9 mm long and wide, apically narrowly
Fig. 9. Distribution of *Myrsine pellucida* (●), *M. guianensis* (○), *M. macrocarpa* (■), *M. perpusillaflora* (▲) and *M. minima* (▲) in Venezuela and bordering Guyana region.
acute to attenuate, prominently black punctate and punctate-lineate medi-
ally, the margin entire, glabrous; corolla campanulate, 3.5–3.8 mm long, 
the tube 0.7–0.9 mm long, the lobes elliptic to lanceolate, 2.7–3 mm long, 
0.9–1 mm wide, apically sharply acute to attenuate, densely and pro-
munately black punctate and punctate-lineate, the margin entire, glandular-
granulose throughout; stamens 2.2–2.5 mm long, the filaments not obvi-
ous (but veins visible) 0.7–0.9 mm long, the anthers ovate, 1.5–1.7 mm 
long, 0.7–0.8 mm wide, apically apiculate, the apically curved inward, basally 
subcordate, the connective with one prominent black punctation at point 
of attachment; pistillode conic, 1.3–1.5 mm long, 0.7–0.8 mm diam., hol-
low or bearing a sterile placenta. **Pistillate flowers** as in staminate but on 
perrenating shoots to 6 mm long; pedicels 1.5–2 mm long. **Pistillate flowers** 
as in staminate but calyx 1.1–1.8, the tube ca. 0.2 mm the lobes ovate, 
1.1–1.3 (−1.5) mm long, 0.7–0.9 mm wide; corolla 2.5–3.5 mm long; the 
tube as in staminate, the lobes 2.5–3 mm long, 0.8–1.2 mm wide; staminodes 
resembling stamens except antherodes broadly ovate 1.0–1.3 mm long, 0.6– 
0.8 mm wide; pistil conic, 1.5–2.5 mm long, 0.8–1 mm diam, the stigma 
conical, with 4 twisted lobes, the placenta conical, the ovules 3–5, uniseriate. 
**Fruit** globose, 3.5–5 mm long and in diam., prominently black punctate.

**Distribution.**—**Myrsine guianensis** is known from French Guiana and 
adjacent Brazil westward through Suriname and Guyana to Venezuela (Fig. 
9), growing at (100–)400–1,400(−2,800) m elevation. Reports of this spe-
cies from Colombia, Ecuador, Peru, Bolivia and Paraguay are based on 
misidentifications. In Venezuela, it is found throughout the states of Bolívar, 
around the margins of Amazonas, in Delta Amacuro, Monagas, Sucre, Nueva 
Espahta, Anzoátegui, Miranda, D.F., Aragua, and Falcón growing in sandy, 
savanna-like situations.

**Ecology and conservation status.**—In Venezuela, **Myrsine guianensis** is known 
from primary and secondary lowland riparian forests on reddish or quartz-
ite sands, premontane forest, cloud forests and rarely, upland savannas.

**Etymology.**—The epithet refers to the species' type locality, French Guiana.

Specimens examined. **Guyana. Mazaruni-Potaro**: Upper Potaro River region, sum-
mit of Mt. Wokomung, 05° 05' N, 59° 50' W, 9 Jul 1989 (fr), B. Boom & G. Samuels 9138 
(MO, NY); Upper Potaro River region, trail Kopinanq-Orindui, ca. 1.5 hr walk from 
Koponang, 04° 57' N, 59° 53' W, 790 m, 22 Jul 1989 (fr), B. Boom & G. Samuels 9285 
(MO, NY); Kaieteur Plateau, forest along trail from Plane-landing to Kaieteur Falls, ca. 
1,400 m, 11 Feb 1962 (fl), R. Coucan & T. Soderstrotn 1826 (K, US); E. Berbice-Corentyne 
Region: Digitima Savannah; Canje River, 10 km S of Mora, 185 km S or mouth of Canje, 
05° 33' N, 57° 40' W, 10–20 m, 29 Oct 1989 (stam. fl), L. Gillespie et al. 2510 (US); Potaro-
Siparuni Region, at southern base of Mt. Kopinang along trail from Kopinang to Orindui, 
05° 00' N, 59° 55' W, 500–600 m, 9 Apr 1988 (fr), W. Habn et al. 4435 (MO, US); Potaro-
Siparuni Region, Kato, 04° 30' N, 59° 55' W, 750 m, 11 Mar 1989 (fr), W. Habn et al. 
5603 (MO, US); E. Berbice-Corentyne Region: W bank of Canje River, Cow Savanna, ca. 1 
km N of Digitima Creek, 1–20 m, 14 Apr 1987 (fr), J. Pipoly et al. 11582 (FDG, MO, NY,
US) Upper Mazaruni River basin, Mt. Ayanganna, on shoulder of E flank, ca. Thompson camp, 1,418 m, 12 Aug 1960 (fr), S. Tillett et al. 43118 (NY-2 sheets); Upper Mazaruni River basin, Kukui River, in Mora forest bordering river at Adaro river mouth, ca. 500 m, 5 Sep 1960 (fr), S. Tillett & G. Tillett 45290 (NY-2 sheets, US). VENEZUELA: Amazonas: Beyond soccer field, San Carlos de Río Negro, 115 m, 17 Sep 1975 (fr), P. Berry 13567 (MO); San Carlos de Río Negro, ca. 20 km S of confluence of Río Negro and Brazo Casiqué, near radar site, 3.4 km NE of San Carlos on Solano road, 01° 56' N, 67° 03' W, 119 m, 13 Mar 1979 (fr), H. Clark 7094 (MO, NY); Serranía de Tapirapecó, Campamento Tamacuari, trail between 2 camps, 01° 14' N, 64° 40' W, 1,400 m, 10 Feb 1989 (fr), A. Henderson et al. 1022 (BRIT, NY); Department: Atures, cumbre del Cerro Yaví, en las cabeceras del Río Parucito, afluente oriental del Río Manapiare, en el sector NE de la cumbre, 05° 43' N, 65° 52' W, 2,100 m, 29 Oct 1986 (fr), O. Huber 11853 (NY); Department: Atures, cumbre del Cerro Coro-Coro, en las cabeceras nor-occidentales del Río Manapiare, sector NW de la Serranía Yutajé, 05° 46' N, 66° 12' W, 2,200 m, 12 Nov 1987 (fr), O. Huber 12318 (US); Sierra Parima, Vecindades de Simarawochí, Río Matacuni, a unos 6-7 km al O de la frontera Venezuela-Brasilera, 03° 49' N, 64° 36' O, 795–830 m, 18 Abr–23 May 1973 (fl), J. Steyermark 106968 (MO, NY); 107113 (F, MO, NY). Anzoátegui: Distrito Bolívar, just S of El Zamuro, Fila El Purgatorio, 9 airline km NE of Bergantín, 10° 02' N, 64° 17' W, 1,100 m, 24 Nov 1981 (fr), G. Dattide & A. González 19400 (MO, NY, VEN), 19402 (US). Aragua: Maracay, without elev., 1934 (fl, fr), P. Vogel 11118 (MO); Arriba de Guamitas, P. N. Aragua, 780 m, 15 Jun 1939 (fr), L. Williams 11125 (F, MO). Bolívar: Near summit of Cerro Bolívar, ironstone area, Ciudad Piar, 750 m, 10 Apr 1954 (fl), L. Aristeguieta 2178 (NY-2 sheets); Distrito Raul Leoni, Río Ariza, 55 km NE of San Francisco de la Paragua, 07° 11' N, 64° 13' W, 485 m, Jun 1989 (fr), L. Delgado 215 (MO, NY); Distrito Gran Sabana, Zona Minera El Polaco, 04° 32' N, 61° 26' W, 950 m, Jul 1993 (stcr.), W. Díaz y S. Elcoro 1580 (MO); Distrito Raul Leoni, Bajo Caróni, Sector III, Cerro Altamira, 07° 27' N, 63° 13' W, 300 m, May 1994 (fl), W. Díaz 2515 (MO); Municipio Piar, 3 km NE of Hato Las Nieves, 07° 28' N, 62° 36' W, 280 m, May 1986 (fr), A. Fernández 2946 (US); Distrito Piar, Serranía Quiribay, 07° 49' N, 62° 43' W, 280 m, 26 Jul 1989 (fr), F. Flores & E. Pérez 557 (MO); Guyana, villa de Upata, without elev., 1864 (fl), D. de Grooswardy 13 (P); Distrito Heres, Meseta del Guaiquinima, S-sloping plain near edge of NE section of the mesera, near the summit, 05° 38' N, 63° 29' W, 1,400 m, 27 Mar 1985 (fr), O. Huber 10389 (MYF, MO, NY); Distrito Heres, Meseta del Guaiquinima, SE sector of the summit, 05° 51' N, 63° 25' W, 1,350 m, 26 Sep 1985 (fr), O. Huber & G. Medina C. 10916 (MYF, NY); Distrito Cedeno, Serranía Guanay, NE sector, sloping toward the S and SW, at the easternmost headwaters of Río Parguaza, 05° 55' N, 66° 23' W, 1,700 m, 20–28 Oct 1985 (fl bud), O. Huber 11062 (MYF, NY); Distrito Piar, Macizo del Chimantá, W sector, SW range of Apacará-tepui, near the connection with Abacapá-tepui, at NW headwaters of Río Tírica, 05° 17' N, 62° 16' W, 2,100 m, 8–10 Mar 1986 (fr), O. Huber 11436 (BRIT, MYF, NY, NY-2 sheets); Distrito Roscio, savannas at W foothills and SW summit of the Altiplanicz de Nuriá, ca. 50 km N of Tumeremo, 07° 37' N, 61° 37' W, 300–450 m, 7 May 1986 (fl buds), O. Huber 11640 (MYF, NY); District Heres, Meseta del Guaiquinima, plain sloping SE, along the SE border of the mesera, at W headwaters of Río Aberaima, 05° 47' N, 63° 48' W, 1,400 m, 20 May 1987 (fl), O. Huber & V. Rull 12273 (MYF, MO, US); Distrito Cedena, Meseta de Jaua, headwaters of Río Marajano, tributary of Río Cácaro, 04° 48' N, 64° 32' W, 1,750–1,800 m, 20 Nov 1989 (fr), O. Huber 13005 (MYF, MO); Uaipan-tepui, between the W & E Peaks of Uaipan, ca. 1,500 m, 4 Mar 1967 (fr), T. Koyama & G. Agustini 7474 (NY, VEN); Cerro Guaiquinima, Río Paragua, lateral S drainage of “North Valley”, 1,700 m, 2 Jan 1952 (fl), B. Maguire 32917 (NY); Ptari-tepui, NW slopes, 1,500–2,000 m, 17 Dec 1952 (FR), B. Maguire & J. Wurdack 33896 (NY); Ptari-tepui, in
vicinity of “Cave Rock” camp, below S face of mountain, 1,600–2,000 m, 14–19 Aug 1970 (bud), H. Moore et al. 9738 (F, NY, US); Pratí-tepui, S slope, 2,600 m, 24 Nov 1983 (fr), J. Pípily 6399 (NY, VEN); Pratí-tepui, S-facing slopes, just NE of “Cave Rock”, 1,800–1,850 m, 4 Nov 1944 (fr), J. Steyermark 59808 (F, NY); Pratí-tepui, at base of cerro along Río Karuai, 1,220 m, 27 Nov 1944 (ster.), J. Steyermark 6062? (F, MO); Chimantá Massif, NW part of summit of Abacápara-tepui, 2,125–2,300 m, 13 Apr 1953 (fr), J. Steyermark 74954 (F, MO, NY); Chimantá Massif, on plateau of SE-facing upper shoulder of Apácará-tepui, 2,000 m, 19 Jun 1953, J. Steyermark 75738 (F, MO, NY); Chimantá Massif, below Upper Falls of Río Tirica above Summit Camp, 1,940 m, 7 Feb 1955 (fr), J. Steyermark & J. Wurdack 594 (BRIT, F, MO, NY); Altiplánico de Nuruia, vicinity of campamento Nuruia, NE of Hato de Nuruia, 530 m, 17 Jul 1960 (ster.), J. Steyermark 86638 (NY); Altiplánico de Nuruia, vicinity of camp, 5 kms from Hato de Nuruia, E of Miamo, 400 m, 12 Jan 1961 (fr), J. Steyermark 88366 (NY); along Río Churín at foot of “Second Wall” of sandstone, N from camp, 5 km to the NE, 1,660 m, 12 May 1964 (fr), J. Steyermark 93748 (NY); Distrito Heres, Cerro Marutaní, 1,420 m, 13 Jan 1981 (fl bud), J. Steyermark et al. 124036 (NY); Distrito Piar, Cerro Torribio, Bajo Caromí, Sector III, 07° 04′ N, 62° 05′ W, 100 m, May 1994 (fr), A. Valencia 563 (MO). Delta Amacuro: Departamento Antonio Díaz, vicinity Caño Torida, tributary of Caño Guiniquina, NW of Epaña near boundary with Departamento Tucupita, 09° 15′ N, 61° 10′ W, 50 m, 20 Oct 1977 (ster.), J. Steyermark et al. 115090 (MO). Distrito Federal: Colonia Tovar, without elev., Dec 1924 (fl), A. Allard 513 (NY). Parque Nacional “El Avila,” near Los Venados, 1,650 m, 22 Dec 1975 (fl), L. Aristeguieta & O. Huber 300 (NY); Reforested hills of the Caracas Botanical Gardens, 870–980 m, 1 Jul 1974 (fr), P. Berry 213 (MO); Calvario de Caracas, without elev., without date (fr), Ernst 10886 (BM); Prope coloniam Tovar, without elev., 1854–1855 (fl), A. Fendler 760 (MO, NY); Parque Nacional El Avila, above Naiguatá, along the right of way for Electricidad de Caracas between the stream of the Río Camurú and the stream of the Río Mazarés en selva, 10° 34.5′ N, 66° 42.3′ O, 800 m, 11–12 Apr 1992 (ster.), W. Meier et al. 2069 (BRIT); Jardín Botanico, Caracas, reforested slopes facing N, without elev., 14 Jun 1960 (fr), J. Steyermark 86309 (NY). Caracas, without elev., 14 Jan 1892 (fl), J. Warming 560 (C 2-sheets). Falcón: Península Paraguana, Cerro Santa Ana, 650 m, 15 Dec 1964 (fl), F. Betleher 4292 (MO, NY); 4299 (F, MO, NY); Península Paraguana, Cerro Santa Ana, 650 m, Dec 1935 (fl), T. Laser & L. Aristeguieta 3410 (2 sheets, VEN); Cerro Santa Ana, ascension del lado S desde el pueblo de Santa Ana, 750 m, 21 Jan 1966 (fl), J. Steyermark & A. Braun 94642 (NY); Península Paraguana, Cerro Santa Ana, without elev., Jan 1939 (fl, fr), F. Tamayo 797 (F). Miranda: Carretera de Tácata-Loma del Hierro abana antropecica, without elev., 1 Jan 1988 (fl), N. Ramirez 2477 (MO, NY). Monagas: San Antonio-Cumaná Road, without elev., 24 Oct 1948 (fl, fr), B. Maguire et al. 27251 (NY); Cerro Negro, above La Sabana de las Piedras, NW of Caribe, 1,500–2,180 m, 15 Apr 1945 (fl), J. Steyermark 62075 (F). Nueva Esparta: Isla de Margarita, Cerro Copey, 500–900 m, Jul 1984 (fl), F. Delacio & A. González 12223 (MO); (fr), 12255 (MO); Copey, 900 m, Dec 1951 (fl), H. Gines 2815 (US), 3461 (US); Isla de Margarita, Cerro Copey, S of Santa Ana, at and near summit, 11° 02′–03′ N, 63° 55′ W, 800–850 m, 24 Mar 1985 (fr), J. Steyermark et al. 131074 (MO). Sucre: Valley of Cocollar, 820 m, 28 Apr 1945 (fr), J. Steyermark 62377 (F); Cerro Turumquique, N-facing slopes above La Trinidad, SW of Cocollar, 2,100–2,200 m, 5 May 1945 (fr), J. Steyermark 62560 (F); Distrito Sucre, La Lomita, between La Sabana and Zurieta, 500–600 m, 18 Aug 1975 (fl), J. Steyermark et al. 107789 (MO, NY). Without locality: Cojícuta, without elev., 17 Jun 1917 (fl, bud), H. Carren & M. Human 1069 (NY).

_Myrsine guianensis_ (Aubl.) kuntze has long been confused with _M. pellucida_ and _M. latifolia_ (Ruiz & Pav.) Spreng., both Andean species. In the Caribbean
and Central America, including the coast of the state of Delta Amacuro, it has been confused with Myrsine cubana A. DC. (often reported as M. floridana A. DC., a nonen superflum, or M. punctatum (Lam.) Stearn, non (H. Lév.) Wilbur). In Brazil, it has been confused with several other species, including Myrsine monticola Mart. (Harvey & Pipoly 1995) and M. umbellata Mart. In Venezuela, Myrsine guianensis is most easily confused with M. nitida, from which it is easily distinguished by the obtruse to broadly rounded leaf apices, with inconspicuously black punctate and punctate-lineate abaxial surfaces, the ovate calyx lobes, larger, black punctate fruits and the cloud forest to lowland savanna habitats.

DOUBTFUL AND EXCLUDED TAXA


This taxon is actually a species of Micropholis (Sapotaceae), and the type was annotated "Micropholis sp." by Pennington in 1985. However, disposition of this name was not made in his Sapotaceae monograph (Pennington 1990).

ACKNOWLEDGMENTS

We thank the Missouri Botanical Garden and the Flora of the Venezuela Project, for funding that allowed J. Ricketson (MO) to travel to Fort Worth, and for Pipoly to make visits to MO. We also thank the curators of the herbaria cited for loans of specimens. We are also grateful to those who have been so instrumental in assisting us in our work, including Gerrit and Jeany Davidse, Linda Oestry, Mary Bard, and Catherine Mayo, (MO), Barney Lipscomb, and Jim Rivers (BRIT).

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1. Myrsine dependens
2a. Myrsine coriacea subsp. coriacea
2b. Myrsine coriacea subsp. reticulata
3. Myrsine maguireana
4. Myrsine minima
5. Myrsine andina
6. Myrsine perpapetiflora

7. Myrsine reinosana
8. Myrsine picturata
9. Myrsine macrocarpa
10. Myrsine pellucida
11. Myrsine nitida
12. Myrsine gianensis

LIST OF EXSICCATAE

Figures in parentheses refer to the numbers from the numerical list of taxa. Collection numbers in boldface type indicate type specimens.

Agostini, G. 174 (2a); Allart, A. 513 (12); Alston, A. 5515 (2a); 6172 (2a); Anderson, W. 13461 (2a); Aristeguieta, L. 2178 (12); 3606 (1); 5998 (2a); Aristeguieta, L. & O. Huber 300 (12); Aublet, J. s.n. (12); Aymard, G. et al. 5190 (2a).

Badillo, V. 7339 (2a); Baruch, Z. 95 (2a); Bernardi, L. 11 (10); 21 (1); 1881 (10); 2292 (10); Bernardi, L. et al. 17136 (1); 17141 (1); Berry, P. 213 (12); 1367 (12); Boom, B. & G. Samuels 9138 (12); 9285 (12); Boom, B. et al. 5335 (5); Breterler, F. 3218 (2a); 3242 (2a); 3313 (10); 3635 (2a); 4289 (2a); 4292 (12); 4580 (2a); Breterler, J. 4629 (1); Bruijn, J. de 988 (2a); Bunting, G. & M. Fucci 6050 (2a); Bunting, G. & A. Stoddart 9745 (10).

Cardozo, A. & H. Meneses 1421 (2a); Cardozo, A. & H. Rodriguez 1218 (2a); Cardozo, A. et al. 1278 (2a); 134 (2a); Charpin, A. & F. Jacquemoud 13136 (2a); 13296 (2a); Clark, H. 7093 (12); Clements, S. & D. Díaz M. 2435 (1); Clements, S. & J. Dugarte 2411 (1); Coilella, M. & O. Huber 451 (2a); 465 (2b); Cowan, R. & T. Soderstrom 1826 (12); Cowan, R. & J. Wurduck 31372 (9); Croar, T. 59551 (3); Cuatrecasas, J. et al. 28185 (1); Cucillo, N. 931 (2a); 1107 (2a); 1256 (2a); 1335 (2a); 1348 (2a); Curran, H. 2114 (2a); Curran, H. & M. Haman 1069 (12).

Davidse, G. & A. González 19400 (12); 19402 (12); 19540 (2a); 19606 (2a); Davidse, G. et al. 20813 (2a); Delascio, F. & A. González 12223 (12); 12255 (12); Delgado, L. 215 (12); 282 (10); Díaz, E. 1765 (10); Díaz, W. 1759 (10); 2515 (12); Díaz, W. & S. Elcoro 1580 (12); Dorr, L. & L. Barnett 5157 (2a); 5162 (2a); 5602 (2a); 7598 (2a); Dorr, L. et al. 5693 (2a); 7872 (10); Dumouret, K. et al. 7611 (2a).

Elcoro, S. & N. Vera 225 (2a); Ernst, A. 1088 (12).

Farney, C. et al. 905 (4); Bertl, A. 755 (2a); 760 (12); Fernández, A. 2946 (12); Flores, F. & E. Pérez 557 (12); Funck, H. 481 (1); 550 (1); Funck, H. & L. Schlim 58 (1); 140 (2a).

Gehringer, H. 28 (1); 270 (10); 401 (2a); Gentry, A. et al. 11090 (10); Gillespie, L. et al. 2510 (12); Gines, H. 2815 (12); 3461 (12); Groosony, D. 13 (1); Guevara, L. C. de 3261 (2a).

Hahn, W. & W. Grifo 3460 (2a); 4971 (5); 4983a (10); Hahn, W. et al. 4435 (12); 5603 (12); Henderson, A. et al. 1022 (12); Hernández, L. & N. Deezo 114 (2a); Hoffman, B. 3230 (11); Huber, O. 9269 (4); 10389 (12); 11062 (12); 11156 (12); 11159 (4); 11460 (12); 11698 (4); 11853 (12); 12318 (12); 13095 (12); 13071 (3); Huber, O. & C. Alarcón 7375 (2a); 7931 (2a); Huber, O. & N. Deezo 8590 (4); Huber, O. & L. Izquierdo 12802 (2b); Huber, O. & G. Medina C. 10916 (12); Huber, O. & W. Morawetz 10823 (10); Huber, O. & V. Rull 12273 (12); Huber, O. et al. 8786 (2a); 10100 (4); Humboldt, A. von & A. Bonpland s.n. (1).

Karsten, G. s.n. (2a); Koyama, T. & G. Agostini 7474 (12); Kral, R. & A. González 70455 (2a).

Lasser, T. & L. Aristeguieta 3410 (12); 3418 (2a); Lícar, A. et al. 650 (2a); Liesner, R. 19543 (11); 23107 (1); 23210 (1); 23296 (1); 23426 (1); 23465 (7); 25354 (7); Liesner, R. & A. González 9933 (2a); 10713 (2a); Liesner, R. & M. Guariglia 11655 (5); 11812 (10); Liesner, R. et al. 7661 (10); 7949 (10); 8202 (2a); 8232 (2a); 8389 (2a); Linden, J. 108 (5); 958 (1); Luteyn, J. & M. Lebrón-Luteyn...
ADDITIONS TO THE GENUS ARDISIA
SUBGENUS GRAPHARDISIA (MYRSINACEAE)

JOHN J. PIPOLY III
Botanical Research Institute of Texas
509 Pecan Street, Fort Worth, TX 76102-4060, U.S.A.
jpipoly@brit.org; slisia@latinmail.com

JON M. RICKETSON
Missouri Botanical Garden
P.O. Box 299, St. Louis, MO 63166-0299, U.S.A.
jon.ricketson@mobot.org

ABSTRACT
Revision of the group of species formerly placed in Zunilia Lundell revealed that the group is synonymous with Ardisia subgenus Graphardisia Mez. This paper incorporates those taxa in the subgenus, necessitating further revision of Graphardisia, including an emended description of the subgenus, a key to the species and subspecies, along with updated descriptions of the two added taxa and new illustrations for each. Two additional taxa are recognized, including one new combination: Ardisia verapazensis subsp. canallata (Lundell) Pipoly & Ricketson. Six binomials are relegated to synonymy within A. verapazensis Donn. Sm. Ardisia hyalina Lundell [Zunilia hyalina (Lundell) Lundell] is excluded from subgenus Graphardisia, and placed in subgenus Ardisia.

RESUMEN
Una revisión del grupo de especies anteriormente clasificadas dentro del género Zunilia Lundell, reveló que Zunilia es sinónimo del género Ardisia subgénero Graphardisia Mez. Se incorporan dichos taxa dentro del subgénero Graphardisia, y se incluye una descripción actualizada, una clave para separar todos los taxa, acompañados de dos descripciones actualizadas y nuevas ilustraciones para ellos. Se reconocen dos taxa adicionales, incluyendo la nueva combinación: Ardisia verapazensis subsp. canallata (Lundell) Pipoly & Ricketson. Se relegan seis binomios a la sinonimia bajo A. verapazensis Donn. Sm. Se excluye Ardisia hyalina Lundell [Zunilia hyalina (Lundell) Lundell] del subgénero Graphardisia, y se la ubica dentro del subgénero Ardisia.

INTRODUCTION
In preparing our treatment of the Myrsinaceae for Flora Mesoamericana, we critically reexamined taxa segregated by Lundell from Ardisia, including Gentlea (Ricketson & Pipoly 1997), Graphardisia (Pipoly & Ricketson 1998a), Chontalesia and species related to it, now known to belong to the genus Hymenandra A. DC. ex Spach. (Pipoly & Ricketson 1999). Since our study of subgenus Graphardisia (Pipoly & Ricketson 1998a), it has become
evident that the taxa comprising the segregate genus *Zunilia* (Lundell 1981) are best placed within *Ardisia* subgenus *Graphardisia*.

In Lundell's description of the genus *Zunilia* (Lundell 1981), he separated it from the genus *Ardisia* based on the following key:

1. Panicles of flowers in corymb, the mature inflorescences heteromorphic with strongly accrescent elongated pedicels arranged either in whorls or opposite or alternate below the apical corymbs ........................................... *Zunilia*

1. Panicles of flowers consisting of simple racemes or spikes, the inflorescences with flowers uniformly distributed, either pedicellate or sessile .................... *Ardisia*

However, we noted that Lundell failed to compare or distinguish *Zunilia* from his genus *Graphardisia*. As we studied the group of species assigned by Lundell (1981) to *Zunilia*, we noted their raised or sessile glandular-papillate filaments, the large accrescent, densely and prominently black punctate and punctate-lineate sepals that clasped the developing fruit, the black punctations and punctate-lineations of all abaxial leaf surfaces, the lanceolate, concolorous, apiculate anthers with subapically poricidal dehiscence, and the style 2–3 times longer than the ovary, all features we used (Pipoly & Ricketson 1998a) to define subgenus *Graphardisia*. Therefore, we find it necessary to relegate the genus *Zunilia* to synonymy under *Ardisia* subgenus *Graphardisia*, specifically as an emended concept of *Ardisia ventrataezeus* Donn. Sm.

NOTES ON KEYS, TAXONOMIC CONCEPTS, TERMINOLOGY

The key is artificial and designed to expedite identification of herbarium specimens. An attempt has been made to emphasize vegetative characters to increase the key's usefulness with sterile material. The respective positions of taxa in the key and correlations with phylogenetic relationships are coincidental. Quantitative and qualitative data presented in keys and descriptions for floral parts and bracts were taken from organs rehydrated from herbarium specimens by boiling in water. Measurements from these range from 10% to 15% greater than those measurements taken directly from dried material. Data regarding stem diameters, inflorescence racemes, pedicels, leaf and fruit shape and size were taken from dried herbarium specimens.

Our concept of subspecies follows that of Pipoly (1987) who defined subspecies as: "groups of populations within a single lineage of ancestor-descendant populations that show variation by unique combinations of plesiomorphies, or homoplasic apomorphies, correlated with biogeography and/or ecology. This rank is primarily used to convey information regarding variation in the life histories of these populations and character state differences hypothesized to be the result of this variation. The subspecific rank in no way attempts to predict speciation events."

Morphological terms in this treatment follow Lindley (1848) and Pipoly (1987, 1992) for the inflorescence, rachis pedicels and floral parts. Descrip-

**TAXONOMIC TREATMENT**


**Subshrubs to trees. Branchlets** mostly terete, glabrous or rarely, glandular-granulose. *Leaves* petiolate; blades membranaceous to subcoriaceous, densely and conspicuously or inconspicuously black (rarely pellucid-) punctate and punctate-lineate, the margins entire to crenulate, rarely sharply and irregularly dentate. *Inflorescence* terminal, un- to tripinnately paniculate, pyramidal to obpyramidal, rarely globose, the ultimate branches corymbose, at times in high anthotactic spirals and thus appearing umbellate, the rachis often densely and prominently black punctate and punctate-lineate; inflorescence and floral bracts foliaceous, mostly persistent, resembling the vegetative leaves but acropetally reduced in size. *Flowers* with perianth white, pink, lavender or purple, densely and prominently black punctate and punctate-lineate; calyx with sepals free or nearly free, large, accrescent and clasping fruits at maturity; corolla rotate, the lobes imbricate in bud, basally short-connate and sparsely to densely yellow glandular-granulose or papillose within; stamens inserted at corolla tube base, the filaments basally connate to form an inconspicuous tube, the tube free from the corolla tube, the apically free portions of the filaments glabrous or glandular-granulose or glandular-papil- late, less than half the length of the anthers, the anthers ovate-lanceolate, linear or lanceolate, prominently apiculate, dehiscent by subapical pores; ovary globose to depressed-globose, the style slender, 2–3 times longer than the ovary, the placenta apiculate, the ovules pluriseriate, biseriate, or apparently uniseriate (few in number and in a very high anthotactic spiral). *Fruit* globose or oblongoid, densely conspicuously punctate and punctate-lineate, usually basally surrounded by persistent, clasping sepals.

**Distribution.**—Four species with seven subspecies found from Mexico to Bolivia and adjacent Brazil.

**Ecology.**—Members of the subgenus occur in diverse vegetation types, including wet and pluvial lowland, premontane, montane, and cloud forests.

The subgenus is defined by: 1) glabrous branchlets and inflorescence rachises; 2) dense and prominently raised or conspicuous black, or rarely, reddish-black, punctations or punctate-lineations on all leaf and/or floral parts; 3)
sepals often accrescent and usually clasping the developing fruit; 5) linear-lanceolate, concolorous, apiculate anthers with subapically poricidal dehiscence; and 6) style 2–3 times longer than the ovary. Species of the subgenus are often used for home decoration and for use in Christian churches for religious holidays (Pipoly, pers. obs.).

KEY TO TAXA OF ARDISIA SUBGENUS GRAPHARDISIA

1. Stoloniferous subshrubs mostly less than 1 (–2) m tall; leaf blade margins sharply and irregularly dentate; corolla tube and filaments yellow glandular-granulose; Ecuador to Bolivia and adjacent Brazil. ........................................ A. weberbaueri

1. Shrubs to small trees (0.5–)2–(–6) m tall without stolons; leaf blade margins entire, undulate or crenulate; corolla tube yellow glandular-granulose; filaments glabrous or sessile to stalked glandular-papillate; Mexico to Colombia.

2. Sepals membranaceous, oblong, 4.2–8 mm long, apically broadly rounded to obtuse, hyaline throughout, the margins entire. ........................................ A. opegrapha

3. Inflorescence obpyramidal; leaf blades oblanceolate or rarely obovate, 3.5–7.5 (–8) cm wide, 3 or more times longer than wide.

4. Floral bracts caducous; stamens 5.2–6.5 mm long; filaments 2.5–3 mm long; sepals 5–8 mm long. ........................................ A. opegrapha subsp. opegrapha

4. Floral bracts persistent; stamens 3.8–5 mm long; filaments 1.5–2 mm long; sepals 4.2–5.2 mm long. ........................................ A. opegrapha subsp. wagneri

5. Inflorescence globose; leaf blades elliptic to broadly elliptic (7.5–)8–14.5 cm wide, 2–2.5 times longer than wide. .... A. opegrapha subsp. paquitisensis

2. Sepals chartaceous, ovate, 1.5–3.2 (–4.0) mm long, apically acute to rounded, opaque except at margin, the margins subentire to erose.

5. Corolla lobes ovate, elliptic or lanceolate; filaments glabrous; ovules 13–16; Panama and Colombia. ........................................ A. bartlettii

6. Sepals 1.5–1.8 mm long; petal lobes 6–6.5 mm long; stamens 3.5 mm long; style base tapering; tall wet forests. ........................................ A. bartlettii subsp. bartlettii

6. Sepals 2–2.5 mm long; petal lobes 7–8 mm long; stamens 1.5–5.7 mm long; style base stylodipoc; strand vegetation and beach forests. ........................................ A. bartlettii subsp. lilacina

5. Corolla lobes oblong; filaments sessile to stalked-glandular-papillate; ovules 22–35; Oaxaca, Mexico to Honduras. ........................................ A. verapazensis

7. Corolla lobes 6.5–6.7 mm long; free portion of filaments 3.3–3.4 mm long; style 3–3.1 mm long; fruit 6.5–9 mm in diam., fruiting style 7–8.6 mm long, usually only the basal portion persistent. ........................................ A. verapazensis subsp. verapazensis

7. Corolla lobes 5.7–5.9 mm long; free portion of filaments 2.6–2.8 mm long; style 5.5–5.9 mm long; fruit 5–6.1 mm in diam., fruiting style 8.8–9.1 mm long, entire style usually persistent .... A. verapazensis subsp. cucullata

Ardisia verapazensis Donn. Sm.

Shrub or small tree to 30 m tall, 33 cm DBH. Branchlets slender to stout, (3–)5–8 mm in diam., glabrous. Leaves with blades membranaceous to
chartaceous, elliptic to oblong or oblanceolate, 7.4–34.5 cm long, 3.2–9.7 cm wide, apically acute to acuminate, basally acute to acuminate, deciduous on the petiole, midrib impressed above, prominently raised below, the secondary veins prominulous above, conspicuous to inconspicuous below, at times prominently reticulate, mostly inconspicuously punctate and punctate-lineate, glabrous, the margins entire, undulate to regularly or irregularly crenulate; petioles canalulate or marginate, 0.4–1.4 cm long, glabrous. Inflorescence terminal, bipinnately paniculate, 4.8–16.2 cm long, 3.9–22.4 cm wide, the rachis glabrous, the branches terminating in corymbs; peduncle 0.9–4.2 cm long; secondary inflorescence bracts early caducous, membranaceous, ovate or oblong, (5.4–)9.9–14.8 cm long, 3.7–4.8 cm wide, apically acute or rounded, otherwise similar to the leaves; floral bracts very early caducous, not leaving detectable scars axillant to pedicel (aborted at primordial stage?), or early caducous, membranaceous, ovate, 0.8–0.9 mm long, 0.7–0.8 mm wide, apically rounded, the midrib inconspicuous, the secondary veins not visible, densely and prominently black punctate and punctate-lineate, the margins hyaline, sparsely glandular-ciliolate; pedicels stout or slender, 0.4–1.8 cm long, accrescent in fruit or not, glabrous. Flowers 5(–6)-merous, membranaceous, chartaceous to coriaceous, 8.4–10.2 mm long; calyx with sepals free, broadly ovate, 3.4–4.0 mm long, the lobes 2.7–3.2 mm long, 2.3–3.0 mm wide, apically acute to rounded, conspicuously and prominently punctate and punctate-lineate, sparsely scattered glandular-glandulose within near the base, often sparsely lepidote medially outside, the margins hyaline, erose to entire or subentire, ciliolate with multicellular hairs; corolla rotate, 7.7–9.2 mm long, the tube 1.9–2.5 mm long, the lobes oblong, 5.7–6.7 mm long, 3.3–4.1 mm wide, apically rounded, conspicuously and prominently punctate and punctate-lineate, yellow glandular-glandulose and or papillose at base between corolla lobe and tube junction and above staminal tube, otherwise glabrous; margins entire; stamens 5.9–7.7 mm long, the filaments 3.4–5.0 mm long, united basally into a staminal tube 0.7–1.6 mm long, the apically free portions 2.6–3.4 mm long, 0.5–0.7 mm diam., slender or stout, epunctate, sessile or stalked glandular-papillate, the anthers lanceolate, 3.0–3.2 mm long, 1.2–1.4 mm wide at base, apiculate, basally sagittate, dehiscent by subapical pores; ovary glabrous, the style 3.0–5.9 mm long, slender, inconspicuously punctate and punctate-lineate, glabrous, the ovules 22–35, pluriseriate. Fruit globose to depressed-globose, 5–9 mm in diam., style 7–9.4 mm long, persistent at least basally, densely and conspicuously punctate, glabrous.

Within subgenus Graphardisia, Ardisia verapazensis is most closely related to Ardisia opegrapha, because of its large, foliaceous inflorescence bracts and glandular-papillate filaments.


Shrub or small tree to 30 m tall, 33 cm DBH. Branchlets stout, (3–)6–8 mm in diam. Leaves with blades 7.4–34.5 cm long, 3.2–9.7 cm wide, the secondary veins inconspicuous below, the margins entire, undulate to regularly crenulate; petioles marginate, 0.6–1.3 cm long. Inflorescence 4.8–16.2 cm long, 3.9–22.4 cm wide; peduncle 1.3–4.2 cm long; secondary inflorescence bracts early caducous, membranaceous, ovate or oblong, (5.4–)9.9–14.8 cm long, 3.7–4.8 cm wide, apically acute or rounded, otherwise similar to the leaves; floral bracts very early caducous, not leaving detectable scars axillant to pedicel (aborted at primordial stage?); pedicels stout, 4–18 cm long, accrescent in fruit. Flowers chartaceous to coriaceous, 10–10.2 mm long; calyx 3.7–4.0 mm long, the lobes 2.8–3.0 mm long, 2.6–3.0 mm wide, often lepidote medially without; corolla 9.0–9.2 mm long, the tube 2.4–2.5 mm long, the lobes 6.5–6.7 mm long, 3.8–4.1 mm wide; stamens 7.5–7.7 m long, the filaments 4.8–5.0 mm long, united basally into a stamina tube 1.5–1.6 mm long, the apically free portions 3.3–3.4 mm long, 0.5–0.6 mm diam., slender, scattered yellow stalked or rarely sessile glandular-papillate, the anthers 3.0–3.2 mm long, 1.2–1.4 mm wide at base; style 3.0–3.1 mm
Fig. 1. *Ardisia verrapazensis* subsp. *verapazensis*, showing foliaceous secondary inflorescence bracts enclosing the immature inflorescence. Drawn from A. Méndez Ton 4488 (MO).
Fig. 2. *Andira terapazon* Donn. Sm. subsp. *terapazon*. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower. E. Detail of stamens, showing adaxial surface. F. Detail of stamens, showing abaxial surface. G. Detail of stamens, showing lateral surface. H. Fruit. A–H drawn from H. von Türckheim II2093 (GH isotype).
long; ovules 22–26. Fruit 6.5–9 mm in diam.; style 7–8.6 mm long, usually only basal portion of style persistent.

**Distribution.**—Ardisia verapazensis subsp. verapazensis is known from Oaxaca, Mexico through central Chiapas to Guatemala (Alta Verapaz, Quiché, Huehuetenango, Quezaltenango, San Marcos, Suchitepéquez) and with one disjunct population in Copán, Honduras. It grows from 500–3,000 m elevation.

**Ecology and conservation status.**—Ardisia verapazensis subsp. verapazensis is known from primary premontane and montane wet forests, and cloud forest margins. It is locally common, but not known to grow in large populations. Given its relatively wide ecological tolerance, this species is not considered threatened at this time.

**Etymology.**—The epithet ‘verapazensis’ refers to the type locality, near Cobán, Department of Verapaz (now Alta Verapaz) in northern Guatemala.

**Local names.**—“Shyash tililja” (Tzeltal), (A. Méndez T. 4404); “niwektilliljaz” (Tzeltal), A. Méndez T. 4488); “b’shyashtililjas,” (A. Shilom T. 7451); “huesito blanco,” (J. Steyermark 33631); “palo cruz,” (J. Steyermark 37367); “camaco,” (T. Hawkins & D. Mejía 241).

Specimens examined. MEXICO. Chiapas: Municipio Berriozábal, 13 km N of Berriozábal near Pozo Tupipache and Finca El Suspiro, 900 m, 9 Oct 1971 (fr), D. Breedlove 20251 (DS, LL, MICH, MO, NY), 1,000 m, 2 Nov 1971 (fr), D. Breedlove & A. Smith 21680 (DS, LL, MICH, MO), 900 m, 26 Dec 1972 (fr), D. Breedlove & R. Thorne 30777 (DS, LL, MICH, MO, NY), 900 m, 15 May 1973 (fr), D. Breedlove 35294 (DS, LL, MICH, MO, NY), 1,000 m, 10 Oct 1980 (fr), D. Breedlove & J. Strother 46019 (CAS, LL, MO), 1,020 m, 28 Sep 1988 (fl, fr), D. Breedlove 70218 (CAS); SE side of Volcán Tacáná above Tialquian, 2,200 m, 16 Jan 1973 (fr), D. Breedlove & A. Smith 31707 (DS, LL, MICH, MO) Cerca de El Suspito, al NNW de Berriozábal, 900 m, 6 Sep 1953 (fl), F. Miranda 7887 (DS, US); Municipio Bochil, along the river E of Bochil, 5,200 ft [1,585 m], 27 Jun 1967 (fr), A. Shilom T. 2574 (DS, F, LL, MICH); Municipio Cintalapa, ridge SE of Cerro Baul on the border of the state of Oaxaca, 16 km NW of Rizo de Oro along a logging road to Colonia Figueroa, 1,600 m, 27 Apr 1972 (fr), D. Breedlove 24916 (DS); On Oaxaca-Chiapas border near La Cienega de Leon, 1,080–1,230 m, 1 Dec 1980 (fr), D. Breedlove & F. Almeda 48217 (CAS, GH, LL, NY); Municipio Pueblo Nuevo Solistahuacán, near Clinica Terba Buena, 3 km NW of Pueblo Nuevo Solistahuacán, 1,700 m, 14 Dec 1971 (fr), D. Breedlove 23201 (DS, MICH, MO), 2.5 mi N of Pueblo Nuevo Solistahuacán, 3,300 ft [1,615 m], 19 Jun 1970 (fr), E. Latibor & R. Thorne 7233 (DS), near Clinica Terba Buena, 2 km NW of Pueblo Nuevo Solistahuacán, 5,400 ft [1,646 m], 23–24 Jan 1965 (fr), P. Raven & D. Breedlove 19918 (DS, F, MICH, US), 3 km NW of Pueblo Nuevo Solistahuacán, on the slopes below Highway 195 in the vicinity of Clinica Yerba Buena, 17° 30' N, 92° 40' W, 5,400 ft [1,646 m], 7 Oct 1971 (fr), R. Thorne & E. Latibor 46084 (MICH, NY), 17° 30' N, 92° 40' W, 5,800 ft [1,768 m], 20 Sep 1970 (fl), H. Zull 398 (DS); 9 Oct 1970 (fl), H. Zull 650 (DS); Municipio Rayón, in the Selva Negra, 10 km above Rayón, Mezcalapa, along road to Jitotol, 1,700 m, 13 Jul 1972 (fr), D. Breedlove 26072 (DS, LL, MICH, MO, NY), 10 Jan 1981 (fl-bud), D. Breedlove & B. Keller 49316 (CAS, LL, MO, NY), 9 mi NW of Pueblo Nuevo Solistahuacán along the road between Rincon Chamula and Rayón, slope near Puerto del Viento, 17° 30' N, 93° 40' W, 5,800 ft [1,768 m], Sep 1971 (fr), R. Thorne & E. Latibor 41689 (DS); Municipio
San Cristobal de Las Casas, Santa Cruz en San Filipe, without elev., 15 Nov 1986 (fr), A. Méndez T. & Al. C. Martínez de López 9844 (CAS, MO, NY, TEX); Municipio Tenejapa, near Paraje Yashanal, 2,460 m, 28 Jan 1981 (fr), D. Brecklove 49643 (CAS); 2,300 m 22 Apr 1981 (fr), D. Brecklove 51046 (CAS); 1,980 m, 13 Jul 1981 (fr), D. Brecklove 51463 (CAS, LL); Municipio Tenejapa, Ojo del Río Yashanal, 1,700 m, 10 Jul 1982 (fr), A. Méndez T 4404 (MEXU, MO), 20 Aug 1982 (fl-bud), A. Méndez T 4488 (MEXU, MO); Municipio Tila, Colonia Kokijaz, 1,000 m, 20 Mar 1983 (fr), A. Méndez T 5700 (MEXU, MO), 5 May 1983 (fr), 5965 (MEXU, MO, TEX), Finca Morelia, without elev., 20 Mar 1984 (fr), A. Shilton T 7451 (LL, MEXU, MO); Mr.Tacana, 2,000-4,038 m, Aug 1938 (fr), E. Mattofa 2392 (F, GH, LL, MICH, MO, NY, UC, US); Barr. Alpujarre, without elev., 3 Dec 1941 (ll), F. Miranda 1746 (MEXU, TEX); Mrs. near Fenix, without elev., Apr-May 1930 (fr), C. Purpos 10100 (GH, NY); Oaxaca: Distrito Ixtlán: Municipio Comaltepec, SW slope of Cerro Relámpago, just above Río Soyolapan, near Federal Electricity Commission Camp, near Highway 175, 17° 29' 15" N, 96° 24' 05" W, 1,750-1,780 m, 3 Dec 1993 (ster.), E. Boyle et al. 2643 (MO); 15 mi N of San Gabriel along road from Puerto Escondido to Oaxaca, 6,000 ft (1,829 m), 9 May 1965 (fr), D. Brecklove 9880 (LL), La Esperanza, 17° 37' N, 96° 21' W, ca. 1,600 m, 9 Jan 1988 (fr), R. López L. & G. Martin 193 (MO), 17° 37' N, 96° 21' W, 1,600 m, 27 Jul 1981 (ll), R. López L. & G. Martin 491 (MO), Vista Hermosa, trail to camp, 48.8 km SW of Valle Nacional, 17° 30' 9" N, 96° 19' W, 1,460 m, 23 Jan 1988 (fr), R. Torres C. & L. Cortés 11623 (BRIT, MEXU); Distrito Miahualtrip: Municipio San Jerónimo Coaltán, 18 km NE of Piedra Larga, road to San Jerónimo Coaltán, 16° 09' N, 97° 01' W, 1,950 m, 16 Jan 1988 (fr), A. Campos V. 957 (F, MEXU, MO), 11.5 km SW of San Jerónimo Coaltán, trail to Piedra Larga, 16° 20' N, 96° 57' W, 2,050 m, 17 May 1988 (fr), A. Campos V. 1819 (F, MEXU, MO), Espuelas de San Antonio, 13.5 km SW of San Jerónimo Coaltán, trail to Piedra Larga, 16° 12' N, 96° 57' W, 1,950 m, 17 May 1988 (fr), A. Campos V. 1834 (F, MEXU, MO), 17.9 km SW of San Jerónimo Coaltán, trail to Piedra Larga, 16° 12' N, 96° 58' W, 1,890 m, 17 May 1988 (fr), A. Campos V. 1853 (F, MEXU, MO), 19.2 km SW of San Jerónimo Coaltán, trail to Piedra Larga, 16° 12' N, 96° 58' W, 1,900 m, 13 Aug 1988 (fl, bud), A. Campos V. & L. Cortés 2242 (F, MEXU, MO), 6 km NE of logging camp Cerro Sol, trail to Progreso, 16° 11' N, 97° 00' W, 1,400 m, 6 Oct 1988 (fl), A. Campos V. 2385 (F, MEXU, MO); 20 km W of San Jerónimo Coaltán, 1,680 m, 26 Oct 1982 (fl, fr). E. Martínez et al. 2501 (BRIT, MEXU); Municipio Valle Nacional, Cerro Mirador, 15 km NNW of Valle Nacional, 17° 93' N, 96° 22' W, 1,000-1,200 m, 15 Oct 1992 (fr), J. Martes del Castillo et al. 1491 (MEXU, MO); Cafetral Santa Lucía, 1,300 m, 9 Sep 1919 (fl), B. Rojo 441 (US), 20.5 km SW of San Jerónimo Coaltán, trail to Piedra Larga, 16° 12' N, 96° 58' W, 2,000 m, 15 Mar 1989 (fr), G. Toriz A. & A. Campos V. 818 (F, MEXU, MO); Cerro Baal, 23 km NE of Rizo de Oro, road to Colonia Rodolfo Figueroa, without elev., 28 Mar 1984 (fr), R. Torres C. & C. Martínez 4889 (MEXU, MO); 9.6 km SE of Cerro de Vidrio, Oaxaca-Puerto Escondido Highway, 1,850 m, 1 Aug 1984 (fr), R. Torres C. & C. Martínez 5824 (MEXU, MO); Distrito Mixe, Municipio Totontepec, 10.5 km N of Totontepec, road to Chaupán, 17° 17' 00" N, 95° 59' 00" W, 1,760 m, 27 Oct 1988 (fl, fr), R. Torres C. & L. Cortés 10388 (BRIT, MEXU); San Miguel Chimlapama, Cerro Salomón, ca. 2 km in straight line NNW of Cerro Guayabitos, ca. 43 km in straight line N of San Pedro Tapanatepec, 16° 45' N, 94° 11' 30" W, 1,850 m, 23 Dec 1985 (fl, fr), T. Wondi et al. 5149 (BRIT, LL, MEXU); Distrito Solo de Vega, Municipio Santa Cruz Zenzonotepec, El Carrizal, 16° 31' 75" S, 97° 26' 06" W, 1,040 m, 14 Apr 1993 (ster.), J. Weiss 118 (TEX); GUATEMALA. Alta Verapaz-Quiché: Chamá to Chihob, 3,000 ft [914 m], 15 Oct 1920 (fl), H. Johnson 865 (F, LL-fragment, US); Huchuetengo: Cerro Huitz, between Mimanhuizt and Yulhuitz, Sierra de los Cuchumatancces, 1,500-2,600 m, 14 Jul 1942 (fr), J. Steyermark 48602 (F, US).
Quezaltenango: Volcán Zunil, 5,500 ft [1,676 m], 3 Aug 1934 (fl), A. Skutch 931 (F, GH); Volcán Santa María, between Santa María de Jesús and Calahuaché, along great barranco between Finca Pirineos and San Juan Patzulín, slopes at San Juan, 1,300–1,500 m, 6 Jan 1940 (ster.), J. Steyermark 33631 (F); Between Quebrada Chicharro and Montaña Chicharro, on SE-facing slopes of Volcán Santa María, 1,300–1,400 m, 18 Jan 1940 (fr), J. Steyermark 34363 (F). San Marcos: Finca Armenia, Rafael de Cuesta, ca., 5,000 ft [1,524 m], 6–7 Jul 1977 (fr), J. Dwyer 14438 (LL, MO); Río Vega, near San Rafael and Guatemala-Mexico boundary, Volcán Tacaná, 2,500–3,000 m, 20 Feb 1940 (fr), J. Steyermark 36261 (F); Above Finca El Porvenir, up Loma Bandera Shac, lower S-facing slopes of Volcán Tajumulco, 1,300–1,500 m, 9 Mar 1940 (fr), J. Steyermark 37367 (F, LL); Near Aldea Fraternidad, between San Rafael Pic de la Cuesra and Palo Gordo, W-facing slope of the Sierra Madre Mountains, 1,800–2,400 m, 10–18 Dec 1963 (fl), L. Williams et al. 25769 (BM, F, UC), 26085 (F, NY), 26278 (F, GH, US); Outer slopes of Tajumulco Volcano, Sierra Madre Mountains about 8–10 km W of San Marcos, ca. 2,300 m, 31 Dec 1964–1 Jan 1965 (fl), L. Williams et al. 26799 (F, NY, US), (fr), L. Williams et al. 27188 (F). Suchitpéquez: Slopes of Volcán Zunil, vicinity of Finca Las Nubes, along Quebrada Chira, E of Pueblo Nuevo, 500–800 m, 2 Feb 1940 (fl), J. Steyermark 35431 (F); Volcán Santa Clara, between Finca El Naranjo and upper slopes, 1,250–2,650 m, 23 May 1942 (fr), J. Steyermark 46650 (F, US). **Without department:** Las Nubes, without elev., Nov 1877 (fl, fr), K. Bernoldi & A. Cario 1975 (GOET). HONDURAS. Copán: S slope of Cerro Azul, 12 km NW of Florida, Cerro Azul National Park, 15° 6' N, 88° 55' W, 1,500 m, 11 Feb 1992 (fr), T. Hawkins & D. Mejía 241 (EAP, HEH, MO, TEFH).

*Ardisia verapazensis* subsp. *verapazensis* exhibits great quantitative variation among relative size of its organs within individuals and among populations. Even though its distribution is somewhat restricted, this had led to taxonomic overdescription, much like what Pipoly and Ricketson (1998a) noted for species such as *Ardisia opegrapha* Oerst.

The type of *Ardisia sexpartita* was collected from populations whose inflorescences are smaller than average and whose flowers are more waxy pink than the average. *Ardisia eschnitensis*’s type is a fragmentary collection whose flowers (in bud) have thinner perianth parts, but whose organs otherwise fall well within the size range of variation for the taxon. *Ardisia alba* was described only because of its white flowers and inflorescences that dry almost white, its relatively larger anthers and less conspicuous punctations. The holotype of *Zunilia eciliata*, mostly in fruit, is notable for anthers slightly smaller than the average for the species, and calyx lobe margins that are entire and without glandular cilia. However, reexamination of the MO isotype clearly shows small scattered cilia present on young calyx lobes in bud. *Zunilia purpurata*, whose type is a fruiting collection, was separated by its larger calyx lobes with acutish apices. However, both of these features lie well within the range of variation for the subspecies.

It is notable that Lundell’s combinations of *Ardisia eciliata* (Lundell) Lundell and *Ardisia feniana* (Lundell) Lundell are both invalid names. We subsequently validated these names with our combinations *Ardisia eciliata* (Lundell)
Pipoly & Rickerson and Ardisia feniana (Lundell) Pipoly & Rickerson (Pipoly & Rickerson 1998b). However, our current studies show that these taxa are clearly synonyms of Ardisia verapazensis subsp. verapazensis.


_Shrub or small trees to 12 m tall. Branchlets slender, 3.5–5(–7) mm in diam._ Leaves with blades 9.2–20.6 cm long, 3.5–8.2 cm wide, the secondary veins conspicuous below, prominently reticulate, the margins entire to undulate, to irregularly crenulate; petioles canalicate, slender, 0.4–1.4 cm long. *Inflorescence 6.5–11.5 cm long, 7–15 cm wide; peduncles 0.9–2.5 cm long; secondary inflorescence bracts early caducous, unknown; floral bracts early caducous, membranaceous, ovate, minute, 0.8–0.9 mm long, 0.7–0.8 mm wide, apically rounded, the midrib inconspicuous, the secondary veins not visible, densely and prominently black punctate and punctate-lineate, glabrous, the margins entire, hyaline, sparsely glandular-ciliolate; pedicels slender, 0.8–1.7 cm long, not accrescent. *Flowers* membranaceous, 8.4–8.6 mm long; calyx 3.4–3.9 mm long, the lobes 2.7–3.2 mm long, 2.3–2.5 mm wide, glabrous without; corolla 7.7–7.9 mm long, the tube 1.9–2.1 mm long, the lobes 5.7–5.9 mm long, 3.3–3.5 mm wide; stamens 5.9–6.0 mm long, the filaments 3.4–3.6 mm long, united basally into a staminal tube 0.7–0.9 mm long, the free portion 2.6–2.8 mm long, 0.6–0.7 mm in diam., stalked or rarely sessile glandular-papillate, the anthers, 3.0–3.1 mm long, 1.3–1.4 mm wide at base; style 5.5–5.9 mm, ovules 10–16. *Fruit* 5.0–6.1 mm in diam., style 8.8–9.4 mm long, entire style usually persistent.

_Distribution._—Ardisia verapazensis subsp. cucullata is endemic to the southwestern region of Chiapas, Mexico, around the Sierra Madre de Chiapas and the Area Natural de Reserva El Triunfo. It grows from 700–2,540 m elevation.

_Ecology and conservation status._—This subspecies grows in wet montane and cloud forests. Although its geographic range is very restricted, it appears to be common, especially in the Reserva de El Triunfo, where it is presumably protected.

_Etymology._—The epithet ‘cucullata’ refers to what Lundell (1981) interpreted as hooded inner petals. The misinterpretation was based on Lundell’s belief that the corolla was fused at the base into a tube, with two larger
Fig. 3. Ardisia verapazensis Donn. Sm. subsp. escallata (Lundell) Pipoly & Ricketson. A. Reproductive branchlet. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of stamens, showing adaxial surface. E. Detail of stamens, showing abaxial surface. F. Detail of stamens, showing lateral surface. G. Fruit. A–F drawn from E. Matuda 5201 (F isotype). G drawn from R. Hapshore et al. 500 (MEXU).
outer lobes and three inner lobes that were “cucullate” or hooved at the apex. Reexamination of the type revealed that the corolla is simply imbricate and any hooved appearance comes from drying effects.

Specimens examined. MEXICO. Chiapas: Municipio Angel Albino Corzo, along Río Cuztepeques, near Finca Cuztepeques, 2,400 ft [732 m], 26 Mar 1968 (fr), A. Shiboni T. 3867 (DS, F, LL 2-sheets, MICH, NY). Municipio Jaltenango, Reserva del Triunfo, Cañada del Pavón NW of Triunfo, 1,800 m, 10 May 1982 (fr), J. Calzada et al. 8739 (LL), trail NNW from El Triunfo Camp to Palo Gordo Camp, 1 km from El Triunfo Camp, 15° 39′ N, 92° 50′ W, 2,000 m, 20 Feb 1990 (fr), R. Hampshire et al. 500 (BM, MEXU), 1–3 km from El Triunfo Camp, 15° 39′ N, 92° 50′ W, 2,000 m, 21 Feb 1990 (fr), R. Hampshire et al. 519 (BM 2-sheets, MEXU, NY); trail WSW from Palo Gordo towards Finca Catarina, 15° 40′ N, 92° 51′ W, 2,000 m, 25 Feb 1990 (fr), R. Hampshire et al. 699 (BM 2-sheets, MEXU); Municipio Jaltenango-Mapastepec, Reserva El Triunfo, near HQ, 15° 39′ N, 92° 48′ W, 1,900 m, May 1989 (fr), M. Heath & A. Long 31 (BM, CHIP), Cañada Honda, near Camp Headquarters, 15° 39′ N, 92° 48′ W, 1,400 m, May 1989 (fr), M. Heath & A. Long 40 (CAS, CHIP); Municipio Mapastepec, Área Natural de Reserva El Triunfo, Cañada Honda, 7 km S of camp, 1,500 m, 1 Mar 1990 (fr), R. Hampshire et al. 1680 (BM 2-sheets, MO), Cañada Honda, 7 km S of camp, 1,500 m, 01 Mar 1990 (fr), A. Reyes G. et al. 1680 (BM 2-sheets, MO); Municipio Motozintla de Mendoza, steep canyon, SW side of Cerro Mazotla, 11 km NW of the junction of the road to Motozintla along road to El Porvenir and Soltek, 2,100 m, 22 Nov 1976 (fr), D. Bredlove 41758 (DS); 23 Nov 1981 (fl), D. Bredlove & B. Bartholomew 55766 (CAS); Municipio Soltek, on ridge above Soltek along road to Huixtla, 2,000–2,400 m, 1 Feb 1982 (fr), D. Bredlove & F. Almeda 58249 (CAS, LL, MO, NY); Pasitar, without elev., 29 Dec 1936 (fl), E. Mattuda 393 (LL, US); Boquerón, Motozintla, 2,450–2,540 m, 5 May 1945 (fr), E. Mattuda 5416 (F, LL 3-sheets); Mt. Ovando, Escuinilla, without elev., 14 Nov 1945 (fl), E. Mattuda 16228 (MO, US).

**Zunilia miranda**e Lundell is known only from the holotype. It is notable only for its short petioles, smaller inflorescence and smaller sepals, but is otherwise indistinguishable the type of the subspecies.

Subspecies *cucullata* is distinguished from subspecies *verapazensis* by its shorter corolla lobes and free portion of the filaments, the style much longer in flower and fruit, and smaller fruit. It appears to be geographically isolated, occurring only in the southwestern region of Chiapas.

**EXCLUDED NAME**


The ovate anthers with subapical pores, opening into slits, and panicle inflorescences bearing racemose branchlets, all indicate that this species belongs to *Ardisia* subgenus *Ardisia*, and not subgenus *Graphardhia*.

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REFERENCES


NUMERICAL LIST OF TAXA

1a. Ardisia verapazensis Donn Sm. subsp. verapazensis
1b. Ardisia verapazensis Donn. Sm. subsp. cucullata (Lundell) Pipoly & Rickerson

LIST OF EXSICCATAE

The figures in parentheses refer to the numbers from the numerical list of taxa. Collection numbers in **boldface** type indicate type specimens.

Bernoulli, K. & A. Cario 1975 (1a); Boyle, B. et al. 2614 (1a); Breedlove, D., 8962 (1a); 9880 (1a); 20251 (1a); 23201 (1a); 23916 (1a); 26072 (1a); 28973 (1a); 35294 (1a); 41758 (1b); 49645 (1a); 51046 (1a); 51463 (1a); 70218 (1a); Breedlove, D. & E. Almeda 48217 (1a); 58249 (1b); Breedlove, D. & B. Bartholomew 55766 (1b); Breedlove, D. & B. Keller 49316 (1a); Breedlove, D. & A. Smith 21680 (1a); 31707 (1a); Breedlove, D. & J. Strother 46019 (1a); Breedlove, D. & R. Thorne 30777 (1a).

Calzada, J. et al. 8739 (1b); Campos V., A., 957 (1a); 1819 (1a); 1834 (1a); 1853 (1a); 2585 (1a); Campos V., A. & L. Cortés 2242 (1a).

Dwyer, J., 14458 (1a).

Hampshire, R. et al. 500 (1b); 519 (1b); 699 (1b); 1680 (1b); Hawkins, T. & D. Mejia 241 (1a); Heath, M. & A. Long 31 (1b); 40 (1b).

Ignacio Aguilar, J., 1679 (1a).

Johnson, H., 865 (1a).

Lathrop, E. & R. Thorne 7233 (1a); López L., R. & G. Martín 193 (1a); 491 (1a).

Martínez, E. et al. 2501 (1a); Matuda, E., 393 (1b); 2392 (1a); 5201 (1b); 5416 (1b); 16228 (1b); 2392 (1a); Meave del Castillo, J. et al. 1491 (1a); Méndez T., A., 4404 (1a); 4488 (1a); 5700 (1a); 5965 (1a); Méndez T., A. & M. C. Martínez, de López 9844 (1a); Miranda, E., 1746 (1a); 7004 (1b); 7887 (1a).

Purpus, C., 100 (1a); 10100 (1a).

Raven, P. & D. Breedlove 19918 (1a); Reko, B., 441 (1a); Reyes G., A. et al. 1680 (1b).

Shilom T., A., 2574 (1a); 3867 (1b); 7451 (1a); Skutch, A., 931 (1a); Steyermark, J., 33608 (1a); 33631 (1a); 34363 (1a); 55451 (1a); 56261 (1a); 57367 (1a); 46650 (1a); 48602 (1a).

Thorne, R. & E. Lathrop 41689 (1a); 46084 (1a); Toritz A., G. y A. Campos V. 818 (1a); Torres C., R. & C. Martínez 4869 (1a); 5824 (1a); Torres C., R. & L. Cortés 10388 (1a); 11623 (1a); Türckheim, H. von, 112093 (1a).

Wendt, T. et al. 5149 (1a); Williams, L. et al. 25769 (1a); 26085 (1a); 26278 (1a); 26799 (1a).

Zuill, H., 398 (1a); 650 (1a).
NOTES ON SECTIONAL DELIMITATIONS IN ERIGERON (ASTERACEAE: ASTEREEAE)

GUY L. NESOM

Biota of North America Program—North Carolina Botanical Garden
Coker Hall CB 3280
University of North Carolina
Chapel Hill, NC 27599, U.S.A.

RICHARD D. NOYES

Plant Genome Mapping Laboratory
Riverbend Research Center, Room 162
University of Georgia
Athens, GA 30602, U.S.A.

ABSTRACT

Erigeron sect. Linearifolii is narrowed to a monotypic taxon, comprising only Erigeron hyssopifolius of northern North America. Erigeron sect. Pycnocephalum is restricted to the 14 species of the E. folius group, which are primarily Californian in distribution. The Mexican species E. exilis is transferred from sect. Cincinnati to sect. Lamprocaules. Erigeron rhizomatus (New Mexico) and E. lepidopodus (Chihuahua and Durango, Mexico) are consolidated as Erigeron sect. Geronpternix Nesom & Noyes, sect. nov. The two species are distinct from other erigerons in their scaled-leaved, rhizomiform caudex branches, large, solitary heads, and long, narrowly oblong cypselas. Sect. Geronpternix is the most primitive phylogenetic element of Erigeron and of subtribe Conyzinae.

RESUMEN

Erigeron sect. Linearifolii se reduce a un taxon monotípico, que comprende sólo Erigeron hyssopifolius del norte de Norte América. Erigeron sect. Pycnocephalum se restringe a las 14 especies del grupo E. folius, que primariamente tienen una distribución Californiana. La especie mexicana E. exilis se transfiere de la sect. Cincinnati a la sect. Lamprocaules. Erigeron rhizomatus (Nuevo México) y E. lepidopodus (Chihuahua y Durango, México) se consolidan como Erigeron sect. Geronpternix Nesom & Noyes, sect. nov. Las dos especies se distinguen de otros erigerons por sus ramas rizomiformes con hojas escamosas, capítulos grandes solitarios y cipselas largas estrechamente oblongas. La Sect. Geronpternix es el elemento filogenético más primitivo de Erigeron y de la subtribu Conyzinae.

Upon consideration of the morphology and systematics of North American Erigeron species, we observe that modifications in sectional alignments should be made. Changes discussed here deal primarily with species regarded as "peripheral to sect. Linearifolii" in the treatment by Nesom (1992).

1. The placement of Erigeron hyssopifolius

Cronquist (1947) included Erigeron hyssopifolius Michx. within the E. folius

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sum of relatives, disparity previously recognized by Nesom (1989) maintained E. hyssopifolius within the group (as sect. Linearifolii) but later (1992) viewed it as peripheral to species of that group. With additional perspective on the genus, the disparity between E. hyssopifolius and the E. foliosus group suggests that it is more realistic to recognize the former at sectional rank, coordinate with the species of the E. foliosus group in its strict sense.

Erigeron hyssopifolius differs from E. foliosus and related species in several features, including cauline leaves abruptly reduced in size below the peduncles, short, axillary, leafy shoots often produced, heads solitary on bracteate peduncles 5–10 cm above the level of the leaves, phyllaries 3-nerved and all nearly equal in length, and lamina of the ray corollas not coiling. Further, sect. Pycnophyllum sensu stricto is almost completely restricted to areas along the Pacific coast of the U.S.A. and Baja California, while E. hyssopifolius ranges across northern North America (mostly Canada) from Newfoundland, Nova Scotia, and various New England states to Yukon and Alberta.

The nomenclature for the two sections concerned is now as follows.


Species included: *Erigeron hyssopifolius* Michx.


Species included: the 14 species of the E. foliosus group (sensu Nesom 1992).

2. **The placement of Erigeron exilis**

*Erigeron exilis*, a species of the Mexican states of Jalisco and Nayarit, was previously included within sect. *Cincinnatii* Nesom (Nesom 1989), but its greater similarity to the species of sect. *Lamprocaules* (Nesom 1994a) has been recognized in recent study and review of Mexican Erigeron. The other species of sect. *Lamprocaules* (discussed as possible relatives of sect. *Linearifolii* by Nesom 1992) also are restricted to Mexico but occur in the northeastern states of Coahuila, Nuevo Leon, and Tamaulipas, compared to the more southwestern distribution of *E. exilis*.

The section, as newly amended, is as follows.


Species included: *E. chiangii* Nesom, *E. exilis* Gray ex S. Wats., *E. pattersonii* Nesom, and *E. scopariooides* Nesom.

These plants are perennials with stems simple or few-branched, slender
to wiry, shiny-textured, leaves all cauline, shiny-textured, narrow, and relatively even-sized, buds erect, and heads relatively small. The scale-leaved rhizomes of *E. exilis* are similar to those of *E. chIangii* and *E. scopariaoides*; the thick, woody, non-rhizomatous base of the gypsum endemic, *E. Pattersonii*, probably is specialized within the section. The stipitate-glandular stems and involucre of *E. exilis* are similar to those of *E. chIangii*.

The ray flowers with coiling lamina of *Erigeron exilis* are unusual in sect. *Lamprocaules*, because the rays in other three species apparently do not coil. Still, the overall similarity among *E. exilis* and other species suggests that they are closely related. Non-coiling (and non-reflexing) rays are uncommon in *Erigeron* and may represent a shared specialized state in the north-eastern species of this group.

3. The status of *E. rhizomatuis* and *E. lepidopodus*

*Erigeron rhizomatuis* and *E. lepidopodus* were placed by Nesom (1989) as members of the *E. foliosus* group (*Erigeron* sect. *Linearifolii* sensu lato), where their relationship as sister species was noted. *Erigeron lepidopodus* occurs from central Chihuahua to northern Durango, Mexico; *E. rhizomatuis* is endemic to Catron and McKinley counties, New Mexico, where it is considered rare and endangered (U.S. Fish and Wildlife Service 1988; Sivinski and Lightfoot 1995). In a detailed treatment of the *E. foliosus* group (Nesom 1992, p. 205), under the heading “Species peripheral to sect. *Linearifolii*,” it again was observed that these two species are closely similar in geographic range and morphology and almost certainly related as sister species. Plants of both produce stems from rhizomelike caudex branches, usually without clustered basal leaves (similar to plants of the *E. foliosus* group), and both species produce large, solitary heads erect in bud, long, non-coiling ray corollas, and long cypselas, unlike plants of the *E. foliosus* group. Cronquist (1947, p. 275) observed that “Although clearly belonging to the small section *Wyomingia*, [*E. rhizomatuis*] does not seem closely related to any other known species. Its subglabrous leaves and involucres separate it from anything else in the section, and its peculiar habit is unique in the genus.” Indeed, of the characters noted by Cronquist to link *E. rhizomatuis* to sect. *Wyomingia* (i.e., imbricate involucral bracts, 4–14-nerved cypselas), the cypsela morphology apparently was emphasized; they have little else in common. *Erigeron rhizomatuis* and *E. lepidopodus* warrant formal taxonomic recognition as a distinct and discrete group.


Ramiis caudicis longis squamifoliatitis rhizomiformibus, capitulis grandibus solitariis in alabastro erectis, ligulis non circinnatis, et achenis longis angustis oblongis distinctus.

Perennial herbs arising from thick, fibrous roots and long, slender, de-
cumbent, often buried, rhizomiform, scale-leaved caudex branches. Stems erect, 6–15 cm tall, simple or with 1-3 short branches on the upper half, stipitate-glandular at least on the peduncle, otherwise sparsely pubescent with appressed to spreading or deflexed hairs, bearing ascending, linear to narrowly oblong leaves. Heads large, 12–20 mm wide; ray flowers 14-45, the lamina 6-14 mm long, white or blue-tinted with an abaxial lilac midstripe, apparently neither coiling nor reflexing at maturity. Cypselas narrowly oblong, 3.5–4.5 mm long, slightly compressed radially and 2- or 4-nerved (E. lepidopodus) or subterete and 5–6-nerved (E. rhizomatus), densely strigose to sericeous; pappus a single series of 25–50 bristles of unequal length, with a few outer setae. Flowering vernal. Base chromosome number, x = 9. For E. lepidopodus: chromosome number, 2n = 18 (Ward & Spellenberg 1988); illustration (Nesom 1981). For E. rhizomatus: chromosome number, 2n = 18 (Ward & Spellenberg 1986); photographs of habit, heads, and habitat (New Mexico Native Plants Protection Advisory Committee 1984; Heil 1995). The name is from Greek, _geron_ (old) and _ptenix_ (stem of a plant), alluding to the name *Erigeron*, to the peculiar stems, and to the phylogenetically basal position (lower or “old stem”) of this group.

Species included: *E. lepidopodus* (B. Rob. & Fern.) Nesom and *E. rhizomatus* Cronq.

Recent studies by Noyes (1999) show that *E. rhizomatus* and *E. lepidopodus* together apparently form the most basal phyletic element within *Erigeron* as well as within the entire subtribe Conyzinae. All of the species at more basal levels of the subtribe are *Erigeron*, as are most of the terminal species. Interpolated at various points in the subtribal topology, however, are other generic-level taxa, including *Conyza*, which apparently is biphyletic, and a group of South American genera (*Leptostelma, Apopyros, Neja, and Hysterionica*) recently recognized by Nesom (1994b), as well as the long-accepted and morphologically divergent genus *Aphanostephus*. The taxonomic implications of the Noyes analysis are complex, but morphological differences among various phyletically divergent infrageneric groups of species traditionally identified as *Erigeron* are in most cases so subtle that attempts to recognize segregate genera would be virtually impossible in actual practice. The two species of sect. *Geronapternix* are relatively easily distinguished as a group, and they are justifiably recognized at sectional rank.

**ACKNOWLEDGMENTS**

We appreciate review comments from Richard Spellenberg and John Strother.

**REFERENCES**


BOOKS RECEIVED


“This beautifully illustrated book presents all [known] 54 wild orchids of Texas.” Contents include: Preface, Acknowledgments, Texas Treasures: Fifty-four Types of Orchids, An Infinite Variety, The Discriminating Orchid, The Natural Regions of Texas, How Texas Orchid Habitats are Described in This Book, Orchids of the Bogs and Savannahs, Orchids of Open Sunny Habitats, Orchids of Forests and Woodlands, Orchids of the Mountains and Canyons, Texas Orchids by Flower Color, Texas Orchids by Genus and Species, Appendix A. Sources of Scientific Names, Appendix B. Excluded Species, Appendix C. Species Distribution by County, Literature Cited, and Index. A full review is forthcoming in the next issue.


“Hawaiian Biogeography compares the biogeographic patterns of many of the archipelago’s species—various flowering plants, birds, spiders, and insects, including fruit flies—with its known geological history. Contributors apply, for the first time, a consistent phylogenetic methodology, using modern cladistic techniques, to a variety of lineages to identify common or discordant evolutionary and biogeographic patterns among the constituent species.” Contents include: Preface, Acknowledgments, Contributors, Introduction, Geology and Biogeography of the Hawaiian Islands, Cladistic Methods, Biogeographic Patterns of Two Independent Hawaiian Cricket Radiations (Lampula and Protarchesbogaerius), Chromosome and Male Genitalia of Hawaiian Drosophila: Tools for Interpreting Phylogeny and Geography, Molecular Approaches to Biogeographic Analysis of Hawaiian Drosophilidae, Evolution of Sarona (Heteroptera, Miridae): Speciation of Geographic and Ecological Islands, Comparison of Speciation Mechanisms in Web-Building and Non-Web-Building Groups within a Lineage of spiders, Evolutionary Relationships of the Hawaiian Honeycreepers (Aves, Drepanidinae), Biogeography of Seven Ancient Hawaiian Plant Lineages, Phylogeny, Adaptive Radiation, and Biogeography of Hawaiian Tetramolopium (Asteraceae, Astereae), Phylogeny and Biogeography in Schiedea and Atripacondron (Caryophyllaceae), Historical Biogeography and Ecology of the Hawaiian Silversword Alliance (Asteraceae): New Molecular Phylogenetic Perspectives, Molecular Evolution, Adaptive Radiation, and Geographic Speciation in Cyana (Campanulaceae, Lobelioideae), Patterns of Speciation and Biogeography in Clermontia (Campanulaceae, Lobelioideae), Phylogenetic Analysis of Hawaiian and Other Pacific Species of Scaevola (Goodeniaceae), Biogeographic Patterns in the Hawaiian Islands, Postscript, Literature Cited, and Index.
NOVELTIES IN THE MYRSINACEAE FROM THE VENEZUELAN GUAYANA

JOHN J. PIPOLY III
Botanical Research Institute of Texas
509 Pecan Street, WORTH TX 76102-4060 U.S.A.
jpipoly@brit.org; clusia@latinmail.com

JON M. RICKETSON
Missouri Botanical Garden
P. O. Box 299, St. Louis, MO 63166-0299, U.S.A.
jon.ricketson@mobot.org

ABSTRACT
Preparation of a taxonomic treatment of the Myrsinaceae for the Flora of the Venezuelan Guayana project resulted in the discovery of a new species, Cybianthus liesneri Pipoly & Rickerson, which is described, illustrated, and its systematic relationships discussed. A key to distinguish Cybianthus liesneri from the other species of Cybianthus subgenus Weigeltia of the Venezuelan Guayana is provided. In addition, Parathesis viridis Lundell is found to be a member of the genus Stylogyne. The combination, Stylogyne viridis (Lundell) Rickerson & Pipoly is proposed, the species is newly illustrated and an updated description is provided. In addition, a key to the species of Stylogyne found in the Venezuelan Guayana is presented.

RESUMEN
Estudios para preparar un tratamiento taxonómico de la familia Myrsinaceae para la Flora of the Venezuelan Guayana dieron como resultado el descubrimiento de una especie nueva para la ciencia. Se describe, se ilustra y se discute el parentesco de la nueva especie, Cybianthus liesneri Pipoly & Rickerson. Se ofrece una clave taxonómica para separar Cybianthus liesneri de las otras especies pertenecientes al género Cybianthus subg. Weigeltia dentro de la Guayana venezolana. Además, se encontró que Parathesis viridis Lundell se ubica mejor dentro del género Stylogyne. Se propone la nueva combinación, Stylogyne viridis (Lundell) Rickerson & Pipoly, se ilustra la especie, y se discute su parentesco. Se aporta una clave para distinguir las especies del género Stylogyne en la Guayana venezolana.

NOTES ON CYBIANTHUS
Of the 56 species known to occur in the area covered by the Flora of the Venezuelan Guayana (Steyermark et al. 1995), 42 taxa, comprising 39 species, belong to the genus Cybianthus Mart. In studying the specimens collected from the region, we noted that one represented an entity we had not seen previously. Several characters, including the abruptly basally swollen petioles, pinnate panicles, stems with appressed brownish furfuraceous lepidote scales and prominently long black punctate-lineations, and 4-lobed calyx
placed the new species in *Cybianthus* subgenus *Weigeltia* (A. DC.) G. Agost., a group consisting of approximately 46 species in South America and the Caribbean (Pipoly 1998). In the Guayana of Venezuela, subgenus *Weigeltia* is represented by six species, separable in the following key.

**KEY TO CYBIANTHUS SUBGENUS WEIGELTIA IN THE VENEZUELAN GUAYANA**

1. Leaves narrowly oblong to oblanceolate (3.1–)4–5(–7.5) cm wide.
2. Petiole terete; leaf blades not black punctate-lineate below; staminate pedicels ca. 1 mm long; pistillate pedicels 0.5–0.6 mm long. .... *C. longifolius* Miq.
3. Petiole canaliculate to base; leaf blades conspicuously black punctate-lineate below; staminate pedicels ca. 1.5–2.5 mm long; pistillate pedicels (0.7) 1.0–1.5 mm long ........................................... *C. surinamensis* (Spreng.) G. Agost.
1. Leaves elliptic to obovate, (6.3–)8–10(–14) cm wide.
2. Leaves membranaceous, prominently black punctate or conspicuously black punctate-lineate below, base acuminate or tapering gradually, decurrent on petiole to base; petiole deeply canaliculate; pistillate pedicels thin, 2–2.5 mm long.
3. Branchlets terete, not brittle, not semi-succulent, with numerous, minute, appressed reddish lepidote scales, inconspicuously black punctate-lineate; leaves conspicuously black punctate-lineate below, the quaternary veins not visible; petioles 3–4.5 cm long, not decurrent. ..........*C. multicostatus* Miq.
4. Branchlets angulate, brittle, semi-succulent, with scattered, minute, appressed, brownish lepidote scales, densely and prominently long black punctate-lineate, leaves densely and prominently black punctate below, the punctations one per areole, formed by prominently raised quaternary veins; petioles 1.5–2 cm long, decurrent on the branchlet onto rounded ridges on branchlet. ....................................... *C. liesneri* Pipoly & Rickerson, sp. nov.
5. Leaves chartaceous to subcoriaceous or thickly coriaceous to cartilaginous, obscurely pellucid punctate below, base acute, barely decurrent on petiole; petiole terete with a narrow, shallow channel barely discernible above; pistillate pedicels obsolete to thicker than long and subobtuse.
6. Branchlets angulate, with few, rounded angles below decurrent petiole bases; petioles 1.3–7 cm long, decurrent onto rounded angles on branchlets; leaves thickly coriaceous to cartilaginous; pistillate calyx lobes deltate, apically acute; staminate calyx lobes linear-lanceolate, apically narrowly acute to attenuate. .................................. *C. grandifolius* (Mez) G. Agost.
7. Branchlets terete, with numerous, raised narrow longitudinal ridges not corresponding to petiole bases; petioles (1.7–)2–3 cm long, not decurrent onto branchlet; leaves chartaceous to subcoriaceous; pistillate calyx lobes very widely ovate to obliterate, apically subacute to obtuse; staminate calyx lobes ovate, apically obtuse with a small acumenum at tip. ..............*C. potiae (Mez)* G. Agost.

The new species is described herewith.

**Cybianthus liesneri** Pipoly & Rickerson, sp. nov. (Fig. 1). **Type:** VENEZUELA, AMAZONAS: Departamento Río Negro; Cerro de la Neblina Camp V; valley N
of base of Pico Cardona, 00° 49' N, 66° 00' W, 1,250 m, 21–24 Mar 1984 (fr). R. Liesner & B. Stannard 16866 (HOLOTYPE: VEN; ISOTYPES: K, MO).

Quoad folia membranacea, subter manifeste atro-punctato arque atro-punctato-lineata, ad bases grade decrescens, ad bases petiolaris decurrentes, petioliis profunde canaliculatos, pedicellos pistillatos graciles, 2–2.5 mm longos, C. multistammatum valde arce affinis, sed ab ea ramulis angulatis (non teretibus), fragilibus (nec flexilibus), semi-succulentis (nec non-succulentis), sparse deminuteque adprese brunei (nec rubigini) squamis lepidotis indutis, necon dense atque prominent (nec inconspicue) longo-atro-punctato-lineatis, foliis subter dense manifesteque atro-punctatis cum punctis uno in quoque areola (non lineatis), denique petiolis 1.5–2 (non 3–4.5) mm longis, ad ramulis decurrentis (nec non-decurrentis) statim distinguetur.

Shrub or small tree to 4 m tall. Branchlets angulate, brittle, semisucculent, 7–10 mm diam., apically with scattered, minute, appressed brownish lepidote scales, densely and prominently long-black punctate-lineate, glabrescent. Leaves pseudoverticillate; blades membranaceous, obovate, 30–43 cm long, 10–14 cm wide, apically acuminate, the acumen 8–10 mm long, gradually tapering to a cuneate base, decurrent to base of petiole; midrib slightly raised above, prominently raised below, the principal secondary veins arcuate from the midrib toward apex, prominulous above, prominently raised below, 13–19 pairs, the tertiary veins prominulous below, perpendicular to the secondary ones, prominently black punctate below, the punctations no more than one per each areole formed by the prominently raised quaternary venation, with scattered conspicuous (but not prominently raised) black punctate-lineations; the margin entire, glabrous; petioles deeply canaliculate, 1.5–2 cm long, decurrent onto the rounded ridges of the branchlet, glabrous. Staminate inflorescence: unknown. Pistillate inflorescence a columnar, pinnate panicle 10–19 cm long, to 6 cm wide, the peduncle, rachis and pedicels densely rufous papillate; inflorescence bract unknown; peduncle 1–2 cm long; pedicels cylindrical, thin, 2–2.5 mm long; floral bracts unknown. Pistillate flowers unknown; fruiting calyx cotyliform, spreading, 0.8–1 mm long, the tube ca. 0.1 mm long, the lobes ovate, 0.7–0.9 mm long, 0.5–0.7 mm wide, apex obtuse to rounded, bearing 3–5 prominently raised black punctations medially, the margins irregular, erose to erose-dentate, glabrous. Fruit (im-mature) 2.5–3.5 mm diam., scattered translucent glandular-lepidote, the style persistent, the stigma subcapitate, 4-lobed.

Distribution and ecology.—Known only from the type, growing at 1,200–1,300 m elevation, Cybianthus liesneri occurs in premontane wet forest, dominated by Iriartea (Areaceae) and several Burseraceae species.

Etymology.—This species is dedicated to Ronald L. Liesner, of the Missouri Botanical Garden, prodigious collector of Amazonian plants.

Paratypes. VENEZUELA. Amazonas: Departamento Río Negro, trail S from Cerro Nebliña Camp V, 00° 49’ N, 66° 00’ W, 1,200–1,300 m, 12 Apr 1984 (fr), A. Gentry & B. Stein 46352 (MO 2-sheets, VEN n.v.).
Fig. 1. Cybianthus liesneri Pipoly & Ricketson. A. Flowering branchlet, habit. B. Close up of abaxial leaf surface, showing prominent black punctations, one per areole. C. Inflorescence branch close up, showing dense papillae. D. Close up of fruit, calyx and pedicel, showing the ovate calyx lobes, persistent subcapitate, 4-lobed stigma. A–D, drawn from type.
The following characters: chartaceous to subcoriaceous leaf blades that are obscurely pellucid punctate below with acute bases; subterete petiole with a narrow, shallow channel barely discernible above, and the flowers that are either sessile or with short, stout pedicels, all indicate that *C. liesneri* is most closely related to *C. multicostatus*. However, the angulate, brittle, semi-succulent branchlets, with scattered minute, appressed, brownish lepidote scales, and dense and prominent black punctate-lineations, leaves black punctate below with one punctuation per areole, shorter petioles decurrent on the rounded ridges of the branchlet, all serve to distinguish *C. liesneri* from *C. multicostatus*.

**NOTES ON STYLOGYNE**

While examining *Parathesis viridis* Lundell, described from the Guayana region, we suspected that it was, in fact, a member of the genus *Stylogyne* A. DC. The species was previously known only from fruit and some poorly preserved flower buds. A new collection provided us with new characters, such as the contorted corolla, linear-lanceolate anthers with sagittate bases and longitudinal dehiscence, long style with punctiform stigma, leaving no doubt that *Parathesis viridis* should be transferred to *Stylogyne*. Therefore, we propose the new combination here and include the new data gleaned from the second collection known for the species. A key to the species of the genus in the Venezuelan Guayana is provided first, below.

**KEY TO SPECIES OF STYLOGYNE IN THE VENEZUELAN GUAYANA**

1. Inflorescence, peduncle, rachis and/or pedicels sparsely to densely papillose, of simple to few-celled papillae, often obscure.

2. Anthers narrowly lanceolate, reddish-concolorous when dried; inflorescence opaque; ovary minutely rufous puberulent apically. *S. viridis* (Lundell) Rickertson & Pipoly, comb. nov.

3. Leaf margins conspicuously crenate; growing in gallery forests on slopes near streams, ca. 500 m elevation. *S. lasseri* (Lundell) Pipoly

4. Mature fruits 10–14 mm diam., depressed-globose; leaf blades chartaceous to coriaceous, usually nitid above. *S. atrata* Mez

5. Mature fruits 4–7(–9) mm diam., globose; leaf blades membranaceous, usually dull above. *S. micrantha* (Kunth) Mez

The transfer and new description is included herewith.

*Stylogyne viridis* (Lundell) Rickertson & Pipoly, comb. nov. (Fig. 2). *Parathesis viridis* Lundell, Phytologia 56:26. 1984. TYPE. VENEZUELA. AMAZONAS: 0–1 km S of San Carlos de Río Negro, 01° 51' N, 67° 03' W, 120 m, 4 Feb 1980 (fr), R. Liesner 9046 (HOLOTYPE: MO; ISOTYPE: VEN n.v.).
Fig. 2. *Stylogyne viridis* (Landell) Rickerson & Pipoly. A. Flowering branchlet habit, showing wings, and leaf punctations. B. Close up of abaxial leaf surce, showing punctations and punctate-lineations. C. Corymb detail, showing reflexed corollas and persistent styles. D. Corolla and adroecium, separated from calyx and developing fruit. E. Stamen, adaxial view, showing hastate base and longitudinal slits. F. Stamen, lateral view. G. Stamen, abaxial view, showing darkened connective. H. Pedicel, calyx and young fruit, showing minute rufous puberulent ovary summit. A–H, drawn from R. Liesner 4182.
Tree to 4 m tall. Branchlets 2–2.5 mm diam., angulate, with ridges forming "wings" ca. 3 mm high, spiralled around the stem to follow the margins of the decurrent petiole bases, glabrous. Leaves alternate, chartaceous, lanceolate to elliptic, 14–19 cm long, 4.0–4.7 cm wide, apically long acuminate-attenuate, the acumen 1–1.8 cm long, basally acute to obtuse, midrib prominulous apically, then canaliculate basally above, prominently raised below, the secondary veins 20–24 pairs, prominulous above and below, connected by a submarginal looping vein ca. 4 mm from margin, with periodic secondary veins extending to a second minor submarginal connecting vein 1 mm from margin, minutely scrobiculate above, densely and prominently orange punctate and punctate-lineate below, the margins flat, entire, decurrent to base of petiole; petiole marginate, roughly trigonal in transverse section, marginate, 6–9 mm long, glabrous. Bisexual inflorescence a terminal, pyramidal, bipinnate panicle 5.5–8 cm long, 6–7.5 cm wide; inflorescence bract unknown; peduncle 1.1–1.5 cm long; floral bracts coriaceous, minute, linear, 0.4–0.6 mm long, 0.1–0.2 mm wide, apex rounded, densely orange punctate, the margin glandular-ciliate, early caduceous; pedicels 4–6 mm long, minutely glandular-papillate. Bisexual flowers chartaceous: calyx campanulate, the sepals free, ovate, 1.1–1.3 mm long, 0.7–0.9 mm wide, apex rounded to obtuse, the margins irregular, somewhat erose apically, very sparsely and minutely glandular-ciliolate; corolla chartaceous, very openly rotate, 4.4–5 mm long, the tube 0.9–1.1 mm the lobes reflexed distally and rolled at anthesis, oblong, 3.5–3.9 mm long, 1.3–1.5 mm wide, apex very broadly rounded to a short acumen, densely and prominently orange punctate and punctate-lineate, the margin entire, opaque, glabrous; stamens 3.3–3.6 mm long, the filaments flat, 1.8–2 mm long, adnate to the corolla tube 0.9–1.1 mm, the apically free portion ca. 0.9 mm long, the anthers concolorous, linear-lanceolate, 2–2.3 mm long, 0.3–0.5 mm wide basally, apically attenuate, basally deeply sagittate, dehiscent by wide longitudinal slits, the connective dark brown; pistil obturate, 4.7–4.9 mm long, the ovary obovoid, 2–2.2 mm long, 1.5–1.7 mm diam. toward apex, narrower below, apically rufous puberulent, the style thin, 2.6–2.8 mm long, the stigma punctiform. Fruit unknown.

Distribution.—Endemic along the Río Negro, south of San Carlos de Río Negro. It grows at 120 m in elevation. No collections are known from the Colombian side of the river, however it should be expected.

Ecology and conservation status.—Seasonally flooded primary forests and secondary areas. Because of its restricted distribution, it should be considered threatened.

Etymology.—The specific epithet comes from the Latin meaning "green," presumably because of the leaf color.

Specimens examined. VENEZUELA. AMAZONAS: S of airstrip of San Carlos de Río Negro and along river for 2 km, 01° 55' N, 67° 05' W, 120 m, 4 Dec 1977 (fl, fr), R. Liesner 4182 (MO).
The minute glandular-papillae of the pedicels makes it most easy to confuse *Stylogyne viridis* with *S. orinocensis*. However, the concolorous, linear-lanceolate anthers, opaque inflorescence rachis and ovary minutely glandular-puberulent apically all easily distinguish *Stylogyne viridis* from *S. orinocensis*.

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NEW SPECIES OF CLUSIA (CLUSIACEAE) FROM THE CORDILLERA OCCIDENTAL OF COLOMBIA

JOHN J. PIPOLY III
Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102-4060, U.S.A.
jpipoly@brit.org; clusia@latinmail.com

ALVARO COGOLLO P.
Fundación Jardín Botánico, Joaquín Antonio Uribe
Apartado Aéreo 51407, Medellín, Antioquia, COLOMBIA
acogollo@latinmail.com; jardinho@md.impsat.net.co

ABSTRACT

Fieldwork conducted during a survey of Las Orquídeas National Park in Antioquia, Colombia, resulted in the discovery of two undescribed species of Clusia section Anandrogyne. Clusia deminuta Pipoly & Cogollo and C. paisarum Pipoly & Cogollo are described and illustrated, and their respective distributions, ecology, conservation status, etymology of epithets and phylogenetic relationships are elucidated.

RESUMEN

El trabajo de campo durante una investigación de la flora del Parque Nacional Natural “Las Orquídeas,” ubicado en el Departamento de Antioquia, Colombia, dio como resultado el descubrimiento de dos especies nuevas, pertenecientes al género Clusia sección Anandrogyne. Se aporran descripciones, ilustraciones, comentarios sobre sus respectivas distribuciones geográficas, ecología y condiciones en cuanto a la conservación, así como la etimología de los epítetos específicos y el parentesco de Clusia deminuta Pipoly & Cogollo y de C. paisarum Pipoly & Cogollo.

The genus Clusia section Anandrogyne Planch, and Triana is now known to contain more than 70 species (Pipoly 1995, 1998) and is defined by the largely antherous staminodes of the pistillate flowers and the pluriseriate, acropetally longer stamens of the staminate flowers, the latter with anthers dehiscent by wide longitudinal slits. While carrying out fieldwork to document the plant diversity of Las Orquídeas National Park, two new species were encountered and are described herewith.

Clusia (§Anandrogyne) deminuta Pipoly, sp. nov. (Fig. 1). TYPE. COLOMBIA. ANTIOQUIA: Mpio. Urrao; Corregimiento La Encarnación; Trail to Parque Nacional Natural “Las Orquídeas,” first hill between Quebrada el Aguacate and Quebrada San 

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Quoad paniculam 5-floridam, folia subsessiles vel sessilis, petiolas late marginatos sepala 4, petala 6. C. papadum est valde arcte affinis sed ab ea ramulis tetragonis (non teretibus), laminis linearibus oblongis vel loratis (non ellipticis) ad apices acuminatis (nec rotundatis), pedicellis tetragonis 2.8–3.2 mm longis (non obsolete), necnon habitu epiphytico (non terrestri) periacule cognoscitur.

Epiphytic shrub to 3 m tall; latex white. Branchlets tetragonal, with the angles formed by small rounded ridges running from the side of each petiole base to the center of the petiole above it, 2.5–3 mm diam. Between nodes, 3–4 mm diam. At the nodes; semisuconnect, the bark smooth, shiny, exfoliating, glabrous. Leaves subsessile to very short petiolate; blades thinly coriaceous, linear, oblong or lorate, (5.2–)6.0–11.5 cm long, (1.2–)2.0–2.4 cm wide, apically acuminate, the acumen 4–8 mm long, basally broadly rounded, the midrib prominently raised above and below, the secondary veins numerous, perpendicular to the midrib, prominently raised above and below, the submarginal collecting vein perpendicular to the secondaries, prominently raised above and below, the tertiary veins not visible from above, prominulous below, glabrous and dull above, pallid below, the latex canals not obvious, bearing numerous rubiginous dots below, the margin revolute, decurrent on the petiole; petiole subobsolete to 4 mm long, deeply canaliculate and widely marginate throughout, glabrous, decurrent on either side of the stem and almost touching the petiole base of the opposite leaf. Staminate inflorescence and flowers unknown. Pistillate inflorescence terminal, dichasial, 5-flowered, with two basal lateral flowers followed by a rachis segment and 3 terminal flowers; peduncle tetragonal, 1.7–2.5 cm long, inflorescence bracts 2, qualitatively identical to foliage leaves but membranaceous, 15–17 mm long, 3–3.5 mm wide, midrib raised in a sunken furrow above, prominently raised below, the secondary venation not visible, the petioles obsolete to 2 mm long; upper peduncle tetragonal, 9–11 mm long; floral bracteoles 2, below the two basal, lateral flowers, stiffly coriaceous, widely ovate, 3–3.5 mm long, 2.4–2.6 mm wide, apex broadly rounded but with a small acuminate-mucronulate tip, ventrally (abaxially) keeled medially, the margin opaque, entire; pedicels of basal lateral flowers like the peduncle; upper bracteoles as in lower bracteoles but 3–3.2 mm long, 2.8–3 mm wide, terminal flower cluster pedicels as in peduncle except 2.8–3.1 mm long. Pistillate flowers with sepals 4, decussate, chartaceous, the outer suborbicular, cuculate 4–4.2 mm long, 3–3.2 mm wide, apically broadly rounded, the margin opaque, entire, inner sepals as in outer except margin irregularly notched; petals 6, contorted, membranaceous, obovate-spathulate, as in sepals except constricted basally; staminodes 5, alternate with the carpels (opposite carpel suture), minute, anantherous, subulate, ca. 1 mm long,
PiPOLY AND COGOLLO, A new species of Clusia from Colombia

Fig. 1. *Clusia deminuta* Pipoly. A. Fruiting branchlet. B. Close up of abaxial leaf surface, showing revolute margin and rubiginous dots. C. Pistillate inflorescence in bud. D. Dissection, showing sepal (left), pistil (upper center), petal (right), and pedicel with floral bracteoles (lower center). E. Fruit. A–E, drawn from type.

0.3 mm wide, early caducous; pistil 5-carpellate, oblongoid, ca. 3 mm long, 1.3 mm diam., the styles obsolete, the stigmas 5, cuneiform, brick red, the surface appearing papillate. *Mature fruit* ovoid, 1.3–2 cm long, 0.8–1 cm
diam. when dried, sutures furrowed, the styles stout, ca. 1.5 mm long, the stigma concave, deltoid (triangular with rounded corners), the seeds small, numerous, with orange arils.

Distribution.—Apparently endemic to Parque Nacional “Las Orquídeas,” in the Municipio of Urrao and the Corregimiento La Encarnación, Department of Antioquia, Colombia, on the Cordillera Occidental of the Andes, growing from 1,300–2,400 m elevation.

Ecology and conservation status.—*Clusia deminuta* is a canopy epiphyte in the pluvial premontane, cloud and elfin forest, where it forms large individuals that often acquire a weight sufficient enough to break the branches of the host tree. In the premontane forest, it is restricted to the tops of emergent trees, whereas higher, in the cloud and elfin forest, it may be found in tangles of fallen vegetation. It requires nearly open light, so is very susceptible to the periodic, catastrophic “blowdowns” seen on radar imagery for the region, mostly attributable to seismic activity. Even though the species has a locally common distribution, I would still consider it threatened because the entire region is prone to frequent and violent seismic activity. It should be noted that the “elfin forests” inhabited by *Clusia deminuta* are some of a very few true elfin forests found on the South American continent, mostly because the mountains on which they occur are not high enough to permit existence of subpáramo and páramo formations.

Etymology.—The epithet “deminuta” refers to the small stature of the plant, its leaves, branchlets, flowers and fruit.

Paratypes. COLOMBIA. Antioquia: Mpio. Urrao; Corregimiento La Encarnación; Parque Nacional Natural “Las Orquídeas,” Sector Calles, Quebrada La Bironda, 06° 31' N, 76° 19' W, 1,300–1,500 m, 3 Apr 1992 (fr), D. Cárdenas & E. Álvarez 3261 (FMB, JAUM, MO), Vereda Calles, right bank of Río Calles, on the mountain range NW of Cabaña Calles, 06° 32' N, 76° 19' W, 1,450 m, 1 Dec 1993 (fr), A. Cogollo et al. 7637 (BRIT, FMB, JAUM); permanent premontane pluvial forest inventory plot, 06° 32' N, 76° 19' W, 1,450–1,500 m, 28 Nov 1993 (ster.), J. Pipoly, A. Cogollo et al. 17292 (BRIT, FMB, JAUM); Zona limitrofe del Parque Nacional Natural “Las Orquídeas,” Vereda Calles, 06° 32' N, 76° 19' W, 1,450–1,500 m, 30 Nov 1993 (pist. fl bud), J. Pipoly et al. 17369 (BRIT, FMB, JAUM).

The cuneiform stigmas, appearing papillate, with 5 carpels and 5 very reduced, subulate staminodes without antherodes, clearly place *Clusia deminuta* within section *Anandrogyne* Planch. & Triana. Section *Anandrogyne* is by far the largest and the most complex within the genus, containing 75 species (Pipoly et al. 1995, 1998), including at least 21 as yet undescribed. The five-flowered panicle, subsessile or sessile leaves, widely marginate petioles (when these are developed), calyx of four sepals and corolla of six petals indicate that *Clusia deminuta* is most closely related to the vicariant *C. popayanesis* Planch. & Triana. *Clusia popayanesis* is a poorly known species, from the Chocó floristic region of western Cauca Department, growing in the subpáramo thicket life zone. *Clusia deminuta* is easily separated from *C. popayanesis* by
its tetragonal branchlets, linear, oblong; or lorate leaf blades with acuminate apices, tetragonal pedicels 2.8–3.2 mm long, and epiphytic habit.

*Clusia deminuta* is an important, locally common endemic from Las Orquídeas National Park. The elfin forest area at the Park’s northern boundary is extensive and our exploration was very limited. Based on collections from the area, the northernmost areas of the Cordillera Occidental of Colombia is home to large numbers of undescribed, yet ecologically important and very conspicuous species of flowering plants.

*Clusia (§Anandrogyne) paisarum* Pipoly, sp. nov. (Fig. 2). Type. COLOMBIA. ANTIOQUIA; Mpio. Urrao; Corregimiento La Encarnación; Trail to Parque Nacional Natural “Las Orquídeas,” first hill between Quebrada el Aguacate and Quebrada San José, 06° 27' N, 76° 13' W, 2,200–2,400 m, 8 Feb 1995 (fr), J. Pipoly, J. Ramírez & J. Arias 18585 (holotype: JAUM; isotypes: BRIT, COL, FMB).

Proper inflorescentium terminalem atque flores congestos, lamina coriacea elliptica vel oblonga, pedunculos quadratos, ovarium 7-carpellarum, derinque fructus globosusque rostratus, C. casa.simulidi valde arcte affinis, sed alius ramulis quadratis (non reribus), laminis acuminaris (non rotundatis), petalis 1.1–2.2 (non usque ad 1.0) cm longis, necnon sepalis 5 (non 4), atque petalis 6 (ne 5), statim separabilis.

Terrestrial shrub to 3 m tall; latex yellow. Branchlets tetragonal, the angles formed by acute angles running from each petiole base to the center of the petiole 90° from and above it, 4.5–5(–7) mm diam., not swollen at the nodes; semisucculent, the bark smooth, sordid, not exfoliating, glabrous. Leaves petiolate; blades coriaceous, elliptic to narrowly oblong or rarely lanceolate, (7.0–)11.5–15(–17) cm long, (3.2–)4–5.5(–6) cm wide, apically short acuminate, the acumen 5–10 mm long, basally acute, midrib raised but canaliculate above, the channel decurrent to petiole base, prominently raised below, the secondary veins 28–34 pairs, diverging at approximately 45° from the midrib and arcuate, barely prominent or inconspicuous above, prominent below, the submarginal connecting vein barely prominent above, prominent below, the secondary veins alternating with shorter intersecondary veins that terminate before reaching the connecting vein, the tertiary veins inconspicuous, the latex canals numerous, linear, black, conspicuous below only on immature leaf blades, glabrous and dull above, pale yellow, the margin entire, flat, decurrent on the petiole; petiole deeply canaliculate and marginate throughout, (1.1–)1.3–1.5(–2.2) cm long, glabrous. Staminate inflorescence and flowers unknown. Pistillate inflorescence terminal, a 6-flowered, congested cyme; peduncle tetragonal, (1.7–)4.0–5.5 cm long; inflorescence bracts 2, qualitatively identical to the vegetative leaves except blades (2.0–)3.0–8.5 cm long, (0.7–)1.2–3 cm wide, the petioles 0.5–1.0 cm long; upper peduncle tetragonal, 5–8 mm long; floral bracts 2, cartilaginous, ovate, 10–12 mm long, 6.5–7 mm wide, apically acute to attenuate, prominently keeled, medi ally strongly rugose, the margin stramineous, entire; floral bracteoles
Fig. 2. *Chissa pusimarus* Pipoly. A. Fruiting branchlet. B. Inflorescence, lateral view. C. Dissected pistillate flower bud, showing sepal (left), pistil (center) and petal (right). D. Inflorescence. A–D, drawn from type.
Mature
animals
dant (rostrate) without
carpines, suborbicular, 8.8–9.2 mm long, 10.1–10.5 mm wide, apically very
broadly rounded, somewhat cucullate, medially somewhat rugose, the margin
opaque, entire; inner sepals acropetally larger, chartaceous, stramineous, ovate,
to 9.4 mm long, 7.3 mm wide, apex broadly rounded, the upper margin
thin, translucent, irregularly incised; petals 6, coriaceous, contorted, ob-
long, 13–14.1 mm long, 6–7.5 mm wide, apically slightly cucullate, the
margin opaque, entire; staminodes 7, alternate with the carpels, anantherous,
connate into a small ring, oblato, 0.7 mm long, 1.3–1.5 mm wide, apically
sharply acuminate; pistil 7-carpellate, obovoid, 9.8–10.2 mm long, the ovary
cavitate, 7.3–7.5 mm wide, the styles 2–3 mm long, the stigmas concave, black, cuneiform, 1.3–1.5 mm long, 1.2–1.4 mm wide, smooth. 
Mature fruit globose, 1.3–2 cm long and wide, the carpels 7, not obvious,
without obvious suture lines, the styles thin, 2–3 mm long, giving a beaked
(rostrate) appearance to the fruit, the stigmas as in the flowers, the seeds
small, numerous.

Distribution.—Apparently endemic to the type area near Parque Nacional
“Las Orquídeas,” in the Municipio of Urrao and the Corregimiento de La
Encarnación, Department of Antioquia, Colombia, along the western slopes of
the Cordillera Occidental of the Andes, growing from 2,200–2,400 m elevation.

Ecology and conservation status.—Clusia paisarum is a terrestrial tree growing
in remnant montane pluvial forest, near small watercourses. It is locally
common along the margins of remnant forest, but particularly abundant
on the ridges above roadcuts. It is also an important element of these
remnants because it is deeply rooted and in fact, is often used to tie pack
animals to as they rest along the paths. However, it does not attain a diam-
eter over 10 cm DBH, and perhaps for that reason, and its copious, sticky
yellow latex, it is rarely cut down. Despite significant effort, no staminate
plants were found, but there were significant numbers of trees not in flower,
some of which may have been staminate.

Etymology.—The specific epithet “paisarum” is derived from the local Spanish
adjective “Paisa,” a colloquialism for Colombians inhabiting the coffee-growing
region comprised of the Departments of Antioquia, Risaralda, Caldas and
Quindío. The region around Urrao, Antioquia is particularly noteworthy
for its production of coffee and grenadilla, a species of Passiflora.

Paratype. COLOMBIA. Antioquia: Mpio. Urrao; Corregimiento La Encarnación; Trail
to Parque Nacional Natural “Las Orquídeas,” first hill between Quebrada el Agucate and
Quebrada San José, 06° 27' N, 76° 13' W, 2,200–2,400 m, 8 Feb 1995 (fr), J. Pipoly. J.
Ramírez & J. Arias 18580 (BRIT, COL, FMB, JAUM).
*Clusia paisarum* is most closely related to *C. cassinoides* Planch. & Triana, with which it shares of its yellow latex, terminal, congested inflorescence, coriaceous usually elliptic or oblong leaf blades, tetragonal peduncles, 7-carpellate ovaries and globose, beaked fruits. However, *Clusia paisarum* can immediately be separated from *C. cassinoides* by the tetragonal stems, short acuminate leaf apices, longer petioles, more numerous sepal and petals.

This species belongs to a group of species within the large *Clusia* section *Anandrogyne* with yellow latex. This group includes such problematic taxa as *Clusia stemphylla* Standl. and *C. longistyloa* Cuatrec., the former found from Mesoamerica to the Darien of Panama, and the latter from the northern pluvial lowland forests of Antioquia and the Choco of Colombia, southward to Esmeraldas, Ecuador, an area still within the Choco Floristic Province. However, both *Clusia stemphylla* and *C. longistyloa* have much larger oblong or elliptic leaf blades with broadly rounded apices and bases, pyramidal panicles, extremely long, alate petioles (3–8 cm long), 5-carpellate fruits and long, thin, persistent styles, clearly distinguishing them from both *Clusia paisarum* and *Clusia cassinoides*.

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**REFERENCES**


SARRACENIA ROSEA (SARRACENIACEAE),
A NEW SPECIES OF PITCHER PLANT FROM THE SOUTHEASTERN UNITED STATES

ROBERT F.C. NACZI and ERIC M. SOPER
Department of Biological Sciences
Northern Kentucky University
Highland Heights, KY 41099, U.S.A.

FREDERICK W. CASE, JR. and ROBERTA B. CASE
7275 Thornapple Lane
Saginaw, MI 48603, U.S.A.

ABSTRACT

Sarracenia rosea is described as a new species from the Gulf Coastal Plain of southern Alabama, northwestern Florida, southwestern Georgia, and southeastern Mississippi. Pink petals, large flowers, short scapes, pitchers with thick lips, and lips deeply concave in dorsiventrally pressed pitchers are among the features that distinguish S. rosea from its closest relative, S. purpurea. Sarracenia rosea most often grows in sunny to lightly shaded, wet, acid sites in pinelands. Its infrequent occurrence within a small geographic range makes its conservation of concern.

INTRODUCTION

The Western Hemisphere pitcher plants (Sarraceniacae) are a small family (15–17 species in 3 genera) of perennial herbs endemic to North America and northern South America. Tubular, pitcher-like leaves ("pitchers") enable these plants to lure, trap, digest, and absorb nutrients from a wide variety
of prey, usually arthropods. Most of these pitcher plant species inhabit sunny, wet, nutrient-poor sites such as bogs, seepages, and wet savannas. The carnivorous habit, peculiar morphology, and unusual ecology of these plants have attracted much interest from horticulturists, ecologists, and systematists. Despite such attention, the ecology, taxonomy, and phylogeny of the Sarraceniaceae remain poorly understood.

The largest genus in the family is Sarracenia (10 or 11 species). The most morphologically divergent member of Sarracenia is S. purpurea L. It is the only species with erect hoods and, consequently, the only species whose pitchers collect rainwater. Other Sarracenia species have hoods that cover the mouths of the pitchers, which are moist inside, but not full of water. Sarracenia purpurea is the only species in which the pitcher tube is curved, the widest part of the tube is near the middle, and the style expansion is glandular-puncticulate. Congeners have straight tubes, tubes widest at or near their mouths, and non-glandular style expansions. Only S. purpurea and S. psittacina possess short, decumbent pitchers with wide wings. Other species of Sarracenia have relatively long, erect pitchers with relatively narrow wings.

Sarracenia purpurea is often locally abundant within its vast geographic range, which is the largest in the family. Its reported natural range spans 32 degrees of latitude (30–62° N) and 70 degrees of longitude (53–123° W), from southeastern Louisiana, southern Alabama, and northern Florida north in the southern Appalachian mountains and along the Atlantic Coast to eastern Newfoundland and then west across the northeastern United States of America and much of southern Canada to northeastern British Columbia (Macfarlane 1908; McDaniel 1971; Cody & Talbot 1973; Rouleau & Lamoureux 1992).

Largely because of its distinctive morphology, relative frequency, and wide range, S. purpurea has a four-century history of study and is the best known member of its genus (Lloyd 1976). Authors have described several infraspecific taxa of S. purpurea (Schnell 1979, 1993; Schnell & Determann 1997; Hanrahan & Miller 1998). In our ongoing field, greenhouse, and herbarium studies of the taxonomy of S. purpurea, we have discovered that one of these taxa (S. purpurea var. burkii D.E. Schnell) is more distinct than previously recognized and deserves recognition as a new species.

MATERIALS AND METHODS

We have investigated the morphology, distribution, and habitats of S. purpurea and the new species in the field at as many sites as possible throughout its geographic range. For the new species, we studied it at 26 sites in Alabama, Florida, and Mississippi. We studied S. purpurea in 4 Canadian provinces and 12 states of the U.S.A. We also borrowed specimens from or studied
specimens at the following 20 herbaria: AUA, DHL, FLAS, FSU, IBE, KNK, KY, LSU, MICH, MO, NCU, NY, OS, PH, TENN, US, USAM, USCH, VDB, and WKU. Abbreviations of herbaria are those of Holmgren et al. (1990).

Previous authors vary in their terminology for the morphology of *Sarracenia purpurea*. In order to standardize terminology and make our descriptions of characters unambiguous, we picture and use the following terms for portions of the pitchers: hood, mouth, lip, tube, wing, and petiole (Fig. 1A). Terms for the description of reproductive morphology are relatively straightforward, with the exception of style expansion, which we have illustrated in Fig. 1B.

Of the herbarium specimens we examined, including our own collections, we selected a representative subset to measure for statistical analyses. We chose only mature specimens that had grown in sunny or lightly shaded habitats because pitchers etiolate and pitcher plants exhibit reduced growth in heavily shaded habitats. For specimens collected by others, we used habitat information on labels and the presence of reddish venation strongly contrasting with the ground color of pitchers as evidence of growth in high-light environments. We also chose specimens that exhibited the full range of morphologic variation for *S. purpurea* and the new species and that originated from throughout the ranges of the two taxa. The set of specimens we measured includes all of the subspecies and varieties currently recognized in *S. purpurea*. Each measured specimen of the new species is denoted by an asterisk following its herbarium of deposit in the citation of types and of representative specimens. Citations of measured specimens of *S. purpurea* can be found in the Appendix. Specimen citations have been purposely abbreviated because of conservation concerns.

We measured at least 74 specimens for most characters of *S. purpurea* and at least 39 specimens for most characters of the new species. Sample sizes vary for the characters since some collections lacked a particular feature or the manner of specimen preparation made measurement impossible. We measured each character only once per specimen. When measuring a structure that is present more than once on a specimen (e.g. petals), we measured the one with the greatest value for a measurement. When measuring the width or thickness of a structure, we measured it at its widest or thickest point. We measured maximum distance of the lip from the horizontal, lip thickness, and style arm length as in Fig. 2. For style arm length and petal length, we measured only styles and petals that were fully expanded. To assess the degree to which *S. purpurea* and the new species differed from each other for each character, we used the independent-samples *t*-test. Because the variances of several characters are heterogeneous (as determined
by the Bartlett chi-square test for homogeneity of group variances), we transformed the data with the common logarithm before conducting the $t$-tests. All statistical analyses were performed on a Macintosh computer using SYSTAT version 5.1 (Wilkinson 1989). In Table 1, we report sample sizes, summary statistics, and $t$-values for the measurements of characters we discovered that best distinguish *S. purpurea* and the new species.

To study the lectotype of *S. purpurea* (McDaniel 1971), which is plate 70 of Catesby (1738), we measured the plate directly as if it were a pressed specimen. Direct measurement is justified because Catesby’s depictions of *S. purpurea* and a frog on the plate are life-sized. In text accompanying plate 70, Catesby states, “These frogs are of various sizes, tho’ commonly about the bigness of the figure. . . .” We did not include measurements of the lectotype in the data or analyses presented in Table 1.
As an additional means of studying the morphology of *S. purpurea* and the new species, we cultivated plants of them under common conditions in the Case greenhouse in Saginaw, Michigan. In the greenhouse, we grew plants from 8 populations of *S. purpurea* (3 from the southern Appalachians, 3 from the Coastal Plain of North and South Carolina, and 2 from Michigan) and 7 populations of the new species (Alabama and Florida). Plants were cultivated for 15–25 years in pots with soil from the same source and watered from a common supply, as described by Case and Case (1976).

For determination of the flowering period of the new species, we considered only specimens bearing at least one fully expanded petal. To determine the geographic range of the new species, we used only herbarium specimens that we examined; each point on the map is based on at least one herbarium specimen.
RESULTS AND DISCUSSION


A Sarracenia purpurea petalis roseis, scapis brevioribus (16.3–35.1 cm longis), floribus grandioribus (brachis stylorum 2.6–1.1 cm longis), labis ascidiornum crassioribus (2.6–7.5 mm crassis), labis ascidiornum proprium curvis bases versus ascidiornum in speciminibus exsiccatis dorsiventraliter complanatis differt.

Perennial herb. Rhizomes usually horizontal, occasionally vertical, 1.2–5.8 cm long, 0.8–1.8 cm wide. Pitchers decumbent to ascending, in basal rosettes, 4–9 in each rosette, 5.9–28.1 cm long, 2.3–6.8 cm wide at tube, 2.1–5.3 times as long as wide, hooded terminally, lipped at mouth, tube arcuate, winged exteriorly on adaxial surface of tube, petiolate. Hood erect, reniform to broadly cordate, apex usually slightly recurved and thus often emarginate in dorsiventrally pressed pitchers, otherwise entire, usually coarsely wavy in abaxial-adaxial plane in life, unconstricted at base and broadly attached to tubular portion of pitcher, 1.8–6.1 cm high, 3.3–13.4 cm wide, 1.5–3.7 times as wide as high, extending laterally from pitcher mouth 0.8–4.2 cm on each side, extending basally from pitcher mouth 0.7–2.8 cm on each side; adaxial surface pubescent with moderately dense, coarse, stiff, decurved hairs 1.0–2.1 mm long, coarsely reticulately veined with veins usually deep red or purple-red and contrasting with background, background pale green or pale green suffused with purple-red; abaxial surface pubescent with moderately dense, fine, soft, appressed hairs 0.3–0.8 mm long, color as on adaxial surface except color of veins usually contrasting less with background color. Mouth 1.9–5.3 cm wide; lip 2.6–7.5 mm thick, curved basally in dorsiventrally pressed pitchers, with maximum distance from horizontal at junction of lip and wing, this maximum distance 2.4–9.7 mm. Tube obovate in dorsiventrally pressed pitchers, slightly constricted apically to wide mouth, gradually tapered basally to narrow petiole, 3.3–17.0 cm long, 2.3–6.8 cm wide; ventricose in laterally pressed pitchers, strongly outcurved abaxially, plane or slightly incurved adaxially; pubescent with moderately dense, fine, soft, appressed hairs 0.3–0.8 mm long except glabrous or sparsely pubescent on abaxial surface; pale green or pale green suffused with dull purplered, frequently with longitudinal veins and some cross-veins dull red and contrasting with paler background. Wing semi-oblanceolate to semicircular, 3.2–16.6 cm long, 0.6–5.4 cm wide, pubescence and color as on tube. Petiole solid, 0.2–6.3 cm long, decurved or straight, glabrous. Flowers pendulous, borne singly on scapes, bracteate. Scape 16.3–35.1 cm high, 1.1–
2.8 times as long as longest pitcher per plant, 2.5–5.4 mm wide at mid-height, distally abruptly decurved to point of attachment with flower. **Bracts** appressed to calyx, 3, broadly ovate, obtuse, entire, 5–8 mm long, 4–7 mm wide, glabrous, persistent through death of scape and shedding of seeds. **Calyx** 5.7–10.6 cm wide in pressed flowers; sepals proximally imbricate, distally non-overlapping, 5; ovate, obtuse, entire, 3.1–4.7 cm long, 1.7–3.8 cm wide, 1.4–2.3 times as long as wide, glabrous; adaxial surface usually very pale green, with deep purple-red margin at anthesis and for a short time afterward, purple-red margin fading to pale green with age; abaxial surface usually deep purple-red to pale purple-red, rarely pale green; persistent as long as scape and pericarp remain green. **Corolla** 8.7–13.2 cm wide in pressed flowers; petals non-overlapping, 5, pandurate, obtuse, entire, 4.5–6.4 cm long, limb 2.9–4.2 cm long and 2.0–3.5 cm wide, base 1.5–2.3 cm long and 1.5–2.2 cm wide, isthmus 1.1–1.8 cm wide, glabrous, very pale to deep pink or very rarely pale yellow in life, rose to lavender or rarely nearly white when recently dried, fading to pale brown or whitish when dry for a longer time, color of adaxial surface same as color of abaxial surface, shed soon after pollen release. **Androecium** of numerous stamens, 2.4–3.1 cm wide in pressed flowers; filaments 6–13 mm long; anthers 2.7–4.0 mm long, 2.0–3.5 mm wide, yellow to red-brown; shed soon after pollen release. **Gynoecium** of 5 connate carpels; ovary globose, 0.9–1.3 cm high, 1.1–1.4 cm wide, very densely verrucose, pale green or whitish; style basally styliform, styliform portion 0.8–1.0 cm long, apically abruptly expanded and umbraculiform, persistent through death of scape and shedding of seeds; stigmas 5. **Style expansion** pentagonal, each angle slightly elongated and forming a short and emarginate lobe, otherwise entire, 4.8–7.4 cm wide, adaxial surface pubescent and glandular-puncticulate, abaxial surface pubescent and glandular-puncticulate, ribbed, membranous during anthesis, thickening soon after anthesis and becoming coriaceous, pale green to nearly white and sometimes lightly suffused with purple-red; lobes 0.4–1.0 cm long, 0.2–0.3 times as long as style arms, notches 2.9–6.2 mm deep; hairs on adaxial surface of style expansion moderately dense, erect, fine, 0.2–0.6 mm long; hairs on abaxial surface of style expansion sparsely to moderately dense, erect, fine, 0.2–0.5 mm long; glands sparsely to moderately dense on adaxial surface of style expansion, moderately dense on abaxial surface of style expansion, slightly raised, depressed-dome-shaped, 0.06–0.13 mm wide, usually pale to deep red-brown, most prominent during anthesis, becoming obscure with thickening of style expansion; ribs 5, each radiating from center of style expansion and terminating in stigma; style arms 2.6–4.1 cm long, 0.078–0.20 as long as scapes. **Stigmas** 0.2–0.6 mm long, 0.4–0.5 mm wide, each restricted to apex of papilla; papillae 5, each in base of notch of style expansion, perpendicular to lobes of style expansion, 0.8–1.6 mm long. **Capsule**
Table 1. Morphologic characters that best distinguish _Sarracenia rosea_ from _S. purpurea_. Quantitative data are means ± 1 SD and ranges for measurements. N = number of specimens measured. The two species differ significantly for all quantitative characters (t-test, _P_ < 0.001). The quantitative characters are listed in descending order of _t_-value.

<table>
<thead>
<tr>
<th>Character</th>
<th><em>S. rosea</em></th>
<th><em>S. purpurea</em></th>
<th><em>t</em>-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. lip thickness (mm)</td>
<td>4.5 ± 1.1</td>
<td>1.8 ± 0.5</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>(2.6–7.5)</td>
<td>(0.7–3.1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 48</td>
<td>N = 85</td>
<td></td>
</tr>
<tr>
<td>2. scape height/style arm length</td>
<td>8.2 ± 1.8</td>
<td>18 ± 4.5</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>(4.9–13)</td>
<td>(9.5–33)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 52</td>
<td>N = 86</td>
<td></td>
</tr>
<tr>
<td>3. scape height (cm)</td>
<td>25.9 ± 5.03</td>
<td>44.2 ± 11.3</td>
<td>13.4</td>
</tr>
<tr>
<td></td>
<td>(16.3–35.1)</td>
<td>(22.3–79.1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 52</td>
<td>N = 86</td>
<td></td>
</tr>
<tr>
<td>4. style arm length (cm)</td>
<td>5.2 ± 0.54</td>
<td>2.5 ± 0.44</td>
<td>9.9</td>
</tr>
<tr>
<td></td>
<td>(2.6–4.1)</td>
<td>(1.7–3.8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 52</td>
<td>N = 86</td>
<td></td>
</tr>
<tr>
<td>5. lip concavity, maximum distance from horizontal (mm)</td>
<td>5.0 ± 1.7</td>
<td>0.7 ± 1</td>
<td>8.4</td>
</tr>
<tr>
<td></td>
<td>(2.1–9.7)</td>
<td>(0.5–3.5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 34</td>
<td>N = 65</td>
<td></td>
</tr>
<tr>
<td>6. hairs on adaxial surface of hood, length (mm)</td>
<td>1.5 ± 0.21</td>
<td>1.2 ± 0.3</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>(1.0–2.1)</td>
<td>(0.6–2.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 47</td>
<td>N = 83</td>
<td></td>
</tr>
<tr>
<td>7. petal length (cm)</td>
<td>5.1 ± 0.48</td>
<td>4.1 ± 0.45</td>
<td>7.4</td>
</tr>
<tr>
<td></td>
<td>(4.5–6.4)</td>
<td>(5.3–5.3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 18</td>
<td>N = 25</td>
<td></td>
</tr>
<tr>
<td>8. scape height/longest pitcher length</td>
<td>2.0 ± 0.47</td>
<td>3.5 ± 0.71</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>(1.1–2.8)</td>
<td>(1.9–5.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 17</td>
<td>N = 47</td>
<td></td>
</tr>
<tr>
<td>9. sepal length (cm)</td>
<td>5.8 ± 0.41</td>
<td>3.2 ± 0.42</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>(3.1–4.7)</td>
<td>(2.2–4.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 34</td>
<td>N = 74</td>
<td></td>
</tr>
<tr>
<td>10. mouth width (cm)</td>
<td>5.4 ± 0.72</td>
<td>2.4 ± 0.44</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>(1.9–5.3)</td>
<td>(1.4–3.6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 39</td>
<td>N = 74</td>
<td></td>
</tr>
<tr>
<td>11. petal width (cm)</td>
<td>2.7 ± 0.35</td>
<td>2.1 ± 0.32</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>(2.0–3.5)</td>
<td>(1.6–2.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 18</td>
<td>N = 25</td>
<td></td>
</tr>
<tr>
<td>12. petal color</td>
<td>usually pink</td>
<td>usually maroon or red</td>
<td></td>
</tr>
</tbody>
</table>

depressed-globose, 1.1–1.4 cm high, 1.6–2.1 cm wide, densely verrucose, brown, dehiscing basipetally. Seeds obovate or oblong in outline, compressed, narrowly ridged along one lateral margin, pyriform in cross-section, 1.8–2.3 mm long, 1.0–1.4 mm wide, brown, verruculose, often slightly glaucous because of a thin coating of wax.
Diagnostic Features
Several morphologic features distinguish *S. rosea* from *S. purpurea* (Table 1). The most obvious diagnostic feature is petal color. *Sarracenia rosea* usually has pink petals (Fig. 3), whereas *S. purpurea* has maroon or red petals (Fig 4). Closely correlated with the paler petals of *S. rosea* are paler gynoecia (Schnell 1993), though we have observed *S. purpurea* with pale gynoecia, too. While Schnell (1993) emphasized the pink coloration of the petals in his diagnosis of *S. purpurea* var. *burkii*, previous researchers believed pink petals were the result of a mutation (Wherry 1933) or of a phenotypic response to low light levels (Bell 1949). Through field observations and greenhouse cultivation, we confirm that pink is the predominant color for petals of *S. rosea*. Indeed, among the species (not hybrids) of *Sarracenia*, pink petals are unique to *S. rosea*.

In *S. rosea*, petal color ranges from very pale pink (almost white) to deep pink. Most commonly, the pink is of medium saturation (as in Fig. 3). Bell (1949: 157) mentioned observing *S. rosea* (as *S. purpurea*) near Bay Minette, Alabama that had dark red petals. We agree with Schnell (1993) that such plants are likely introgressants with one of the species that possesses maroon petals, most likely *S. leucophylla* Raf. Putative hybrids of *S. leucophylla* and *S. rosea* (as *S. purpurea*) are reported from several localities, including Bay Minette (Bell 1949, 1952; Bell & Case 1956; McDaniel 1971). Very rarely, plants of both *S. purpurea* and *S. rosea* produce yellow petals, due to failure of anthocyanin production (Sheridan & Mills 1998a, 1998b; Hanrahan & Miller 1998). These yellow-flowered plants also lack reddish coloration.
in pitchers and calyces. This variation of *S. purpurea* is *S. purpurea* f. *heterophylla* (Eaton) Fernald. For *S. rosea*, the analogous form has been described by Hanrahan and Miller (1998), but must be transferred from *S. purpurea*, as we do here. 


In addition to petal color, we found that nearly every feature of the flower is substantially larger in *S. rosea* than in *S. purpurea*. The sepals of *S. rosea* are 3.1–4.7 cm long, whereas those of *S. purpurea* are only 2.2–4.2 cm long. The petals of *S. rosea* are longer and wider than those of *S. purpurea* (Fig. 5): 4.5–6.4 cm long and 2.0–3.5 cm wide for *S. rosea* versus 3.3–5.3 cm long and 1.6–2.9 cm wide for *S. purpurea*. Style size, as measured by style arm length, is greater for *S. rosea* (2.6–4.1 cm) than *S. purpurea* [1.7–2.9(–3.8) cm].

The scapes of *S. rosea* are relatively short, only 16.3–35.1 cm high versus 22.3–79.1 cm high for *S. purpurea*. These short scapes are remarkable in

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light of the comparatively large flowers of S. rosea. As a result, the ratio of scape height/style arm length is a particularly strong quantitative character in separating S. rosea from S. purpurea (Table 1). The values of this ratio are 4.9—13 for S. rosea and 9.5—33 for S. purpurea. The visual difference between the two species in flower size-scape height proportions is striking (Fig. 6).

Several vegetative characters are also diagnostic. First, the lips of S. rosea are thicker than those of S. purpurea (Fig. 7): 2.6—7.5 mm thick for S. rosea versus 0.7—3.1 mm thick for S. purpurea. Second, in dorsiventrally pressed pitchers, the lips of S. rosea curve basally, forming a relatively deep concavity. The lips of S. purpurea are horizontal or form a shallow concavity. Thus, the maximum distance of the lip from horizontal (the maximum depth of the concavity) is greater in S. rosea than S. purpurea (Fig. 7): 2.4—9.7 mm for S. rosea versus 0—5.3 mm for S. purpurea. A third diagnostic feature from the pitchers is the length of the stiff, decurved hairs on the adaxial surface of the hoods. In S. rosea, these hairs are (1.0—)1.3—2.1 mm long, whereas they are 0.6—1.6(—2.2) mm long in S. purpurea. Fourth, the pitchers of S. rosea are relatively thin-walled, while those of S. purpurea are thicker. Probably as a result of this difference in thickness, overwintered pitchers of S. rosea exhibit slight to extensive winter-kill. Pitchers of S. purpurea are evergreen, even on plants in the northern portion of its range.

The pitchers of S. rosea tend to be larger than those of S. purpurea (Fig. 7).
As a result, the ratio of scape height/longest pitcher length differs for the two species: 1.1–2.8 for $S$. rosea and 1.9–5.2 for $S$. purpurea. Also, pitchers of $S$. rosea have wider mouths (1.9–5.3 cm wide) than those of $S$. purpurea (1.4–3.6 cm wide). However, we find most pitcher dimensions and shapes to be practically useless in unambiguously separating $S$. rosea and $S$. purpurea. Pitchers of both species are quite variable in size and shape (Figs. 7, 8). Measurements of many pitcher characters we studied (pitcher length, pitcher width, hood height, hood width, width of the portion of the hood that extends laterally from the mouth, wing width, pitcher length/pitcher width, hood width/hood height, hood height/pitcher length, hood width/pitcher length, hood height/mouth width, hood width/mouth width, mouth width/pitcher length, mouth width/pitcher width, wing width/pitcher length) overlap extensively for $S$. rosea and $S$. purpurea. The t-values for measurements of these characters are all lower than for any of the characters listed in Table 1.

Some of the quantitative characters exhibit clinal variation across the combination of $S$. purpurea and $S$. rosea (Fig. 9A). For example, style arm length is highly correlated with latitude in the combined data set ($r =$
-0.76, \( p < 0.001, N = 138 \), as is length of hairs on the adaxial surface of the hoods (\( r = -0.75, p < 0.001, N = 130 \)). However, several other characters do not exhibit clinal variation (Fig. 9B). For example, scape length has a very low correlation with latitude (\( r = 0.377, p < 0.001, N = 138 \)), as does the ratio of scape length/longest pitcher length (\( r = 0.34, p = 0.012, N = 54 \)). The diagnostic characters that are nonclinal indicate \( S. \) rosea is not merely the extreme of a cline of \( S. \) purpurea, but rather a taxon distinct from it.

In summary, several characters can be used to separate \( S. \) rosea from \( S. \) purpurea (Table 1). The quantitative features that are the best for distinguishing the species, based on having the highest \( t \)-values, are both vegetative (lip thickness) and reproductive (scape height/style arm length). Though ranges of measurements for all of the quantitative characters overlap for both species, a scatter plot of scape height/style arm length versus lip thickness separates specimens of \( S. \) rosea and \( S. \) purpurea (Fig. 10). This plot and the wealth of other diagnostic features for \( S. \) rosea, including qualitative characters, clearly indicate \( S. \) rosea is distinct from \( S. \) purpurea at the rank of species.

Evidence from additional sources also indicates \( S. \) rosea deserves recognition as a species. In greenhouse cultivation, the differences between \( S. \) rosea and \( S. \) purpurea are maintained. Under common greenhouse conditions for 15 years or more, plants from 7 populations of \( S. \) rosea continue to possess pink petals, short scapes, thick lips, and deeply concave lips while plants of \( S. \) purpurea from 8 populations continue to possess maroon petals, tall scapes, thin lips, and horizontal or shallowly concave lips, as examples of some of the differences that are maintained during common cultivation. These re-

Fig. 9. Scatter plots of some diagnostic features vs. latitude for \( Sarracenia \) purpurea (open circles) and \( S. \) rosea (solid squares). A. Cline in style arm length. B. Absence of cline in scape length.
Nomenclature
We are unaware of any prior names at the rank of species that apply to S. rosea. None of Rafinesque’s (1840) names for Sarracenia (as “Sarazina”) results suggest the differences we have noted between the species are genetically-based. A second additional source of support for recognizing S. rosea comes from allozyme analysis of the S. purpurea complex. Godt and Hamrick (1999) discovered that S. rosea (as S. purpurea var. burkii) is the most genetically divergent member of the complex. In addition, the genetic distance between S. rosea and S. purpurea is relatively large and is similar to that found between many congeneric species (Gottlieb 1977, 1981; Crawford 1983).
appear to apply to S. rosea, though the applications of these names are some what uncertain. Geographically, four of these new names could fit S. rosea. Rafinesque stated his S. venosa, "...differs from S. gibbosa [a northern-rang ing new species of his, under which he lists S. purpurea as a synonym], by ... flowers smaller—Virg. ad Florida." Clearly, S. venosa cannot apply to the large-flowered S. rosea. As well, S. parviflora Raf. ("...appendice [hood] concavo fomicato ... very distinct sp. of Florida, yet akin to the last [S. venosa], leaves 3 to 6 inches long, nervose, flowers very small, purplish.") does not apply to S. rosea. Most likely, S. parviflora is a synonym of S. psittacina Michx. (a quite distinctive species having small flowers and relatively short pitchers with strongly arched and concave hoods), though McDaniel (1971) placed S. parviflora in synonymy with S. purpurea. Both S. acuta Raf. ("fol. tubul. longiss. nervosis ala angustissima ... Alabama ...") and S. adunca Raf. ("...fol. tubul. longis ... ala angust. ... Florida ...") do not apply because S. rosea has short pitchers with wide wings. Also, S. adunca Raf. is preoccupied by S. adunca Sm., 1805, a synonym of S. minor Walter. Unfortunately, botanists probably will never know the application of Rafinesque's names in Sarracenia. Most of Rafinesque's herbarium was discarded soon after his death in 1840 (Stuckey-1971). Previous workers have not located types of Rafinesque's names in Sarracenia. Searches by us and herbarium curators for Rafinesque specimens at DWC, G, NY, P, PH, and WIS have been fruitless.

McDaniel (1971) lectotypified S. purpurea with plate 70 of The Natural History of Carolina, Florida and the Bahama Islands (Catesby 1738). Catesby did not mention the provenance of the illustrated specimen, but most likely it was outside the range of S. rosea. His "Map of Carolina, Florida and the Bahama Islands, with the Adjacent Parts" indicates the Florida of his day ranged only as far west as the present-day Aucilla River, east of the range of S. rosea. Nevertheless, the possibility that Catesby obtained the plant from further west means the plate must be evaluated before S. rosea can be accepted as a correct name. Although the petals are anomalously purplish pink (though described by Catesby as "...of a purple colour..." in text accompanying plate 70), the species illustrated in the plate is otherwise typical S. purpurea. Measurements of the plate for nearly every diagnostic character lie within the range for S. purpurea, but several are outside the range for S. rosea. For example, lip thickness is 1.2 cm, style arm length is 2.1 cm, and the ratio of scape height/style arm length is 16. In addition, the lips appear to be horizontal, not concave, though the partially obscuring hoods make the determination of this condition somewhat uncertain. Measurements of the Catesby plate fall well within the cluster of specimens of S. purpurea in the plot of scape height/style arm length versus lip thickness (Fig. 10).
Etymology
We have chosen “rosea,” meaning pink, as the epithet for this new species because of its distinctively colored petals. This epithet is descriptive, easily comprehended, and is in the tradition of several other specific epithets in the genus by applying to flower color (e.g. S. flava L., S. rubra Walter, and S. purpurea). We use a new epithet for this species, rather than transfer the epithet used when this taxon was treated as a variety (Schnell 1993), as permitted by article 11.2 of the International Code of Botanical Nomenclature (Greuter et al. 1994). Our choice is intended to avoid confusion of ranks that may ensue from using the same epithet for both variety and species. Furthermore, by using a new epithet, we underscore the recognition of S. rosea as a species with a suite of features that differentiate it from S. purpurea.

Phenology
The flowering period of S. rosea extends from mid-March to mid-April, with the peak in the last 10 days of March. The earliest flowering date of herbarium specimens is 14 March and the latest is 20 April. At the time of flowering, pitchers of the current season are usually undeveloped or incompletely developed. Overwintered pitchers are present at the time of flowering, but these are often slightly to nearly completely brown and withered due to winter-kill (Fig. 3).

Typification
For the holotype of S. rosea (Fig. 6), we have selected a post-anthesis specimen because it has fully developed pitchers of the current season. In addition, the holotype has the thickened style expansion typical of post-flowering plants. Such a style expansion is less prone to damage than the fragile ones of plants during anthesis. The holotype is quite representative of S. rosea for key quantitative features (Fig. 10). Plants observed from the same population as the holotype in the following year uniformly bore flowers with pink petals (Nazzi 3639).

Distribution
Sarracenia rosea ranges from southwestern Georgia (Tift County) and northwestern Florida (Gadsden County) west to George and Jackson counties, southeasternmost Mississippi (Fig. 11). It occurs solely on the Coastal Plain in the drainage of the Gulf of Mexico. Most populations are within 120 km (75 mi) of the coastline. McDaniel (1966) cites a specimen of S. purpurea from Taylor County, Georgia, which we have not seen, that is probably S. rosea. The collection locality lies within the Gulf of Mexico drainage, but it is farther north than any other population known and about 300 km (185 mi) from the coast. The range of S. rosea is almost identical to that of S. leucophylla (McDaniel 1971), with which it often grows.
Sarracenia rosea and S. purpurea are allopatric. Sarracenia purpurea ranges further north and east of S. rosea. The collection of S. purpurea that is closest to the range of S. rosea is from Tattnall County, Georgia (Harper 2151). Thus, a minor disjunction of about 135 km (85 mi) separates the ranges of S. rosea and S. purpurea. More significantly, S. purpurea is apparently absent from the Gulf of Mexico drainage, the Tattnall County site and all other localities in the southeastern U.S.A. being in the Atlantic drainage.

Based on two specimens, S. purpurea is reported from Louisiana (MacRoberts & MacRoberts 1988). One would expect these collections to be S. rosea, since Louisiana is in the Gulf of Mexico drainage and far from the range of S. purpurea. The attribution of S. rosea to Louisiana based on these collections is problematic, though. The original label of one of these collections (US 782242) reads, “Sarracenia purpurea/wet pine woods/St. Helena, La.” With its lip 1.4 mm thick, lip’s maximum distance from horizontal of 1.6 mm, scape height of 42.4 cm, and style arm length of 2.4 cm, this collection is clearly S. purpurea, not S. rosea. The second collection reputed to be a voucher from Louisiana (LSU 006007) has “Saraceniaceae [sic]/Sarracenia rubra Walt./Red flowered Trumpetleaf/Covington/AF [‘AL.?”]” handwritten on the original label. The specimen is quite fragmentary; it consists of two isolated, laterally pressed pitchers and a portion of a scape bearing only 2 sepals (3 sepals, corolla, androecium, and gynoecium are all lacking). This specimen is also
S. purpurea, since the lip is only 1.1 mm thick. The scape fragment is 30.1 cm high and the longer sepal is 3.3 cm long, both of which are inconclusive since these measurements fall within the range of overlap between S. purpurea and S. rosea. The collection locality of this specimen may not be Louisiana. The script leaves determination of the final pair of letters equivocal. Instead of “...Covington/AF [Americus Featherman, a collector in late 19th-century Louisiana]” (MacRoberts & MacRoberts 1988), the label may actually read “...Covington/AL.” Thus, the label may actually indicate Covington County, Alabama. The single period after the final pair of letters (not after each letter, as one would expect if the correct reading is “A.F.”) supports this interpretation. Further support is the fact that S. rubra is unknown from Louisiana (Murry & Urbatsch 1979), but does occur in Covington County, Alabama (e.g., MacDonald 13556, IBE). Whatever its origin, the specimen does not appear to belong with its label since it is neither S. rubra nor S. rosea, which would be expected if the collection came from either Covington, Louisiana or Covington County, Alabama. In light of the evidence, we advise caution when considering the inclusion of S. purpurea in the flora of Louisiana. It seems more reasonable to discount the two specimens because of possible labeling errors than to accept the disjunct occurrence of S. purpurea in Louisiana, a disjunction of about 800 km (500 mi) southwest from the nearest population in Tattnall County, Georgia.

Habitats
Sarracenia rosea usually grows in sunny to lightly shaded, wet, sandy, acid soil in relatively open sites, often with scattered pines and shrubs. Populations of S. rosea also occur in ditches, shrubby thickets, edges of swamps, and the dense shade of swamp interiors. In swamps, population densities and the proportion of flowering or fruiting plants are lower than in sunnier habitats. Using the terminology for pitcher plant habitats of Folkerts (1991), most populations of S. rosea we have observed inhabit seepage bogs and savannas, though we have also observed them in stream terraces and swales. Usually, S. rosea grows with other Sarracenia species. We have observed it growing with S. alabamensis F.W.Case & R.B.Case ssp. wherryi F.W.Case & R.B.Case, S. alata (A.W.Wood) A.W.Wood, S. flava, S. leucophylla, S. psittacina, and S. rubra ssp. gulfensis D.E.Schnell.

Conservation
Most populations of S. rosea are in the western panhandle of Florida and adjacent southernmost Alabama. It is very rare in Mississippi. We have seen neither populations nor recent collections from Georgia. Where they occur, plants of S. rosea can be numerous. However, populations are infrequent and local in the small geographic range of S. rosea.
Folkerts (1977, 1982, 1990) has documented the extensive destruction of pitcher plant habitats and the consequent decline of pitcher plant abundance. Our experiences have shown habitat destruction and fire suppression to be among the most serious threats to *S. rosea*. Many other menaces exist, though. Despite the availability of reasonably priced, commercially cultivated plants of *S. rosea*, overcollection from the wild damages many populations. Twice, when visiting a locality where we had studied *S. rosea* populations, we discovered recently-dug holes and most of the plants missing. Since *S. rosea* appears to be an uncommon species, is exceptionally attractive, and faces many threats to its survival, we recommend its current conservation status be reviewed and it be considered for protection throughout its range.

**KEY TO SARRACENIA ROSEA AND PURPUREA**

Petals usually pink, lip 2.6–7.5 mm thick at thickest point, lip usually deeply curved toward pitcher base, scape 16.5–35.1 cm high, style arm 2.6–4.1 cm long, scape height/style arm length = 4.9–13

*Sarracenia rosea*

Petals usually maroon or red, lip 0.7–3.1 mm thick at thickest point, lip usually horizontal or shallowly curved toward pitcher base, scape 22–79 cm high, style arm 1.7–2.9 (–3.8) cm long, scape height/style arm length = 9.5–3

*Sarracenia purpurea*

**Representative Specimens**


APPENDIX

Measured Specimens of Sarrraceia purpurea


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THE VASCULAR FLORA OF BISCAYNE NATIONAL PARK, FLORIDA

RICHARD STALTER and JOSEF TAMORY
Department of Biological Sciences
St. John’s University
Jamaica, NY 11439, U.S.A.

PATRICK LYNCH and BRIAN LOCKWOOD
Biscayne National Park
Homestead, FL 33090, U.S.A.

ABSTRACT

The vascular flora of Biscayne National Park, Florida consists of 372 species within 277 genera and 92 families. The largest families in the flora are the Poaceae (47 species), Asteraceae (34 species), and Fabaceae (28 species). The largest genera are Tillandsia (7 species), Chamaesyce (7 species), and Cyperus, Eugenia, Kalanchoe and Paspalum, each with 5 species. Each taxonomic entry in the checklist is accompanied by an annotation, when appropriate, which includes: C = cultivated species, not escaped; H = historical record, now extirpated; X = naturalized exotic species; E = Florida endangered; T = Florida threatened; CE = Florida commercially exploited.

Key words: flora, distribution, biodiversity, Biscayne National Park, Florida.

INTRODUCTION

Biscayne National Park, (BNP) comprising 181,000 acres /73,000 hectares, is located between 25° 17' and 25° 40' N Latitude and 80° 05' and 80° 21' W Longitude (Fig. 1). The Park was designated in 1968 as a National Monument, and, in 1980, the Monument was expanded and redesignated as a National Park. The park is located approximately 20 miles (32 km) south of Miami, Florida. The park’s northern boundary is near the southern end of Key Biscayne, while the southern boundary is near the northern end of Key Largo. Most of the land, (171,925 acres/69,577 ha) is submerged.

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The largest islands, listed in decreasing order of size are Elliott Key (1,651 acres/668 ha), Old Rhodes Key (641 acres/259 ha), Sands Key (416.7 acres/169 ha), Totten Key (379.9 acres/154 ha), Little Totten Key (196.7 acres/80 ha) and Long Arsenicker Key (124.9 acres/50.5 ha). There are 42 islands in the park.
The University of Georgia developed a map of major shoreline and upland vegetation units at the park in the summer of 1997 (Madden et al. 1999). These include mangrove (6905 acres/2794.4 hectares), hammock hardwoods (126 acres/40.5 hectares), grasslands and marshes (197 acres/79.7 hectares). The total area of the shoreline and upland communities is 7416 acres/3001 hectares.

Climate
Climatological data presented is from the nearest weather station, Miami Beach, 25 miles (40 km) north of the park headquarters. The climate of Biscayne National Park is subtropical marine characterized by dry mild winters and long warm summers (Jordan 1985; Winsberg 1990, 1992). Mean annual temperature is 76.0°F (24.4 degrees C). January is the coolest month with a mean temperature of 68.4°F (20.2°C) while August is the warmest month averaging 83.1°F (28.4°C). Annual rainfall, generally a product of convective sea breezes, is 46.02 inches (1169 mm). Occasional tropical storms and hurricanes may produce heavy amounts of precipitation. Most of the rain falls during the summer. August is the wettest month averaging 7.11 inches (180.6 mm) while March is the driest month averaging 1.56 inches (39.6 mm). No frost was recorded at the Miami weather station between 1951 and 1974 (Anonymous 1974).

Detailed climatological data for Miami Beach and Tavernier, stations north and south of Biscayne National Park, can also be found in the monthly publication of the National Oceanographic and Atmospheric Administration. Temperature data from 1980 to 1997 indicate that the temperature at Miami Beach reached freezing on March 3, 1980 and on December 24, 1989. The lowest temperature recorded at Tavener was 35°F/1.1°C on December 25, 1989. A freeze was recorded at the Turkey Point Weather Station, “for a few seconds” on December 24, 1989 (personal communication with Ralph Heistand, Florida Power and Light, Turkey Point Power Plant Meteorological Data Manager) (see Fig. 2 for location of the Turkey Point weather Station).

Hurricanes
Hurricanes have ravaged Florida since time immemorial. Between 1900–1989, Florida experienced 56 hurricanes. The strongest, a category 5 storm, (see Fernald & Purdum (1992) for an explanation of Saffir/Simpson Hurricane Categories) struck the Florida Keys September 3, 1935, killing 408 people. Other storms of note in the vicinity of BNP since 1960 were Donna (1960), Betsy (1965), and most recently Andrew (1992). The major effects of hurricanes on vegetation are wind damage and flooding associated with the storm surge and/or heavy rainfall. Hurricane Andrew, a category 4 storm, struck Elliott Key at 4:55 a.m. August 24, 1992. Hurricane Andrew’s sustained winds reached 230 kph (145 mph) with gusts in excess of 280 kph
(175 mph) (Howard & Schokman 1995). Damage to vegetation on Elliott Key was excessive. Twenty to thirty percent of the trees were downed and large branches were sheared off almost all trees. Most small trees survived with less structural damage, though many of the small trees were completely defoliated. The trees at Adam’s Key, Biscayne National Park, were deunded of leaves; most trees were broken off at 10–15 feet above the ground (Howard & Schokman 1995).

*Schinus terebinthifolius*, a highly invasive exotic, suffered severe initial damage from Hurricane Andrew. Many *Schinus* were blown down and nearly all were defoliated. Individual *S. terebinthifolius* that survived the hurricane leafed out more readily than the native surviving mangroves. Howard and Schokman (1995) observed that *S. terebinthifolius* appeared to have been spread by Hurricane Andrew.

Native *Rhizophora mangle* fared poorly after Hurricane Andrew, especially the dwarf forms, which were killed by the powerful storm. *Avicennia germinans* and *Laguncularia racemosa* were also uprooted and killed by the hurricane, although the surviving trees left standing sprouted soon after the hurricane (Howard & Schokman 1995).

**Water Salinity**

Water quality monitoring sites in the park are shown in Figure 2. Water salinity ranged from 25.4 ppt at Turkey Point to 39.4 ppt at Caesar’s Creek, in 1997. There is little variation in water salinity at Alina’s Reef where salinity ranged from 33.9 to 37.0. Salinity values are generally highest during June when rainfall is low and evaporation high. Low salinity values have been recorded near land during run-off immediately after heavy rains (Anonymous 1995).

**Historical Information**

Prior to the Spanish cession of Florida to the United States in 1821, Native Americans, Spaniards, Bahamians, and Americans established temporary salvage camps in the Florida Keys (Leynes & Cullison 1998). The land presently encompassing Biscayne National Park was sparsely settled in 1870; only eighty five people were recorded in Dade County by the U.S. census at that time (Niemec 1992). In 1877 Commodore Ralph Munroe reported that there were “but a few dozen settlers,” in the Biscayne Bay area. The Florida keys in the 1800s were valued for their mahogony. Because of the thin soil, early settlers generally viewed the tropical key hammocks as “worthless” for farming (Leynes & Cullison 1998). However settlers found that pineapple could be grown here, and by 1890 pineapple was well established as a successful crop.

One of the earliest homesteaders on Elliott Key was Asa Sweeting, a Bahamian immigrant, who moved to Key West in 1866. He emigrated to Elliott Key
from Key West in 1882, claiming 154.4 acres. The Sweeting holdings were gradually enlarged to 238.8 acres. By 1887 he cleared and planted 30 acres, gradually increasing his cultivated land to 100 acres. Pineapples and key limes were raised as the main crops (Leynes & Cullison 1998), along with bananas and tomatoes (Niemec 1992). A devastating hurricane in 1906...
signaled the end of profitable pineapple production. Key lime production peaked in 1923 when more than 40,000 boxes were harvested. The destructive hurricane of 1926 destroyed Sweeting's lime groves, and the depression (1930s) and competition with lime production in the West Indies and Mexico hindered recovery. In 1935 lime production in the Florida Keys was a quarter of the production of 1923. Moreover, the demand for other fruits and vegetables declined. By the late 1930s, sale of Elliott Key produce was nonexistent (Niemec 1992).

Development of land around Biscayne Bay and the Upper Florida Keys grew rapidly as Miami Beach grew and prospered. The introduction of the motorboat enabled wealthy individuals easy access to the nearby Keys, and millionaires purchased the land on the Keys for weekend retreats (Leynes & Cullison 1998). In 1904, Henry Flagler opened a fishing lodge on Soldier Key. Carl Fisher established a vacation lodge on Adams Key in 1916, and with several business associates, purchased Boca Chita Key as well. Dr. John Gifford, subdivided and sold twenty-acre lots on Elliott Key stretching from the bay to the ocean. Charles Brookfield operated a fishing camp, Ledbury Lodge, on Elliott Key during the 1930s.

During the late 1950s, land "promoters" proposed to connect the Keys to the mainland. After several years of wrangling over road construction, Dade County officials decided against the construction of a causeway to the islands, and stated, if a road were to be built, it would be financed by island landowners. The island landowners incorporated, and created the City of Islandia in 1960. Conservationists blocked Islandia's efforts to build a causeway to the islands, and in 1965 conservationists secured the support of the Hoover Foundation to preserve the upper Keys. To foil the conservationists, the Islandia governing officials approved the bulldozing of a highway, a 120'-wide strip down the middle of Elliott Key, in the fall of 1967. The road, known as "Spite Highway," passed through a county park without authorization, and destroyed 6.3 acres of vegetation. Remnants of this road persist today.

Congress approved the creation of Biscayne National Monument, and President Johnson signed the bill into law on October 18, 1968. The bill authorized the National Park Service to purchase and develop the park over a five year period at the cost of twenty-five million dollars.

**History of Floristic Work in the Park**

Avery (1978) prepared an annotated list of 276 vascular plants on thirteen keys of Biscayne National Park. Included on his list were frequency of occurrence (common, uncommon and rare, cultivated and non-native taxa) and the distribution of the species on thirteen keys. The next study of importance was that of Hammer and Bradley (1997) who reported 302 species; no cultivated plants were included on their list. Four species, *Sporranthes*
polyantha (Mesadenus polyanthus), Microgramma heterophylla, Neuroodium lanceolatum, and Zamia pumila spp. pumila are known only from historical records. The native status of six plants on the list prepared by Hammer and Bradley (1997) is disputed: Acacia farnesiana, Carica papaya, Commelina diffusa, Cordia sebestena, Oeceoclades macilata and Yucca aloifolia. In addition, Lockwood et al. (1997) prepared a list of the vascular plants at Biscayne National Park during the summer of 1997.

**Geology and Soils**

Biscayne Bay is a shallow-water estuary along the southeast coast of Florida ranging in depth from approximately one to three meters (Anonymous 1995). An elongated ridge of Key Largo Limestone forms a border on the eastern boundary of the park. Eleven bottom types are described from Biscayne Bay including some spoil margins and mangrove soils (Anonymous 1995). The soils on the Keys at Biscayne National Park are generally classified as Entisols (Meyers & Ewell 1990). Soils are generally very shallow. The underlying rock is porous Miami Oolite (Oolite limestone) of Pleistocene origin (Robertson 1955). Much of the rainfall is lost by runoff, or is leached through the porous parent material (Stalter 1993).

**METHODS**

Collecting trips were made to the park in January, February, July and December, 1997 and February, 1998. Objectives for each trip included the collection of voucher specimens and accumulation of information on abundance and apparent habitat preferences for each species.

More than 500 specimens collected above, herbarium specimens at Everglades National Park and Fairchild Tropical Garden, and plant lists generated by Avery (1978), Hammer and Bradley (1997) and Lockwood et al. (1997), form the basis for this study. Taxonomically problematic specimens were sent to various experts for identification; experts consulted include Steve Clements (Amaranthaceae and Chenopodiaceae), Ihisan Al-Shehbaz (Brassicaceae), Richard Mitchell (Polygonaceae), Robert Meyer (Poaceae), James Montgomery (ferns), Charles Sheviak (Orchidaceae), Gordon Tucker (Cyperaceae), Bruce Hansen, and Richard Wunderlin (various taxa). Voucher specimens collected in the present study will be deposited in the herbarium at Everglades National Park, Homestead, Florida, and partial duplicate sets have been deposited in the herbaria of Brooklyn Botanic Gardens (BKL), University of Michigan (MICH), Missouri Botanical Gardens (MO), New York State Museum (NYS), University of South Florida (USF), James Montgomery's private herbarium (JM), and Fairchild Tropical Garden (FTG). Accession numbers will be assigned by the staff at Everglades National Park to the primary set of specimens at the herbarium at Homestead and will be available upon request from the National Park Service.
The annotated checklist contains an inventory of the vascular plants that reproduce spontaneously and persist for more than one year without cultivation, and includes native taxa, naturalized and adventive weeds, escapes from cultivation and historical records. In the checklist, plants are arranged using the Cronquist (1988) system first by division, and then alphabetically by family and by species. Nomenclature follows Wunderlin (1998). Synonyms are listed only for names used by Kartesz (1994).

RESULTS AND DISCUSSION

The vascular flora of the Biscayne National Park consists of 372 species within 277 genera and 92 families. Ninety-three species, including nine cultivated plants, or 25% of the flora, are not native to the region. A statistical summary is given in Table 1, and an annotated list of species is included at the end of the paper.

The major families include the Poaceae (47 species), Asteraceae (34 species) and Fabaceae (28 species). Other large families are the Euphorbiaceae (16 species) and Rubiaceae (13 species). Twenty-two percent of the species comprising the total flora are contained in the Poaceae and Asteraceae. The largest genera are Tillandsia (7 species) and Chamaesyce (7 species).

Plant Communities

The flora of the Florida Keys has much in common with the West Indies (Stalter 1993; Austin et al. 1987; Murphy & Lugo 1986; Correll & Correll 1982; Loope 1980; McGuire & Brown 1974; Thorhaug 1976; Robertson 1955). Davis (1942) recognized four major communities: strand-beach zone, dune zone, scrub zone and hammock forest. Only the hardwood hammock community is an important community at BNP. Two additional communities, the mangrove forest and submerged aquatic communities exist at Biscayne National Park.

The strand-beach community is dominated by halophytes (Stalter 1993). Some species tolerate flooding, such as Cakile lanceolata and Sporobolus virginicus, while others (e.g. Spartina patens) tolerate salt spray. Additional plants of this community include: Chamaesyce spp., Ipomoea pes-caprae, Panicum spp., Sesuvium maritimum, S. portulacastrum and Argusia gnaphalodes.

A poorly developed dune community exists in back of the strand-beach zone. Common species here tolerate high concentrations of salt spray. Chamaesyce mexombrani,amphiphilosa, Spartina patens, Sporobolus sp., Sisyrinchium maritimum, Arumus gnaphalodes and Waltheria indica grow in this community. This community is insignificant at BNP.

A xeric scrub ecotone, a transition zone of shrubs is poorly developed on the Florida Keys (Davis 1942; Stalter 1993). Sisyrinchium maritimum, Borrichia arborescens, Lantana involucrata, Solanum habanense and members of the Cactaceae family are generally found here.
Table 1. Statistical summary of the vascular flora of Biscayne National Park, Florida.

<table>
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<th>Pteridophyta</th>
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<th>Liliopsida</th>
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</table>

The hardwood hammock community contains a greater diversity of species than the other plant communities. Many of the broad-leaved evergreen trees that grow at BNP are typical of the Bahamas and Greater Antilles (Davis 1942; Correll & Correll 1982; Fernald & Purdum 1992). Seven species of Tillandsia are found in this community. Schinus terebinthifolius, a highly invasive exotic is common here. S. terebinthifolius is a serious threat to native South Florida species, and is most abundant along the upland fringe of the mangrove community. Some of the trees of this community are: Amyris elephant, Canella winterana, Coccoloba diversilolia, Coccoloba uvifera, Conocarpus erectus, Cordia sebestena, Drypetes diversilolia, Eugenia foetida, Kruukiodendron ferreum, Lysiloma latisiliquum, Metopium toxiferum, Panicum spp., Piscidia piscipula, Pithecellobium spp., Schaefferia frutescens, Smilax auriculata, Swiriana maritima, Swietenia mahagoni, and Thrinax norrisii. For additional information on the plant species comprising the hammock community, the reader is directed to Harper (1927), Davis (1942), Forsgren and Kephant (1978), Robertson (1955), Stalter (1993), and Myers and Ewell (1990).

Extensive mangrove forests are found in the intertidal zone. Mangroves are sensitive to tidal flooding and are found in distinct zones. These species, listed in order of their tolerance to tidal flooding are, Rhizophora mangle, Avicennia germinans, and Laguncularia racemosa. Buttonwood, Conocarpus erecta, is considered by Tomlinson (1986) as a mangrove associate, and is on the upland fringe of the mangroves. Hurricane Andrew (1992) caused extensive damage to this community, especially to Rhizophora mangle (Howard & Schokman 1995). Extensive information on this community are in publications by Davis (1942), Tomlinson (1986) and Anonymous (1995).

The submerged "sea grass" community is the most extensive community of the park comprising slightly more than 50% of the park. The sea grass community is one of the most productive and important inshore marine communities (Fernald & Purdum 1992; Myers & Ewell 1990). The "sea grasses" of importance are Turtle Grass, Thalassia testudinum, Manatee Grass, Syringodium filiforme and Shoalweed Halodule wrightii. Sea grasses are distributed in accordance to their tolerance of salinity, and substrate prefer-
ence (Fernald & Purdum 1992; Anonymous 1995). There is little salinity variation in the bay near the islands where freshwater runoff during storms is minimal (Fig. 2). Water salinity is more variable near the mainland when runoff from torrential rains is substantial.

Several species in the flora are noteworthy because of their special status. *Pseudophoenix sargentii*, Sargent's Palm, is believed to be planted in the Florida Keys by early Bahamian settlers; it is not native to Florida according to Avery (1978). Bruce Ledin in an unpublished manuscript disputed the native status of Sargent’s Palm in 1950. Avery (1978) reports that *Aristolochia pentandra*, formerly known from Soldier Key is now restricted to Elliot Key. *Bucida biceras*, Black Olive, and *Spiranthus polyantha*, Florida Keys Ladies Tresses, were historically recorded on Elliot Key, though Avery (1978) believed that *B. biceras* was planted on Elliot Key. *Kalancheo-fedtschenkoi*, Lavender Scallops, *K. gastronis-bonnieri*, Palm Beachbells, and *K. tubiflora*, Chandelier Plant were cultivated on Adams Key and persist after cultivation (Avery 1978). *Clusia rosea* was, “probably originally native to the Florida Keys,” though at present it is only known from introductions (Wunderlin 1998). *Microgramma heterophylla* was historically present on Adams Key, and is now only extant at Key Largo (Avery 1978).

Three species, *Schinus terebinthifolius*, *Casuarina equisetifolia*, and *C. glauca* are on the Florida prohibited plant Dist. 9 (DEP Chapter 62C-52). *Coccoloba uvifera* is on Florida’s protected plant list. Plants, designated by the letter E (Endangered) in the annotated checklist are on the State endangered list.

Species of foreign origin are only a minor component of the natural vegetation. Most non-native plants occur principally in ruderal sites, lawns, and along the edges of trails and roads. Several exotics, *Schinus terebinthifolius*, *Casuarina equisetifolia* and *Colubrina asiatica* pose a threat to the native species in the park. The introduction of seventeen non-native species of grasses (Poaceae), 18.3% of the non-native species, is especially noteworthy in the flora. Other families containing a high number or high percent of non-native plants are the Agavaceae, Arecaceae, Grassulaceae, Fabaceae, and Sapotaceae.

**ANNOTATED CHECKLIST OF SPECIES**

The vascular plant taxa have been arranged according to the following categories: ferns and fern allies, gymnosperms, dicots, and monocots. Within each category, families and lower taxa are arranged alphabetically. Nomenclature primarily follows Wunderlin (1998) and Kartez (1994). Each entry includes the following information sequence: native or non-native status (C = cultivated species; not escaped, H = historical record, now extinct, X = naturalized exotic species, E = Florida endangered, T = Florida threatened, CE = Florida commercially exploited); scientific name; pertinent synonym, enclosed in brackets.
**PTERIDOPHYTA**

**ADIANTACEAE/PTERIDACEAE**—Maidenhair Family
- *Adiantum aureum* L. Golden Leather Fern
- *Adiantum danacum* Langsd. & Fisch. Giant Leather Fern
- *Pteris vittata* (L.) Chinese Ladder Brake; X

**NEPHROLEPIDACEAE/DRYOPTERIDACEAE**—Sword Fern Family
- *Nephrolepis biserrata* (Sw.) Schott, [N. falcata (Cav.) C. Christens.] Sword Fern; T

**POLYPODIACEAE**—Polypod Family
- *Microgramma heterophylla* (L.) Wherry. Climbing Vine Fern Historically present on Adams Key; now the only extant site in Florida is on Key Largo. Hammer and Bradley 1997; E,H
- *Nephrolepis lanceolatum* (L.) Fée. [P. lanceolatum (L.) K.Presl.] Ribbon Fern; E,H

**PSILOTACEAE**—Whiskfern Family
- *Psilotum nudum* (L.) P. Beauv., Whisk-Fern

**THELYPTERIDACEAE**—Marsh Fern Family
- *Thelypteris kunthii* (Desv.) C.V. Morton, Southern Shield Fern

**GYMNOSPERMATAE**

**ZAMIACEAE**—Zami Family
- *Zamia pumila* L., [Zamia integrifolia L.f.] Florida Arrowroot; Coontie; EX

**MAGNOLIOPHYTA-MAGNOLIOPSISDAE**

**ACANTHACEAE**—Acanthus Family
- *Blechnum pyramitatum* (Lam.) Urb., Browne’s Blechum; X
- *Diciplera sexangularis* (L.) Juss., Sixangle Foldwing

**AIZOACEAE**—Mesembryanthemum Family
- *Senecio maritimus* (Walt.) Britton, Sterns, & Poggenb., Slender Seapurslane
- *Senecio portulacastrum* (L.) L., Shoreline Seapurslane

**AMARANTHACEAE**—Amaranth Family
- *Alternanthera flavescent* Kunth, Yellow Joyweed
- *Amaranthus hybridus* L., Slim Amaranth; Pigweed
- *Blutetron venticula* (L.) Mears, Samphire; Silverhead
- *Celosia nitida* Vahl, West Indian Cock’s Comb
- *Iresine diffusa* Humb. & Bonpl. ex Willd., Juba’s Bush

**ANACARDIACEAE**—Cashew Family
- *Mangifera indica* L., Mango; X
- *Metopium toxiferum* (L.) Krug & Urb., Poisonwood
- *Schinus terebinthifolius* Radcl, Florida prohibited plant; Brazilian Pepper; X

**ANNONACEAE**—Custard-Apple Family
- *Annona glabra* L., Pond Apple

**APOCYNACEAE**—Dogbane Family
- *Caesalpinia rosae* (L.) G. Don, Madagascar Periwinkle; X
- *Echites umbellata* Jacq. Devils Potato; Rubbervine
- *Nerium oleander* L., Oleander; C
- *Pentalinus lanceum* (L.) B.F. Hansen & Wunderlin, Wild Allamanda; Hammock Viperstail
- *Rhabdadenia biflora* (Jacq.) Muell. Arg., Rubbervine; Mangrove
- *Thevetia peruviana* (Pers.) K. Schum., Luckynut; C
- *Vallesia antillana* Woodson, Tearshrub; E

**ARALIACEAE**—Ginseng Family
- *Schizandra actinophylla* (Endl.) Harms, Australian Umbrella Tree; Octopus Tree; X

**ARISTOLOCHIACEAE**—Birthwort Family
- *Aristolochia petandra* Jacq., Marsh’s Dutchman’s-Pipe; now restricted to Elliot Key; formerly known from Soldier Key Tropical hammock’s; Rare; Dade County; E

**ASCLEPIADACEAE**—Milkweed Family
- *Cynanchum bahamense* (Griseb.) Gillis, Bahamian Swallowwort; Bahama Cynanchum
- *Cynanchum scoparium* Nutt., Leafless Swallowwort
- *Sarcostemma clavatum* (Jacq.) Roem. & Schult., White Twinevine; X
ASTERACEAE—Aster Family
Aubrosia artemisiifolia L., Common Ragweed
Aster tenuifolius L., Bitterweed Aster
Baccharis angustifolia Michx., Saltwater Falseewillow
Baccharis halimifolia L., Groundsel Tree;
Sea Myrtle
Biden alba (L.) DC. var. radiata (Sch. Bip.)
Ballard ex. T.E. Melchert, Beggarticks
Borrichia arborescens (L.) DC., Tree Seaside Oxyeye
Borrichia frutescens (L.) DC., Bushy Seaside Oxyeye
Comphylla trifida (L.) Strother, Creeping Oxyeye
Conyza canadensis (L.) Cronq. var. panicula
(Nutt.) Cronquist, Dwarf Canada Horseweed
Eclipta prostrata (L.) L., False Daisy
Emilia sonbergii Nicolson, Florida Tassel flower
Emporatorium capillifolium (Lam.) Small,
Doughfennel
Emporatorium leptophyllum DC., Falsefennel
Flaveria trinervia (Spreng.) C. Mohr, Clustered Yellowtops
Flaveria linearis Lag., Narrowleaf Yellowtops
Gymnochaetum ptychotrichum Willd., Pennsylvania Everlasting
Helianthus debilis Nutt., Dandelion
Iva imbricata Walter, Seacoast Marshelder
Lauaria intybus (Jacq.) Beauv., Achicoria Azul, X
Medicago nana (L.) Small, [M. aspera (Jacq.)
Small] Snow Squarestem
Mikania scandens (L.) Willd., Climbing Hempwe
Parthenium hysterophorus L., Santa Maria Feverfew
Pectis glaucow (Cass.) D.J. Keil, Sanddune Cinnchweed
Pectis prostrata Cav., Spreading Cinnchweed
Phacelia coronarum (Jacq.) D. Don, [Neomolaena lobata (L.) Cass.] Care-For-All
Phacelia odorata (L.) Cass., Sweetscents
Phacelia rosea R.K. Godfrey, Rosey Camphorweed
Solidago sempervirens L., Seaside Goldenrod
Sonchus oleraceus L., Common Sowthistle; X
Tridex procumbens L., Coat Buttons; X
Veronica cynarea (L.) Less., Little Ironweed; X
Wildlife tribolata (L.) A.S. Hitchc., creeping oxeye
Youngia japonica (L.) DC., Oriental False Hawksbeard; X
AVICENNIAEAE
Aricenia germinans (L.) Black Mangrove
BATAEAE—Saltwort Family
Batia maritima L., Saltwort; Turtlweed
BORAGINACEAE—Borage Family
Argynia gnaphalodes (L.) Heine, Sea Rosemary;
Sea Lavender; R
Bourreria suaveolenta Jacq., [B. ocata Mierts]
Bahama Strongbark
Corisa subsidies L., Largeleaf Geigertree; C
Heliotropium angiospermum Murray,
Scorpionstail
Heliotropium curassavicum L., Seaside Heliotrope;
Salt Heliotrope
Heliotropium polyphyllum Lehman., Pineland Heliotrope
Tournefortia volubilis L., Twining Soldierbush
BRASSICACEAE—Mustard Family
Cakile lanceolata (Willd.) O.E. Schulz,
Coastal Seapocket
Coronopus dysmus (L.) Sm., Lesser Swinecress
Erucastrum gallicum (Willd.) O.E. Schulz,
Common Dogmustard
Lepidium virginicum L., Virginia Pepperweed
BUDDLEJACEAE—Butterfly Bush Family
Polypremnum procumbens L., Rustweed;
Juniperleaf
BURSERACEAE—Gumbo-Limbo Family
Bursera simaruba (L.) Sarg., Gumbo-Limbo
CACTACEAE—Cactus Family
Acanthoracereus tetragonus (L.) Hummelink,
Triangle Cactus; Dildoe Cactus; T
Harrisia aborignima Small ex Britton & Rose,
Prickly Applecactus; R
Opuntia stricta (Haw.) Haw., [O. stricta var.
difficilis (Ker-Gawl.) L.D. Benson] Erect
Pricklypear; T
CANELLACEAE—Canella Family
Canella winterana (L.) Gaertn., Pepper
Cinnamon; Cinnamon Bark; E
CAPPARACEAE—Caper Family
  Capparis cynophallophora L., Jamaican Captop
  Capparis flexuosa L., Bayleaf Capertree
CARICACEAE—Papaya Family
  Carica papaya L., Papaya; X
CASUARINACEAE—Sheoak Family
  Casuarina equisetifolia L., Australian-Pine; Horsetail Casuarina Florida prohibited list; X
  Casuarina glauca Sieb. ex Spreng., Gray Sheoak; Suckering Australian Pine Florida prohibited list; X
CELASTRACEAE—Stafftree Family
  Celastrus paniculatus (Jacq.) Standl., Carpet
  Maytenus phyllanthoides Benth., Florida Mayten; T
  Schneeffia frutescens Jacq., Florida Boxwood; E
CHENOPODIACEAE—Goosefoot Family
  Atriplex porrentra (Jacq.) Standl., Crested Saltbush
  Salicornia bigelovii Torr., Annual Glasswort; Dwarf Glasswort
  Salicornia perennis Mills., [S. virginica L.] Perennial Glasswort
  Suaeda linearis (Elliott) Moq., Sea Blite; Annual Seepweed
CLUSIACEAE—Mangosteen Family
  Clusia rosea Jacq., Pitchapple; Hammer and Bradley (1997) contend this taxon was, "erroneously recorded as a native species to the lower Florida Keys"; X
COMBRETACEAE—Combretum Family
  Bucida buceras L., Black Olive. Records indicate this was planted on Elliott Key; "It is now believed that B. buceras was planted on the islands." Hammer and Bradley (1997).
  Conocarpus erectus L., Buttonwood
  Laguncularia racemosa (L.) C.F. Gaertn., White Mangrove
  Terminalia catappa L., West Indian Almond; X
CONVOLVULACEAE—Morningglory Family
  Dichondra carolinensis Michx., Carolina Poyosfoot
  Ipomoea alba L., Moonflowers; Tropical White Morningglory
  Ipomoea indica (Burm.) Merr., Oceanblue Morningglory
  Ipomoea pes-caprae (L.) R. Br. spp. brasiliensis (L.) Ooststr., Railroad Vine; Bayhops
  Ipomoea violacea L., Heavenlyblue Morningglory
CRASSULACEAE—Orpine family
  Kalanchoe daigremontiana Raym.-Hamet & H.Perrier, Devils Backbone; X
  Kalanchoe fedtschenkoi Raym.-Hamet & H.Perrier, Lavender Scallops; X
  Kalanchoe gastonis-bonnieri Raym.-Hamet & H.Perrier, Palm Beachbells; X
  Kalanchoe pinnata (Lam.) Pers., Cathedral Bells; Life Plant; X
  Kalanchoe tubiflora (Harv.) Raym.-Hamet, Chandelier Plant; X
CUCURBITACEAE—Gourd Family
  Melothria pendula L., Creeping Cucumber
  Monardicia gramatissima L., Balsampear; X
EUPHORBIAEAE—Spurge Family
  Acalypha chamaesyce L. (Lam.) Muell. Arg., Bastard Copperleaf
  Chamaesyce bloudetti (Engelm. ex, Hitchc.) Small, Limestone Sandmat
  Chamaesyce birta (L.) Millsp., Pillpod Sandmat
  Chamaesyce hypericifolia (L.) Millsp., Graceful Sandmat
  Chamaesyce hyssopifolia (L.) Small, Hyssopleaf Sandmat
  Chamaesyce mesembrianthemifolia (Jacq.) Dugand, Coastal Beach Sandmar
  Chamaesyce ophiochlamica (Pers.) D.G.Burch Florida Hammadock Sandmar
  Chamaesyce porteri jania Small Porter's Sandmat; E
  Drypetes diversifolia Krug & Urb., Whitewood; Milkbarb; E
  Drypetes lateriflora (Sw.) Krug & Urb., Guiana Plum; T
  Gymnanthes lucida Sw., Crabwood; Oysterwood
  Hinnopane mancinella L., Manchineel; E
  Jatropha multifida L., Coralbush; X
  Phyllanthus amarus Schumach. & Thonn., Gale-of-Wind; Carry-Me Seed; X
  Pointsettia cyathophora (Murray) Bartl., [Euphorbia cyathophora Murray] Paintedleaf;
FABACEAE—Pea Family
Acaia farinosa (L.) Willd., Sweet Acacia
Caesalpinia bondu (L.) Roxb., Gray Nicker
Caesalpinia major (Medik.) Dandy & Exell
Hawaii Pearl; E
Canavalia rosea (Sw.) DC., Baybean; Seaside Jackbean
Crotalaria pumila Ortega Low Rattlebox
Dalbergia brownii (Jacq.) Schinz, Brown's Indian Rosewood; E
Dalbergia ecastophylla (L.) Taub., Coinvine
Desmanthus virgatus (L.) Willd., Wild Tantan
Desmodium incanum DC., Ticktrefoil
Galactia striata (Jacq.) Urb., Florida Hammock Milkpea
Gliricidia sepium (Jacq.) Kunth ex Walp.; X
Indigofera spicata Forssk., Trailing Indigo; X
Leucaena leucocephala (Lam.) de Wit, White Leadtree; X
Lysiloma latifolium Benth., False Tamarind
Medicago lutulina L., Black Medick; X
Melilotus albus Medick., White Sweetclover
Melilotis officinalis (L.) Lam., Yellow Sweetclover; X
Parkinsonia aculeata L., Mexican Palo Verde; Jerusalem Thorn; X
Piricidia pisipila (L.) Sarg., Florida Fishpoison Tree; Jamaican Dogwood
Pithecellobium dulce (Roxb.) Benth., Monkeypod; X
Pithecellobium keyense Britton ex Britton & Rose, Florida Keys Blackbead; T
Pithecellobium unguis-cati (L.) Benth., Catchaw Blackbead
Rhynchosia minima L. (DC.), Least Snoutbean
Sophora tomentosa L., Yellow Necklacepod
Stylosanthes barata (L.) Taub., Cheeseytoes
Tamarindus indica L., Tamarind; X
Trifolium repens L., White Clover; Dutch Clover; X
Vigna latifolia (Jacq.) Benth., Hairypod Cowpea

LEPTCHAMIDEAE—Gentian Family
Eustoma exaltatum (L.) Salisb. ex G. Don, Marshgentian; Catchily; Prairie gentian
Leiphathium parasitica Schrdl. & Cham., [Voyria parasitica (Schrdl. & Cham.) Ruyters. & Maas.] Parasitic Ghostplant; E
HALORAGACEAE—Watermilfoil family
Proserpinaca palustris L., Marsh Mermaidweed
HIPPOCRATEAE—Hippocrates Family
Hippocrates rupicola L., Medicine Vine
LAMIACEAE—Mint Family
Salvia seratina L., Little Woman
LAURACEAE—Laurel Family
Cassia flava L., Love Vine; Devil's Gut
Octea coriacea (Sw.) Britton, Lancewood
LENTIBULARIACEAE—Bladderwort Family
Uraria filosa L., Leafy Bladderwort
LOGANIACEAE—Logania Family
Mitrida petiolarata (J.F. Gmel.) Torr. & A. Gray,
[Cynometra mitrida (L.) Britton] Lax Honpod
LYTHRACEAE—Loosestrife Family
Ammannia latifolia L., Pink Redstem, Toothcup
MALVACEAE—Mallow Family
Abutilon pernulle (Willd.) Sweet, Coastal Indian Mallow
Herissantia crispa (L.) Brizicky, Bladdermallow
Hibiscus rosa-sinensis L. var. rosa-sinensis, Rosemallow; Shoe-Back-Plant; X
Hibiscus tiliaceus L., Sea Hibiscus; Mahoe; X
Malvastrum corchorifolium (Desr.) Britton ex Small, False Mallow
Sida abutilifolia P. Mill, Spreading Fanpetals
Sida acuta Britton, Common Wireweed, Common Fanpetals
Sida ciliaris (L.) Britton, Tracted Fanpetals; Fringed Fanpetals
Sida rhombifolia L., Cuban Jute; Indian Hemp
Thespesia populnea (L.) Sol. ex Correa, Portia Tree; X

MELIACEAE—Mahogany Family
Swietenia mahagoni (L.) Jacq., West Indian Mahaogany; E

MORACEAE—Mulberry Family
Ficus altissima Blume, Council Tree; X
Ficus carica Nutt., Strangler Fig; Golden Fig
Ficus circifolia Mill., Wild Banyan Tree

MYRSINACEAE—Myrsine Family
Ardisia escallonoides Schiedl. & Deppe ex Schidl. & Cham., Marlberry

MYRTACEAE—Myrtle Family
Calyptranthes pallens Griseb., Pale Lidflower; Spicewood
Engenia axillaris (Sw.) Willd., White stopper
Engenia confusa DC., Redberry Stopper
Engenia foetida Pers., Spanish Stopper; Boxleaf Stopper
Engenia rhomboea Krug & Urb. ex Urb., Red Stopper
Engenia uniflora L., Surinam Cherry; X

NYCTAGINACEAE—Four O’Clock Family
Boerhavia diffusa L., Red Spiderling; Wineflower
Boerhavia erecta L., Erect Spiderling
Boquainvillea glabra Choisy Paper Flower; X

OLACACEAE—Ximenia Family
Ximenia americana L., Tallow Wood; Hog Plum

OLEACEAE—Olive Family
Jasminum saxosum (L.) Aiton, Arabian Jasmin; C

ONAGRACEAE—Evening Primrose Family
Gaura angustifolia Michx., Southern Beeblossom
Ludwigia bonariensis (M. Michel) H. Har., Carolina Primrose-Willow
Ludwigia octovalvis (Jacq.) Raven, Mexican Primrose-Willow

OXALIDACEAE—Wood sorrel Family
Oxalis corniculata L., Common Yellow Wood sorrel; Creeping Wood sorrel

PAPAVERACEAE—Poppy Family
Argemone mexicana L., Mexican Prickly-Poppy

PASSIFLORACEAE—Passion Flower Family
Passiflora multiflora L., Whiteflower Passion Flower; E
Passiflora suberosa L., Corkstem Passion Flower

PHYTOLACCACEAE—Pokeweed Family
Rivina humilis L., Rougeplant

PLUMBAGINACEAE—Leadwort Family
Limonium carolinianum (Walter) Britton, Carolina Scalavender

POLYGONACEAE—Buckwheat Family
Coccoloba diversifolia Jacq., Tietongue; Pigeon Plum
Coccoloba uvifera (L.) L., Seagrape. Protected by Florida Law 370.041

PORTULACACEAE—Purslane Family
Portulaca oleracea L., Little Hogweed; X
Portulaca pilosa L., Pink Purslane; Kiss-Me-Nor

PRIMULACEAE—Primrose Family
Samolus obtusifolius Kunth, Water Pimpernel
Samolus vernalis L. subsp. parviflorus (Raf.) Hultén, Pineland Pimpernel; Seaside Brookweed

RHAMNACEAE—Buckthorn Family
Colubrina arborescens (Mill.) Sarg., Greenhart; E
Colubrina asiatica (L.) Bronn., Leatherleaf; Asian Nakedwood; X
Colubrina elliptica (Sw.) Brizicky & W.L. Stern, Soldierwood; E
Gonaria lapuloides (L.) Urb., Chewstick; White root
Krugiodendron ferreum, (Vahl) Urb., Black Ironwood; Leadwood
Reynotia supentricionalis Urb., Darlingplum; T

RHIZOPHORACEAE—Mangrove Family
Rhizophora mangle L., Red Mangrove

RUBIACEAE—Madder Family
Chiosocora alba (L.) Hitchc., {C. parvifolia Wullschl. ex Griseb.} Snowberry; Milk berry
Exotonia carbunculus (Jacq.) Schltr., Carribean Princewood; E
Gardenia angusta (L.) Merr., Gardenia; C
Genipa clusiifolia (Jacq.) Griseb., {Casisia clusiifolia (Jacq.) Urb.} Seven year Apple
Guettarda elliptica Sw., Hammock Velveteen
Guettarda scabra (L.) Vent., Rough Velveteen
Hedyotis korbyosa (L.) Lam., {Oldlandia korbyosa L.} Flattop Mille Graines
Morinda royoc L., Redgal
Psychotria nervosa Sw., Wild Coffee
Randia aculeata L., White Indigoberry
Richardia grandiflora (Cham. & Schltdl.) Schltr. & Schltr. f., Largeflower Mexican Clover
Spermacoce floridana Urb., Florida False Buttonweed
Spermacoce verticillata L., Shrubby False Buttonweed; X

RUTACEAE—Citrus Family
Amyris eleutheria L., Sea Torchwood
Citrus aurantifolia (Christm.) Swingle, Key Lime; X
Citrus aurantium L., Sour Orange; C
Citrus limon (L.) Burm. f., Lemon; C
Citrus reticulata Blanco, Tangerine; C
Zanthoxylum fagara (L.) Sarg., Wild Lime; Lime Pricklyash

SAPINDACEAE—Soapberry Family
Carolinia baccata var. Caroliniana L., Love-in-a-Puff; X
Erythrina crista-galli (Juss.) Raddk. ex Durand, Butterbough
Melicocca bijuga Jaccq., Spanish Lime; X
Sapium sebiferum L., Soapberry

SAPOTACEAE—Sapodilla Family
Chrysophyllum oliviforme L., Satinleaf; T
Manilkara jumaquica (C. Wright ex Griseb.) Dubard ssp. carpinifolia (L.) Cronquist, Wild Dilly
Manilkara zapota (L.) P. Royen, Sapodilla; X
Pouteria campechiana (Kunth.) Bachn., Eggfruit; Canistel; X
Pouteria domingensis (Gartn. f.) Bachn.; X
Sideroxylon edulestrum (Kunth) T.D. Penn., Saffron Plum
Sideroxylon foetidissinum Jaccq., False Mastic
Sideroxylon salicifolium (L.) Lam., Willow Bristle; White Bully

SCROPHULARIACEAE—Figwort Family
Bafoa montana (L.) Pennell, Herb-of-Grace
Caprinia biflora L., Goatweed
Linaria canadensis L. Chaz., [Inattallanthus canadensis (L.) D.A. Sutton] Canada Toadflax

SIMAROBACEAE—Quassia Family
Simarouba glauca DC., Paradisetree

SOLANACEAE—Nightshade Family
Capsicum annum L. var. glabrisulcum (Dunal) Heiser & Pickersgrill, Bird Pepper; Cayenne Pepper
Lycium carolinianum Walter, Christmasberry; Carolina Desertthorn

Solanum andigena P. Mill., American Black Nightshade
Solanum baehmenense L., Bahama Nightshade
Solanum chenopodium Lam., [S. nigrescens Martens & Galeotti misapplied], Black Nightshade
Solanum erianthum D. Don, Potatotree

STERCULIACEAE—Cacao Family (Includes Byttneriaceae)
Wrightia indica L., Sleepy Morning

SURIANACEAE—Bay-Cedar Family
Suriana maritima L., Bay Cedar

THEOPHRASTACEAE—Theophrast Family
Jacquinia keyensis Mez, Joewood; T

ULMACEAE—Elm Family
Tremex lanariusum (Schult.) Blume, Pain-in-the-Back; West Indian Tremex

URTICACEAE—Nettle Family
Parthenaria floridana Nutt., Florida Pellitory
Pila microphylla (L.) Liebm., Artillery Plant; Rockweed

VERBENACEAE—Vervain Family
Citharexylum spinosum L., [C. fruticosum L.] Florida Fiddleneck
Lantana camara L., Lantana; Shrub Verbena; X
Lantana involucrata L., Buttonbush
Phyla nodiflora (L.) Greene, Capeweed; Turkey Tangle Fogfruit
Stachytarpheta jamaicensis (L.) Vahl, Blue Porterweed; Joew

VITACEAE—Grape Family
Vitis rotundifolia Michx., Muscadine

ZYGOPHYLLACEAE—Caltrop Family
Gnaphalium sambuceum L., Holywood Lignumvitrae; E

MAGNOLIOPHYTA-LILIOPSIDA

AGAVACEAE—Agave Family
Agave deceptor Baker, False Sisal
Agave sisalana Perrine, Sisal Hemp; X
Aloe vera L., Aloe; X
Sansevieria hyacinthoides (L.) Druce, Bowstring Hemp; Mother-in-Law-Tongue; African Bowstring; X
Sansevieria trifasciata Prain cv. 'Laurentii', Bowstring Hemp; X
Yucca aloifolia L., Spanish Bayonet; Aloe
Yuca; X

ALISMATACEAE—Water-platnain family
Sagittaria graminea Michx. var. waterbeana
(Fernald) Bogin, Weatherby's Arrowhead
Sagittaria lancifolia L., Bull Tongue Arrowhead

AMARYLLIDACEAE—Amaryllis family
Hymenocallis latifolia (Mill.) M. Roem.,
Mangrove Spiderlily; Perfumed Spiderlily

ARACEAE—Arum Family
Epipremnum pinnatum (L.) Engl., Golden
Pothos; X

ARECACEAE—Palm Family
Cocos nucifera L., Coconut Palm; X
Phoenix dactylifera L., Date Palm; Date Fruit; X
Phoenix reclinata Jacq., Senegal Date Palm; X
Pseudophoenix sargentii H. Wendl. ex Sarg.,
Sargent's Cherry Palm
Sabal palmetto (Walter) Lodd. ex Schult. &
Schult. f., Cabbage palm
Thrinax morrisii H. Wendl., Brittle Thatch
Palm; Key Thatch Palm; E
Thrinax radiata Lodd. ex Schult. & Schult. f., [T. parriflora auct. non Sw.] Florida
Thatch Palm; E
Veitchia merrillii (Becc.) H.E. Moore, Ma-
nila Palm; X

BROMELIACEAE—Pineapple Family
Tillandsia bulbiflora Schult. & Schult. f.,
Northern Needleleaf; T
Tillandsia fasciculata Sw., Cardinal Airplant;
E
Tillandsia flexuosa Sw., Twisted Airplant; E
Tillandsia panici/olia Baker, Potbelly Airplant
Tillandsia recurvata (L.) L., Ballmoss
Tillandsia usneoides (L.) L., Spanish Moss
Tillandsia usniculata L., Giant Airplant; E

COMMELINACEAE—Spiderwort Family
Commelina diffusa Burm. f., Dayflower
Tradescantia pallida (Rose) D.R. Hunt,
Purplequeen; X
Tradescantia spathacea Sw., [Rboe spathacea
(Sw.) Stearn] Moses-in-the-Cradle;
Oyster-Plant; X

CYMODOCEACEAE—Manateegrass Family
Halodule wrightii Ashe, [H. baudettei (den
Hartog) den Hartog] Shoalweed
Syringodium filiforme Kurz., [Cymodocea
filiformis (Kurz.) Correll] Manateegrass

CYPERACEAE—Sedge Family
Cladium jamaicense Crantz, [C. mariscus (L.)
Polih subsp. jamaicense (Crantz) Kuk.]
Jamaica Swamp Sawgrass
Cyperus esculentus L., Yellow Nutgrass; Chufa
Flatsedge; X
Cyperus involucratus Rothb., Umbrella Plant; X
Cyperus ligularis L., Swamp Flatsedge
Cyperus planifolius L.C. Rich., Flatleaf
Flatsedge
Cyperus polystachyos Rothb., Manyspike
Flatsedge
Eleocharis estriata (Elliott) Torr., Jointed
Spikerush
Rhynchospora colorata (L.) H. Pfeiff., Starrush
Whitetop

HYDROCHARITACEAE—Frog's Bit Family
Halophila decipiens Ostent., Carribean
Seagrass
Thalassa testudinum Banks & Sol. ex. J.
Koenig, Turtlegrass

LILIACEAE—Lily Family, See Agavaeae and
Amaryllidaceae

MUSACEAE—Banana Family
Musa acuminata Colla, 'Dwarf Cavendish'
Dwarf Banana; C

ORCHIDACEAE—Orchid Family
Bletia purpurea (Lam.) DC. [Oietis purpurea
(Lam.) A. de Candolle] Pine Pink; X
Encyclia borealis (Lindl.) Dressler, Dol-
lar Orchid; E
Encyclia tampensis (Lindl.) Small, Florida
Butterfly Orchid; CE
Oeceoclades maculata (Lindl.) Lindl., Monk
Orchid; X
Spiranthes polyantha Rchb. f., Florida Keys
Ladies Tresses; Gray Ladestresses. His-
torically reported from Elliott Key;
H, E

POACEAE—Grass Family
Andropogon glomeratus (Walter) Britton,
Sterns, & Poggenb., Bushy Bluestem
Andropogon perforatus Trin. ex Fourn.,
Beardgrass
Andropogon virginicus L., Brownseedge Bluestem
Bouteloua barbata (Lag.) Herter, Beardgrass; X
Bouteloua aristida (L.) A. Camus, [Andropogon aristiida (L.) Willd.] Pitted Beardgrass; X
Cenchrus brownii Roem. & Schult., Slimbristle Sandbur
Cenchrus echinatus L., Southern Sandbur
Cenchrus intortus M.A. Curtis, [C. cardinalis Walt.] Coastal Sandbur
Cynodon dactylon (L.) Pers., Bermuda Grass; X
Dactylis glomerata (L.) Willd. ex Asch. & Schwein., Durban Crowsfootsgrass; X
Digitaria biuncis (Lam.) Roem. & Schult. ex. Loudon, Asia Crabgrass; X
Digitaria ciliaris (Retz.) Koeler, Southern Crabgrass
Digitaria ischaemum (L.) Koeler var. dolichophylla (Hennard) Wipf, Caribbean Crabgrass
Distichis spicata (L.) Greene, Saltgrass
Eleusine indica (L.) Gaertn., Indian Goosegrass, X
Eragrostis amabilis (L.) Wight & Arn., [E. tenella (L.) P. Beauv. ex Roem. & Schult.] Feather Lovegrass; X
Eragrostis ciliaris (L.) R. Br., Gophertail Lovegrass; X
Eragrostis lottii S. Watson, [E. campestris Trin.] Elliott's Lovegrass
Eragrostis petryi (Sw.) Desv., [Chloris pteryza Sw.] Pinewoods Fingergrass
Lanicae divaricata (L.) Hitchc., Smallcane; Florida Tibece
Monochloa chlorotricha (L.) Hitchc., Shoregrass; Keygrass
Neyraudia reynaudiana (Kunth) Keng ex Hitchc., Burmæreed; Silkeed; X
Panicum amarum Elliott, Bitter Panicgrass
Panicum repens L., Torpedograss; X
Panicum virgatum L., Switchgrass
Paspalum bladhii Chapm., Coral Paspalum; Boldgert's Crowngress
Paspalum distichum L., Knotgrass
Paspalum notatum Fluegge, Bahiagrass; X
Paspalum setaceum Michx., Thin Paspalum
Paspalum vaginatum Sw., Seashore Paspalum
Pennisetum polystachion (L.) Schult., [Pennisetum setaceum (Sw.) Rich] West Indian Pennisetum; Missiongrass
Panicum repens (Willd.) C.E. Hubb., Rose Natalgrass; X
Schizachyrium sanguineum (Retz.) Alston. [S. commutatum (L.) C.E. Hubb.]
Schizachyrium scoparium (Michx.) Nash, Little Bluestem
Setaria pumila (J. König) Stapf, Palmgrass; X
Setaria petiolaris (Poir.) Kerguelen, [S. viridis (Poir.) P. Beauv.] Yellow Bristlegrass; Knotroot Foxtail
Speltaria patens (Aiton) Muhl., Marshhay Cordgrass; Saltmeadow Cordgrass
Sporobolus domingensis (Trin.) Kunth, Coral Dropseed
Sporobolus indicus (L.) R. Br., [S. poirettii (Roem. & Schult.) Hitchc.] Smutgrass
Sporobolus pyramidatis (Lam.) Hitchc., Whorled Dropseed
Sporobolus virginicus (L.) Kunth, Seashore Dropseed
Stenatherium secundatum (Walter) Kunze, St. Augustinegrass
Urochloa brachiata (Trin.) R.D. Webster, [Brachiaria brachiata (Trin.) Parodi] Dominican Signalgrass
Urochloa mutica (Forssk.) Nguyen, [Brachiaria mutica (Forssk.) Stapf.] Paraggrass; X
Urochloa subquadripennis (Trin.) R.D. Webster, [Brachiaria subquadripennis (Trin.) Hitchc.] Tropical Signalgrass; X
Zosia japonica Steud., Korean Templegrass; Japanese Lawngrass; X
Zosia matrella (L.) Merr., Manila Templegrass; X
SMILACACEAE—Smilax Family
Smilax aspera (L.) Walter, Earleaf Greenbrier
Smilax nemorosa Jacq., Everglades Greenbrier
TYPHACEAE—Cattail Family
Typha domingensis Pers., Southern Cattail
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A CHECKLIST FOR THE VASCULAR PLANTS OF PADRE ISLAND NATIONAL SEASHORE

I.G. NEGRETE1, A.D. NELSON2, J.R. GOETZE3, L. MACKE2, T. WILBURN2, and A. DAY2

1Department of Biology, Box 158
Texas A&M University-Kingsville
Kingsville, TX 78363, U.S.A.

2Department of Biological Sciences, Box T-0100
Tarleton State University
Stephenville, TX 76402, U.S.A.

3Science Department
Laredo Community College
Laredo, TX 78040, U.S.A.

ABSTRACT

The flowering plants of Padre Island National Seashore (PINS) were sampled over a two year period in three different regions of the island. Specimens from our investigation and plants reported for PINS from the literature were compiled into a checklist. The flora contains both Flaveria browni and Sporobolus tharpii which are endemics of the western Gulf of Mexico barrier islands. Lycium carolinianum var. quadrijidum, reported only along bayshores in Texas, was found in the tidal flat community. Two hundred and fifty-nine genera and 456 species of flowering plants were identified as part of the PINS flora. These occur in 77 families with the Poaceae (95 spp.), Asteraceae (57 spp.), Fabaceae (44 spp.) and Cyperaceae (29 spp.) most common.

RESUMEN

Se han tomado muestras de las angiospermas del parque nacional “Padre Island National Seashore” (PINS) durante un periodo de dos años, en tres áreas diferentes de la isla. Se hizo un catálogo de los “especímenes” de nuestra investigación y de las plantas citadas a PINS procedentes de una serie de artículos. La flora contiene tanto Flaveria browni como Sporobolus tharpii que son endémicas de las islas de barrera del Oeste en el Golfo de México. Se ha encontrado en la comunidad de la zona mareal plana Lycium carolinianum var. quadrijidum que antes solamente se había citado a lo largo de las bahías de Texas. 259 géneros y 456 especies de angiospermas fueron identificados en la flora de PINS. Las plantas mencionadas pertenecen a 77 familias siendo las familias Poaceae (95 especies), Asteraceae (57 esp.), Fabaceae (44 esp.), y Cyperaceae (29 esp.) las más abundantes.

INTRODUCTION

The Texas Coast is framed by sandy barrier islands which are floristically similar to other barrier islands of the Gulf of Mexico and Atlantic Coast. However, upland sites on Texas barrier islands often grade into extensive
grassland areas (Duncan & Duncan 1987). Padre Island National Seashore (PINS) encompasses most of the barrier island often referred to as northern Padre Island (Figure 1) and contains extensive grassland areas between its foredune ridges on the eastern gulf side and tidal flats bordering the western Laguna Madre. Southern Padre Island has been considered separately from northern Padre Island in terms of floristic analysis (Judd et al. 1977; Lonard et al. 1978; Lonard & Judd 1980) and is physically separated by the Mansfield Ship Channel. In contrast, Corpus Christi Pass once separated Padre Island from Mustang Island but this pass is now filled and the two islands are joined (Weise & White 1980). There have been a number of investigations involving the vegetation of upland and wetland habitats on northern Padre Island. Most recently, Nelson et al. (1997, 1999) examined four communities in regard to vegetational ecology and floristics near Big Ball Hill on PINS (Fig. 1). Drawe and Ortega (1996) examined effects of seismic survey vehicles on vegetation from five different communities on the northern one-third of the island during October 1988 as well as April and September, 1989. Also, Brown et al. (1989) compiled a vegetative history of the island summarizing early historical accounts and scientific works. Carls et al. (1991) assessed the impact of oil industry activities on three plant communities on the northern one-third of the island, and McAtee and Drawe (1975, 1980, 1981) examined the impacts of vehicular and pedestrian traffic patterns on the northern one-third of the island. However, the most comprehensive ecological treatment of PINS vegetation was done by Baccus and Horton (1979) and Baccus et al. (1977). They examined vegetation along the entire length of PINS and focused on areas with differing amounts of vehicular and pedestrian traffic. Drawe et al. (1981) and Kattner (1973) conducted comprehensive vegetation studies of five habitats about 13 km south of the PINS Ranger Station during each of six seasons from winter 1972 to spring 1973. Higginbotham (1972) analyzed vegetation data from four habitats in the northern one-third of the National Seashore, and Orten et al. (1972) investigated dune vegetation near the PINS Ranger Headquarters.

PINS was established in 1963 and since that time a considerable number of ecological investigations have been conducted, whereas only four floristic studies have been completed. Rabalais (1975) produced a list of the flora of PINS using work by Jones et al. (1961), Jones (1966), and Rechenthin and Passey (1967). A checklist incorporating data from the aforementioned ecological and floristic studies has never been published. The purpose of this investigation was to produce a checklist for PINS using data from the literature as well as our own field studies of the island. A checklist can aid researchers in identifying plants, provide data for the development of a flora or manual, and allow for biogeographic comparisons with other islands (Nelson Goetze & Lucksinger, unpublished data).
Areas known as Big Ball Hill, Ranger Road, and Bird Island Basin were sampled during the investigation (Fig. 1). In the Big Ball Hill region, floristic surveys were conducted in May and August through November of 1996, as well as January through March and May of 1997. The Ranger Road and Bird Island Basin regions were sampled from January through April of 1998. Sampling was done by establishing approximately 500m belt transects in each community type with the aid of a Magellan GIS navigator. Communities identified for sampling included coppice dunes, foredunes, barrier flats and secondary dunes, tidal flats (Nelson et al. 1998), and disturbed areas such as roadside ditches. Transects in each community were walked and plants in flower within sight of the transect were sampled. In a few instances, woody vegetation was sampled that was not in flower. Plants collected along the transects were identified by using Jones (1982), Correll and Johnston (1970), Gould (1975), and Gould and Box (1965). Species nomenclature was updated to Jones et al. (1997). Common names were taken from Correll and Johnston (1970) taking into account nomenclatural changes based on Jones et al. (1997). Vouchers were deposited in the herbarium at Texas A&M University-Kingsville (TAIC) and Tarleton State University (TAC) in Stephenville, Texas. In addition to our field data, information from the investigations summarized in the introduction were used in compiling the checklist. Rechenthin and Passey (1967) reported several specimens only as genera; these records were not included in our checklist. These include Allium, Abutilon, Callirhoe, Desmodium, Penstemon, Polygonum, Rumex, and Tragia. The checklist is arranged alphabetically by and within family and includes the scientific name, authority, common names (if available), herbarium, collector (if available), and collection number. Acronyms used for Texas herbaria include: C.C. Museum (Corpus Christi Museum), PINS (Padre Island National Seashore, Corpus Christi), TAC, and TAIC. When collection data are not available, the abbreviation NSA (No specimen available) is used and investigations where this species was reported are listed. Following the collection data are annotations on habit, endemism, and habitat. Plants that are woody are listed as such; plants without this designation are herbaceous in habit. When known, habitat designations of coppice dunes (CD), foredunes (FD), barrier flat (BF), and tidal flat (TF) (Nelson et al. 1997, 1999) are used.

RESULTS AND DISCUSSION

Seventy-seven families, 259 genera, and 456 species are reported from PINS. The five most common families are Poaceae (20.8%), Asteraceae (12.5%), Fabaceae (9.6%), Cyperaceae (6.4%), and the Euphorbiaceae (4.2%). The flora of PINS primarily represents a subset of the flora of the South Texas
Fig. 1. Map (Weise & White 1980) indicating the location of the study sites. Hatched lines indicate the boundaries of Padre Island National Seashore. Inset shows location of Padre Island National Seashore in Texas.
mainland with the exception of *Flaveria brownii* and *Sporobolus tharptii*, which are reported as possible endemics on Padre Island and the Tamaulipan barrier islands of northern Mexico (Britton & Morton 1989). *Lycium carolinianum* var. *quadridum*, reported only along bayshores in Texas (Britton & Morton 1989), was found in the tidal flat community of PINS.

The lack of woody vegetation is a striking feature in regard to the PINS flora. Less than 10% of the species from PINS are considered subshrubs, shrubs, or trees. When one considers the populations of these species in comparison to the total vegetative community of the island, it is estimated that less than 1.0% of the vegetation is woody. Based on historical accounts prior to the early nineteenth century, it appears that woody forms of vegetation have always been scarce on the island (Brown et al. 1989). Britton and Morton (1989) point out that this is not typical of all barrier islands as those of the eastern Gulf and Atlantic shores often support oak- or pine-dominated woodlands. Arid climate is a likely factor in the lack of woody vegetation but is not the only factor as a number of northern Mexico barrier islands have dense stands of thorn-scrub woodland (Britton & Morton 1989). Northern Padre Island may have supported some scattered oak mortes that have declined through time (Britton & Morton 1989; Brown 1989) but is primarily a grassland ecosystem. Therefore, central and southern Texas barrier islands are unique in having a herb-dominated flora and PINS is an excellent example of this type of ecosystem. PINS also has the richest flora of the four barrier island ecosystems that have been studied in Texas (Nelson, unpublished data). A forthcoming investigation will use data from this checklist to elucidate a common flora for four South Texas barrier islands, examine community similarities among the islands, and discuss unique floral components for Matagorda Island, Mustang Island, northern Padre Island, and southern Padre Island (Nelson, unpublished data).

**CHECKLIST OF THE VASCULAR FLORA OF PADRE ISLAND NATIONAL SEASHORE**

Plants that are woody are listed as such; plants without this designation are herbaceous in habit. Habitat designations: coppice dunes (CD), foredunes (FD), barrier flat (BF), and tidal flat (TF) (Nelson et al. 1997, 1999).

**ACANTHACEAE**

*Ruellia corvus* Tharp & Barkl., PINS, Lee 2532.

**AGAVACEAE**

*Yucca constricta* Buckley, Beargrass, Spanish bayonet. PINS, Jones 756. Shrub. BF and FD.


**AIZOACEAE**

*Mollugo verticillata* L., Indian chick weed. PINS, Jones 499.

*Sesuvium maritimun* (Walt.) Britton, Sterns, & Poweg., Sea purslane. NSA; Rechenthin and Passey (1967).

*Sesuvium portulacastrum* (L.) L., Cenicienta. TAIC, Nelson and Odvody N293. CD. *Sesuvium tricentennialis* Correl, Sea purslane.
TAC, Nelson, Macke, and Willburn N697.
BF.

Sesuicium verrucosum Raf., Sea purslane. PINS, Jones 6460.

Triamubna portulacoides L., Horse purslane. PINS, Jones 498.

ALISMATAEAE

Echinodorus beterii (Spreng.) Fassett, Burhead. PINS, 1153.

AMARANTHACEAE

Amaranthus areolatus I. M. Johnston, Sandhills amaranth. PINS, 6662.

Amaranthus blitum L., NSA; Rabalais (1975).

Amaranthus greggii S. Watson, Pigweed, Amananth. TAIC, Nelson N514, CD.

Amaranthus polygonoides L., Tropical amaranth. PINS, 500.

Blutajaratu arenicola (L.) Mears, Silver head. TAIC, Nelson and Horansky N 398, TF.

Celosia nitida Vahl, PINS, Whistler 2470.


Froelichia floridana (Nutt.) Moq. var. floridana, Snake cotton, Cottonweed. PINS, 6689.

Tidestromia laungiina (Nutt.) Standl. var. laungiina, Espanta vaqueros. TAIC, Nelson N 417, BF.

APIACEAE

Centaurea aviatia (L.) Urb., PINS, Jones 893.

Hydrocotyle bonariensis: Commers. ex Lam., Sombrerillo. TAIC, Nelson and Perez-Johnson N 318, FD and BE.

Hydrocotyle umbellata L., Ombilgo de Venu. PINS, Jones 1390.

ASCLEPIADACEAE

Asclepias emoryi (Greene) Vail, Milkweed, Silkweed. NSA; Jones (1966).

Asclepias oenotheroides Cham. & Schrdll., Hierba de zizotes. TAIC, Nelson N328, FD.

Asclepias viridiflora Raf., Milkweed, Silkweed. NSA; Rechenthin and Passey (1967).

Cynanchum angustifolium Pers., PINS, 924.

ASTERACEAE

Ambrosia artemisiifolia L., Short ragweed, Altamisa. NSA; Baccus and Horton (1979), Higginbotham (1972), Rabalais (1975).

Ambrosia psilostachya DC., Western ragweed. TAIC, Nelson and McKeller N352, FD, BE, and TF.


Aphanostephus skirrbobasis (DC.) Trel. var. rubrosalis Shinniers, Lazy daisy. TAIC, Nelson and Guerra N 375, BF.


Borrichia frutescens (L.) DC., Sea-oat daisy. TAIC, Nelson and Goodridge N 365. Sub-shrub to shrub. BF and TF.

Centacenta americana Nutt., Basketflower, Thornless thistle, Cardo del valle. NSA; Rechenthin and Passey (1967).

Chrysocephalum pilosum Nutt., Golden aster, Camphor weed. C.C. Museum, Jones 6265.

Cirsium borrialeum Michx. var. elliptiii Torr. & A. Gray, Bull thistle, Yellow thistle. TAIC, Nelson, Macke, and Willburn N717, BF.

Cirsium texanum Buckley, Thistle, Plumed thistle. NSA; Rabalais (1975).

Convolvulus anomalous (Mill.) King & Rob., TAIC, Nelson and Martinez N383, FD, BE, and TF.

Comyza coronoides (L.) Cronquist, Horseweed. PINS, 7925.

Comyza greggii (L.) Cronquist, NSA; McAtee (1975).

Coreopsis tinctoria Nutt., Coreopsis, Tickweed. TAC, Nelson, Macke, and Willburn N655, TF.

Crotalaria diversum (Nutt.) Raf., Scratch-daisy. TAIC, CSP 44.

Crotalaria rigidifolia (E. B. Sm.) E. B. Sm., Scratch-daisy. TAC, Nelson, Macke, and Willburn N636, FD.

Dysodia pentacta (DC.) Robins. var. pentacta, Parralena. TAC, Nelson, Macke, and Willburn N648, BF.
Eclipta prostrata (L.) L., C.C. Museum, Jones 6913.
Erigeria procumbens (Hoist. ex Mill.) Nesom, Fleabane. TAIC, Nelson N624. BF and FD.
Enantia compositifolia Walter, Yankee weed. PINS, Jones 5871.
Enthemia leptomorpha (Torr. & A. Gray) Greene, PINS, 6264.
Evax verna Raf., Rabbit-tobacco, Cottonrose. PINS, Jones and Baker 6407.
Flaveria brownii Powell, Longleaf flaveria. TAIC, Nelson N495. Endemic. BF
Gaillardia pulchella Foug., Indian blanket, Firewheel. TAIC, Nelson and Soto N361.
FD, BF, and TF.
Gamochaeta falcatia (Lam.) Cabrera, Cudweed, Everlasting. PINS, Jones and Baker 6409.
Gamochaeta pensilvanica (Willd.) Cabrera, Cudweed, Everlasting. NSA; Jones (1966).
Helenium amarum (Raf.) H. Rock var. amarum, C.C. Museum, Jones 7927.
Helianthus annuus L., Common sunflower, Mirasol. PINS, 543.
Helianthus argophyllus Torr. & A. Gray, Silverleaf sunflower. PINS, 2516.
Helianthus debilis Nutt. subsp. cucumerifolius (Torr. & A. Gray) Heiser, Cucumberleaf sunflower. TAIC, Nelson, Macke, and Wilburn N684. TF.
Helianthus praeceps Engelm. & A. Gray subsp. runyonii (Heiser) Heiser, Sunflower PINS, 2364.
Heterotheca subaxillaris (Lam.) Britton & Rusby, Camphorweed. TAIC, Nelson and Resende N307. CD and FD.
Iva annua L., Sumpweed, Marsh-elder, Pelocote. NSA; Rechenthin and Passey (1967).
Iva imbricata Walter, Sumpweed, Marsh elder. NSA; Jones (1966), Rabalais (1975).
Iva texensis R. R. Johnson, Sump-weed, Marsh-elder. TAIC, Nelson N483. BF and TF.
Liatris elegans (Walter) Michx. var. elegans, Gay-feather, Button-snakeroot, Blazing star. PINS, 1180.
Macerocentra phyllolepa (DC.) Shinners, Camphor daisy. TAIC, Nelson N420. BF and TF.
Palafaxia hookeriata Torr. & A. Gray, PINS, 1383.
Palafaxia rosea (Bush) Cory var. rosea, NSA; Jones (1966).
Palafaxia texana DC. var. ambigua (Shinners) B.L. Turner & M. I. Morris, C.C. Museum, Jones 6776.
Pincus purpurscens (Sw.) DC., Canela. PINS, 2424.
Ratibida peduncularis (Torr. & A. Gray) Barnh. var. peduncularis, Mexican hat. PINS, 530.
Solidago odora Aiton var. odorata, Sweet goldenrod. PINS, 1248.
Solidago sempervirens L., Seaside goldenrod. PINS, Jones 1256.
Sondan ader (L.) Hill, Achicoria dulce. NSA; Jones (1966).
Sonchus oleraceus L., Sow thistle. TAC, Nelson, Macke, and Wilburn N653. BF.
Symphyotrichum divaricatum (Nutt.) Nesom, Hierba del marrano. PINS, Loc 2471.
Tetragonotheca repanda (Buckley) Small, Nerve-ray. NSA; Rabalais (1975).
Thelesperma filifolium (Hook.) A. Gray, Green-thread. PINS, Whistler and Norfleet 1864.
Thelesperma nucuene B. L. Turner, Green-thread. PINS, Jones 1348.
Verbesina encelioides (Cav.) Benth. & Hook. ex A. Gray, Cowpen daisy. C.C. Museum, Jones 7585.

AVICENNIAE
Avicennia germinans (L.) L., Black-mangrove, Mangle blanco. PINS, 6668. Shrub.
**HYPERICACEAE**

Hypericumpaniculatum Kunth, St. John’s wort. PINS, O’Brien 2540.

**COMMELINACEAE**

Commelina erecta var. angustifolia (Michx.) Fern., Widow’s-tears, day-flower. PINS, 521.

Commelina erecta var. erecta, Hierba del po.llo. TAIC, Nelson and Hornsby N303. FD and BF.

Tradescantia hastata Rose, Spiderwort, spiderily. PINS, 520.

**CONVOLVULACEAE**

Ipomea cordatotriloba Dennst., Morning glory. PINS, Lee 2474.

Ipomea imperati (Vahl) Griseb., Beach morning glory. TAIC, Nelson and Goodridge N289. CD and FD.


Ipomea sagittata Poir., Morning glory. PINS, Lee 2391.

**CUCURBITACEAE**

Citrullus lanatus (Thunb.) Matsum. & Nakai var. citroides (L.H. Bailey) Mansf., Watermelon sandia. PINS, Jones 1382.

Cucumis melo L., var. melo, Musk melon. NSA; Jones (1966), Rabalais (1975).

Cucurbita foetidissima Kunth, Buffalo-gourd, Calabacilla loca. NSA; Rechenthin and Passney (1967).

**Cyperaceae**


Melopathria pendula L., var. pendula, Meloncito. C.C. Museum, Jones 7146.

**Aloonaceae**

Cuscuta tricuspidata (Kunth) Correll, Manateegrass. NSA; Rabalais (1975).

Healogone beadlei (den Hartog) den Hartog, PINS, Pratt 2352.

**Cyperaceae**


Cyperus semperflorens L., Yellow nut-grass. TAIC, Nelson N494. FE.

Cyperus rotundus L., Flatsedge. PINS, Jones 1381.

Cyperus pseudoscythis Rottb., Flatsedge. PINS, Whistler and Lee 2415.

Cyperus esculentus L., Yellow nut-grass. TAIC, Nelson N494. FE.

Cyperus retrorsus Buckley var. retrorsus, C.C. Museum, Jones, 6695.

Cyperus retrorsus Buckley var. retrorsus, C.C. Museum, Jones, 6695.

**CUCURBITACEAE**

Cucurbita ficifolia (Cucurbita ficifolia) var. ficifolia, Cucurbita ficifolia, Cucurbita ficifolia. NSA; Jones (1966), Rabalais (1975), Rechenthin and Passney (1967).


**Cymodoceaceae**

**Cymodocea filiformis (Kutz.) Correll, Manateegrass. NSA; Rabalais (1975).**
Fimbristyris castanea (Michx.) Vahl, TAIC, Nelson N 4/19. BF.

Euphorbia charoides Michx., C.C. Museum, Fall 76D457.

Euphorbia simplicis Vahl, Umbrella-grass. PINS, O'Brien 2512.

Lipocarpus micranthus (Vahl.) G.C. Tucker, PINS, Jones 891.

Rhynchospora colorata (L.) H. Pfeiff., White-topped umbrella grass. TAC, Nelson, Macke, and Willburn N 696. BF.

Schoenoplectus erato (Poir.) Palla ex J. Raynal, Bullrush. PINS, Jones 6834.

Schoenoplectus purgens (Vahl) Palla var. longifolius (Britton) S.G. Sm., Sword-grass, Three-squared-bullrush. TAC, Nelson, Macke, and Willburn N 654. BF.

Schoenoplectus saximontanus (Fern.) J. Raynal, Bullrush. NSA; Jones (1966); Rechenthin and Passey (1967).

DROSERAECAE

Drosera brevifolia Pursh, Sundew. PINS, Jones 6828.

ELATINACEAE

Elaine triandra Schkuhr., Waterwort. C.C. Museum, Jones 6833.

EUPHORBIACEAE

Acalypha radiata Tott., Three-seeded mercury. PINS, Jones 6560.


Croton argyranthemum Michx., C.C. Museum, Jones 6541.


Croton coryi Croizat, PINS, Jones 959.

Croton glandulosus L. var. lindheimeri Müll. Arg., TAIC, McAtee.

Croton glandulosus L. var. palustrisissimun Croizat, PINS, Lee 2414.


Croton monanthogynus Croton. Michx., PINS, Fall 1258.

Croton parvis epiz Croizat, Croton. C.C. Museum, Jones 6670.

Croton punctatus Jacq., Hierba del jabali, Beach-tea. TAIC, Nelson and Guerra, N 285. Subshrub. CD and FD.


Euphorbia cordifolia Elliott, Spurge. PINS, Whistler 2527.

Euphorbia cordifolia L., Spurge. NSA; Carls et al. (1987).


Euphorbia faccellata L., Spurge. PINS, Jones 1287.

Euphorbia serpens Kunth, Hierba de la golondrina. C.C. Museum, Jones 7687.

Phyllanthus abnormis Baill. var. abnormis, Leaf-flower. PINS, Fall 1250.

Phyllanthus polygonoides Nutt. ex Spreng., Leaf-flower. PINS, Jones and Baker 604.

Phyllanthus padus Wheeler, Leaf-flower. NSA; Rabalais (1975).

Stillingia sylvatica Garden ex L. subsp. sylvatica, Queen's delight. PINS, Jones 617.

FABACEAE


Acshyphonoe viscida Michx., Sticky jointvetch. PINS, Jones 745.

Astragalus brazennsis Buckley, Milk-vetch, Loco weed. PINS, Jones 6795.

Astragalus leptocarpus Tott. & A. Gray, Milk-vetch, Loco weed. PINS, Jones 7620.

Baptisia bracteata Nutt. var. lanceolata (Nutt.) Kartesz & Gandhi, Plains wild indigo. NSA; Rabalais (1975).

Baptisia bracteata Muhl. ex Elliott var. lancifolia (A. Gray ex Canby) Isley, Plains wild indigo. TAIC, Nelson and Negre N 402. BF.

Cataulaia rosea (Sw.) DC., Jackbean. Swordbean. PINS, Jones 919.

Centrosema virginianum (L.) Benth., Butterfly pea. PINS, Jones 747.

Cheiracanthia fasciiculata (Michx) Greene, Partridge pea. TAIC, Nelson N 489. FD and BF.

Clitoria mariana L. PINS, Lee 2400.
Crotalaria sagittalis L., Rattlepod. PINS, Jones 4092.

Dalca emarginata (Torr. & A. Gray) Shinners, PINS, Nelson, Macke, and Wilburn N713. BE.

Dalca lanata Spreng., Woolly dalea. PINS, Jones and Baker 6562.

Dalca obovata (Torr. & A. Gray) Shinners, Pussyfoot. PINS, Jones 738.

Dalca pogonathera A. Gray, Hierba del coraz{on}, Bearded dalea. NSA; Carls et al. (1987).

Deosanthes virgatus (L.) Willd. var. depressus (Humb. & Bonpl. ex Willd.) B.L. Turner, PINS, Jones 850.

Erythrina herbacea L., Coral bean, Color{in}. PINS, 734.

Galactia canescens Benth., Hoary milk pea. PINS, Lee 2420.

Galactia marginalis Benth., PINS, Whistler 2524.


Indigofera miniata Ortega var. miniata, Scarlet pea. TAIC, Nelson and Horbury N301. FD and BE.

Indigofera suffraticosa Mill., C.C. Museum, Jones 6673. Shrub.

Leucaena leucocephala (Lam.) de Wir, C.C. Museum, Jones 7924. Shrub or tree.

Medicago polymorpha L., Bur clover. PINS, Jones 751.

Melilotus albus Medik., White sweet clover, Huban. PINS, Whistler and Lee 248.

Melilotus indicus (L.) C. All., Sour clover, Alfalfilla. TAC, Nelson, Macke, and Wilburn N692. BE.

Mimosa latidens (Small) B.L. Turner, Sensitive briar. PINS, Whistler 1837.


Neptunia lutaea (Leavenw.) Benth., Yellowpuff. NSA; Rechenthin and Passey (1967).

Neptunia pubescens Benth. var. pubescens, PINS, Jones and Baker 741.


Prosopis glandulosa Torr. var. glandulosa, Honey mesquite. PINS, Jones 912. Shrub or tree.

Rhynchosia americana (Houst. ex Mill.) Metz., Snoutbean. TAIC, Nelson and Goodridge N321. FD and BE.

Rhynchosia miniata (L.) DC., Snoutbean. TAIC, Nelson and Perez-Johnson N306. FD and BE.

Rhynchosia repentis (Pursh) DC., Dollar-leaf. NSA; Rechenthin and Passey (1967).

Rhynchosia sena Gillies ex Hook. var. tamentosa, Snoutbean. TAC, Nelson, Macke, and Wilburn N704. BE.

Sesbania drummondii (Ryd.) Cory, Rattlebush, Poison bean, Coffee bean. PINS, Jones 914. Shrub.


Sophora venusta L. var. occidentalis (L.) Isely, Yellow Sophora. PINS, Tharp 40. Shrub.

Strophostyles helvola (L.) Ellior, Amberique bean. PINS, Pratt 2358.

Strophostyles lenta (Torr. & A. Gray) Piper, Sleek-seed bean. PINS, Jones 913.

Stylisamnes viscosa Sw., Pencil-flower. PINS, Lee 2383.


FAGACEAE
Quercus minima (Sarg.) Small., C.C. Museum, Jones 7922. Shrub.

Quercus virginiana Mill. var. fusiformis (Small) Sarg., Oak. TAIC, Nelson N562. Shrub or tree. BE.

Quercus virginiana Mill. var. virginiana, Live oak, encino. PINS, Jones 931. Tree.

FUMARIACEAE
Corydalis micrantha (Engelm. ex A. Gray) A. Gray subsp. texensis G. Ownbey, Scrambled eggs. NSA; Jones (1966), Rabalais (1975).
GENTIANACEAE

*Eustoma exaltatum* (L.) Salisb. ex G. Don, Catchfly-gentian. PINS, Jones 883.

*Salvia arvensis* Greenm., Rose-gentian. TAIC, Nelson N625. FD and BF.

GOODNIACEAE

*Sisyrinchium biforme* E.P. Bicknell, Blue-eyed grass. TAIC, Nelson and Martinez N386. BF.

HYDROCHARITACEAE


HYDROPHYLLACEAE

*Sisyrinchium aquitiferum* E.P. Bicknell, Blue-eyed grass. PINS, Jones 724.

JUNCACEAE


*Junecus bufonisius* L. var. bufonisius, Toad-rush. C.C. Museum, Jones 1829.

*Junecus marginatus* Rostk., Rush, Bog-rush. PINS, TAC, Nelson, Macke, and Wilburn N664. TF.

*Junecus megacephalus* M.A. Curtis, Rush, Bog-rush. TAC, Nelson, Macke, and Wilburn N699. BF.

*Junecus roemerianus* Scheele, PINS, Whistler 2484.

*Junecus serpoides* Lam., Neddlepod rush. TAIC, Nelson N513. BF.

*Junecus validus* Coville var. fasciatus M.C. Johnston., Rush, Bog-rush. PINS, Jones 6864.

LAMIAEAE

*Monarda punctata* L. var. lasiophanta A. Gray, Spotted bee-balm, Horsemint. C.C. Museum, Jones 7699.


*Scutellaria marina* L., Skullcap. PINS, Jones 6566.

*Teucrium cabanii* Jacq. var. cabanii, Germander. NSA; Rechenthin and Passey (1967).

LAURACEAE

*Persea borbonia* (L.) K. Spreng., Red bay. PINS, Jones 905. Shrub or tree.

LENTIBULARIACEAE

*Utricularia pulula* L., Bladderwort. C.C. Museum, Jones 6827.

LILACEAE

*Cochlospermum amabile* Herb., Cebolletta. NSA; Rabalais (1975).


LINACEAE


*Linum aristatum* Engelm., Flax. NSA; Rabalais (1975).

*Linum imbricatum* (Raf.) Shinners, Tufted flax. NSA; Rabalais (1975).

LOASACEAE


LYTHRACEAE

*Ammannia latifolia* L., C.C. Museum, Jones 3377.

*Lythrum alatum* Pursh var. lanceolatum (Elliott) Torr. & A. Gray ex Rothr., Loosestrife. TAIC, Nelson N424. TF.


*Rotala ramosior* (L.) Koehne, Tooth-cup. PINS, Jones 6831.

MALVACEAE


*Malvastrum americanum* (L.) Torr., Malva loca. PINS, Jones 916.
\textbf{Malvaceae}

\textit{Malvastrum coromandelianum} (L.) Garcke, PINS, Jones 917.

\textit{Sida ciliaris} L., Bracted sida. Whistler and Lee 2417.

\textit{Sida cordifolia} L., NSA; Rabalais (1975).

\textit{Sida lintheimleri} Engel. & A. Gray, PINS, Jones 868.

\textit{Sphaeralcea lintheimleri} A. Gray, False mallow, Globe mallow. PINS, Baker 763.

\textbf{Myricaceae}

\textit{Morella cerifera} (L.) Small, Wax-myrtle, Candle-berry. PINS, Jones 764. Shrub.

\textbf{Najadaceae}

\textit{Najas guadalupensis} (Spreng.) Magnus, Common water-nymph. PINS, Hambly and Jones 1152.

\textbf{Nyctaginaceae}

\textit{Boerhavia cocinea} Mill., Scarlet spiderling. NSA; Rabalais (1975).

\textit{Mirabilis alba} (Walter) Heimerl., White four-o'clock. PINS, Jones 6777.

\textbf{Onagraceae}


\textit{Calylophus serrulatus} (Nutt.) P.H. Raven, Yellow evening primrose. TAIC, Nelson and Perez-Johnson N343. TF.

\textit{Gaura longiflora} Spach, NSA; Jones (1966), Rabalais (1975).


\textit{Ludwigia glandulosa} Walter, Cylindric-fruited ludwigia. NSA; Jones (1966), Rabalais (1975).

\textit{Oenothera drummondii} Hook. subsp. \textit{drummondii}, Beach evening primrose. TAIC, Nelson and Perez-Johnson N287. CD and FD.


\textit{Oenothera laciniata} Hill, Cut-leaved evening primrose. TAIC; Nelson N566. BF and TF.

\textit{Oenothera speciosa} Nutt., PINS, Hambly 1195.

\textbf{Ochidaceae}

\textit{Spiranthes tenuis} Engel. & A. Gray, Spring ladies’ tresses. TAIC, Nelson and Sato N329. FD and BF.

\textbf{Orobanchaceae}


\textbf{Oxalidaceae}


\textit{Oxalis drummondii} A. Gray, Wood-sorrel, lady’s sorrel. NSA; Rabalais (1975).

\textbf{Papaveraceae}

\textit{Argemone albiflora} Hornem. subsp. \textit{texana} G.B. Ownbey, White prickly poppy. NSA; Higginbotham (1972).

\textit{Argemone sanguinea} Greene, Red poppy. NSA; Jones (1966), Rabalais (1975).

\textbf{Phytolaccaceae}

\textit{Phytolaca americana} L., Pokeweed, pokeberry. C.C. Museum, Jones 7657.

\textbf{Plantaginaceae}

\textit{Plantago heterophylla} Nutt., Plantain. PINS, Jones 6807.

\textit{Plantago hookeri} Fisch. & C.A. Mey., Tallow weed. TAC, Nelson, Macke, and Willburn N678. TF.

\textit{Plantago virginica} L., Pale-seeded plantain. TAIC, Nelson N565. TF.

\textbf{Plumbaginaceae}

\textit{Limonium carolinianum} (Walter) Britton, Sea-lavender, Marsh-rosemary. TAIC, Nelson N518. TF.

\textbf{Poaceae}

\textit{Andropogon gerardii} Vitman, Big bluestem. PINS, Whistler 2479.

\textit{Andropogon glomeratus} (Walter) Britton, Sterns, & Poggenb., Bushy beardgrass. TAIC, Nelson and Resendez N381. TF.

\textit{Andropogon ternarius} Michaux var. \textit{ternarius}, Splitbeard bluestem. PINS, Jones 1312.

\textit{Andropogon virginicus} L., Broomsedge. PINS, Jones 903.
Aristida longiseta Poir. var. geniculata (Raft.) Fern., Three-awn grass. TAIC, Nelson N 4992. TE
Aristida oligantha Michx., Prairie three-awn. NSA; Rechenthin and Passey (1967).
Aristida purpurea Nutt. var. purpurea, Purple three-awn. NSA; Rechenthin and Passey (1967).
Aveno donax L., Giant reed, Carrizo, Georgia cane. TAC, Nelson, Mack, and Wilburn N 632. BF
Arina fatata L., Oats. NSA; Jones (1966), Rabalais (1975).
Bothriochloa barbimoda (Lag.) Herter var. barbimoda, Beardgrass. TAIC, Guerra 00066.
Bothriochloa ischaemum L. var. songarica (Fisch. and C.A. Mey.) Celarier & Harlan, PIN5, Whistler 2462.
Bothriochloa lagaroides (DC.) Herter subsp. torreyana (Steud.) Hack., Silver beardgrass, Silver bluestem. PIN5, Jones 7684.
Bromus catharticus Vahl, Rescue grass. NSA; Jones (1966), Rabalais (1975).
Cenchrus echinatus L., Cadillo. TAC, Nelson, Mack, and Wilburn N 706. FD and BE.
Cenchrus spinifex Cav., Grassbur, Coast sandbur. TAC, Nelson and Odhova N 315. FD and BE.
Chloris andropogonoides Fourn., Fingergrass. PIN5, Jones 6732.
Chloris canaria Arech. var. canarii, Fingergrass. NSA; Jones (1966), Rabalais (1975).
Chloris gayana Kunth, Rhodes grass. PIN5, Jones 7447.
Chloris verticillata Nutt., Windmill fingergrass, Tumble windmill grass. NSA; Rechenthin and Passey (1967).
Cynodon dactylon (L.) Pers. var. dactylon, Bermuda grass, Pata de gallo. PIN5, Fall 1242.
Dactylolomnium acuta (L.) Beauv., Crowfoot. NSA; Jones (1966), Rabalais (1975).
Dichanthium aristatum (Forsk.) Stapf var. annulatum, PIN5, Whistler 2480.
Dichanthium aristatum (Poir.) C.E. Hubb., C.C. Museum, Jones 6733.
Digitaria arenicola (Swall.) A. Beetle, Crabgrass. TAC, Nelson, Mack, and Wilburn N 717. FD.
Digitaria bicornis (Lam.) Roem. & Schult., C.C. Museum, Jones 7902.
Digitaria cayenensi (Schult.) Pilg., Crabgrass. PIN5, Fall 1253.
Digitaria sanguinalis (L.) Scop., Northern crabgrass. NSA; Rechenthin and Passey (1967).
Digitaria texana Hitchc., Crabgrass. PIN5, Fall 1267.
Distichlis spicata (L.) Greene, Saltgrass. PIN5, Whistler 2478.
Echinochloa crus-galli (L.) Beauv. var. crus-galli, Barnyard grass. NSA; Rechenthin and Passey (1967).
Echinochloa crus-patronics (Kunth) Schult., NSA; Rechenthin and Passey (1967).
Echinochloa walteri (Parsh.) A. Heller, NSA; Rechenthin and Passey (1967).
Eragrostis barreleri Daulte, Lovegrass. C.C. Museum, Jones 7582.
Eragrostis curtispediculata Buckley, Gummy lovegrass. NSA; Rechenthin and Passey (1967).
Eragrostis intermedia Hitchc. var. intermedia, Lovegrass. NSA; Rechenthin and Passey (1967).
Eragrostis lugens Nees., Lovegrass. TAIC, Estrello.
Eragrostis pectinacea (Michx.) Nees., Lovegrass. NSA; Rechenthin and Passey (1967).
Eragrostis setalabii (Parsh) Steud., Lovegrass. PIN5, Jones 1386.
Eustachys petrae (Sw.) Desv., TAC, Nelson, Mack, and Wilburn N 642. BF.
Hordum pasilum Nutt., Little barley. TAIC, Nelson N567. TF.

Leersia hexandra Sw., PINS, Whister 2503.

Leptochloa dubia (Kunth) Nees., Green sprangletop. NSA; Jones (1966), Rabalais (1975).

Leptochloa fascicularis (Lam.) A. Gray var. fascicularis, Sprangletop. NSA; Baccus and Horton (1979), Jones (1966), Rabalais (1975).

Leptochloa mucronata (Michx) Kunth, Red sprangletop. NSA; Rechentin and Passey (1967).


Monanthochloa litorea Engelm., TAC, Nelson, Mackie, and Wilborn N687. TF.

Muhlenbergia capillaris (Lam.) Trin., Gulf muhly. PINS, Whister 2502.


Panicum aciculare Desv. ex Poir. var. angustifolium (Elliot) Wipfl and S. D. Jones, PINS, Jones 7621.

Panicum acuminatum Sw., Panic grass. PINS, Jones 3961.

Panicum amarum Elliot var. amarum (A. Hitchc. & Chase) P. Palmer, Beach panic. TAC, Nelson N624. CD and FD.

Panicum amarum Elliot var. amarum, Beach panic. TAIC, Nelson N493. CD and FD.

Panicum capillarioides Vasey, Panic grass. TAIC, Nelson and Hornsby, N309. FD.

Panicum nodatum Hitchc. & Chase, Panic grass. PINS, Fall 1261.

Panicum aligosanthes Schult., PINS, Whister 2513.

Panicum portoricense Desv. ex W. Hamilt., Panic grass. TAIC, Nelson and French N369. BF.

Panicum sphaerocephalon Elliot, Panic grass. TAIC, Nelson N360. BF.

Panicum virgatum L., PINS, Whister 2508.

Parapholis incurva (L.) C.E. Hubb., Sicklegrass. TAIC, Alaniz.

Paspalum monostachyum Vasey, Paspalum. TAIC, Nelson, N486. FD and BF.

Paspalum plicatum Michx. var. plicatum, Brownseed paspalum. PINS, Jones 899.

Paspalum setaceum Michx., Paspalum. TAIC, Nelson and McKeller N299. FD and BF.

Paspalum vaginatum Sw., Paspalum. PINS, Jones 1881.

Pennisetum ciliare (L.) Link var. ciliare, Buffelgrass. TAIC, Nelson and Hornsby, N297. FD.

Pennisetum glaucum (L.) R. Br., NSA; Rechentin and Passey (1967).

Phragmites australis (Cav.) Trin. ex Steud. subsp. australis, Common reed. C.C. Museum, Jones 6768.

Polypogon monspeliensis (L.) Desf., Rabbitfoot grass. TAC, Nelson, Mackie, and Wilborn N680. TF.

Schedonorus panicolatus (Nutt.) W. Trel., Tumblegrass. NSA; Jones (1966), Rabalais (1975).

Schizachyrium scoparium (Michx.) Nash var. littorale (Nash) Gould, Seacoast bluestem. TAIC, Nelson and Cadena N314. FD and BF.


Setaria macrostachya Kunth, NSA; Rechentin and Passey (1967).

Setaria parviflora (Poir.) Kerguelen, NSA; Jones (1966), Rabalais (1975), Rechentin and Passey (1967).

Sorghastrum nutans (L.) Nash, PINS, Whister 2504.


Spartina alterniflora Lois. var. glabra (Bigel.) Fern., Smooth cordgrass. C.C. Museum, Jones 6906.

Spartina patens (Ait.) Muhl., Salmmeadow cordgrass. TAIC, Nelson N423. BF.

Spartina spartinae (Trin.) Merr. ex Hitchc., Sacahuista, Gulf cordgrass. C.C. Museum, Jones 7181.


Sporobolus airoides (Torr.) Torr. subsp. airoides, Alkali sacaton. NSA; Jones (1966),


POLYGALACEAE

Polygala alba Nutt., Polygala, Milkwort. TAC, Nelson N626. FD and BF.

Polygala incarnata L., Polygala, Milkwort. TAC, Nelson, Macke, and Willburn N637. BF.


POLYGONACEAE

Eriogonum longifolium Nutt. var. longifolium, Wild buckwheat. NSA; McAtee (1975), Rabalais (1975).

Eriogonum multiflorum Bent., Wild buckwheat. TAC, Nelson, Alacke, and Willburn N628. FD and BF.

Polygonaella polygona (Vent.) Engelm. & A. Gray, October-flower. PINS, Jones 6698.

PORTULACACEAE


PRIMULACEAE


Rubiaceae

Cephalanthus occidentalis L. var. californicus Bent., Common buttonbush, Honey-bells, Globe-flowers. PINS, Jones 908. Shrub or small tree.

Disokera teres Walter var. teres, Poor Joe, Rough buttonweed. PINS, Jones 6559.


Oldenlandia rostellata L., PINS, Jones 7441. Richardia brasiliensis Gomes, PINS, Jones 7560.

Ruppiaceae

Rippia maritima L., Widgeon-grass. PINS, Jones and Baker 6552.

Rutaceae

Zanthoxylum clava-beroides L., Pepperbark,
Hercules-club, Pricklyash, Tickle-tongue, Toothache tree. PINS, Jones 7038. Shrub or small tree.

Zanthoxylum hisutum Buckley, Tickle-tongue, Toothache tree, Pricklyash. PINS, Jones 786. Shrub or small tree.

**SALICACEAE**

Salix nigra Marshall, Black willow, Saúz. TAIC, Nelson N563. Tree. BE.

**SAXIFRAGACEAE**

Leporepetalum spathulatum Elliott, C.C. Museum, Jones 6808.

**SCROPHULARIACEAE**

Agalinis fasiculata (Elliott) Raf., C.C. Museum, Jones 7579.

Agalinis heterophylla (Nutt.) Small ex Britton. Prairie agalinis. TAIC, Boggsch and Molby 2402.

Agalinis maritima (Raf.) Raf. var. glandiflora (Benth.) Shinners, Seaside gerardia, Salt marsh gerardia. TAIC, Nelson and Negrete N411. BE.

Agalinis strictifolia (Benth.) Pennell, PINS, Lee and Whistler 2390.

Bacopa caroliniana (Walter) Robins., Blue hyssop. NSA; Recchenthin and Passey (1967).

Bacopa monnieri (L.) Pennell, Water-hyssop. PINS, Jones and Hamby 1157.

Bacopa rotundifolia (Michx.) Wettst., PINS, Whistler 2467.

Buchnera americana L., Bluehearts. TAIC, Nelson N623. BE.

Castilleja indivisa Engelm., Indian paintbrush, Paintedcup. NSA; Recchenthin and Passey (1967).

Lindernia dubia (L.) Pennell var. anagallidea (Michx.) Cooper, False pimpernel. PINS, Jones 6806.

Maerandya anribinizhafra Humb. & Bonpl. ex Willd. subsp. anribinizhafra, Snapdragon vine. PINS, Jones and Baker 790.

Nuttallanthus texanus (Scheele) D.A. Sutton, Texas toad-flax. NSA; Jones (1966), Rabalais (1975).

Stemodia lanata Ses. & Moc. ex Benth., Woolly stemodia. TAIC, Nelson and Negrete N409. FD and BE.

**SOLANACEAE**

Capsicum annuum L. var. annuum (Dierb.) D'Arcy & Edbaugh, Bird pepper, Chili pepper, Chili pequin. NSA; Rabalais (1975). Subshrub or shrub.

Lycium carolinianum Walter var. quadrifidum (Dunal) Hitchc., Carolina wolfberry. TAIC, Nelson N490. Shrub. TF.

Nicotiana glanca Grab., Tree tobacco, Mustard tree, Rapé, Gigante, Buena moza. C.C. Museum, Jones 7584. Shrub or small tree.

Physalis cinerascens (Dunal) Hitchc. var. spathulifolia (Tor.) J. Sullivan, Ground cherry. TAIC, Nelson and Martinez N296. CD, FD, and BE.

Solanum americanum Mill., American nightshade, Hierba mora negra. PINS, Jones 7309.

Solanum rostratum Dunal, Buffalo bur, Kansas-thistle, Mala mujer. NSA; Recchenthin and Passey (1967).

**TAMARICACEAE**

Tamarix aphylla (L.) Karst., Tamarisk, Salt cedar. NSA; Rabalais (1975). Tree.

Tamarix canariensis Willd., Tamarisk, Salt cedar. NSA; Rabalais (1975). Shrub or tree.

Tamarix chinensis Tour., Tamarisk, Salt cedar. C.C. Museum, Jones 8147. Shrub or small tree.

Tamarix gallica L., Tamarisco, Rompevientos. PINS, Jones 6551. Shrub or small tree.

Tamarix ramosissima Ledeb., Tamarisk, Salt cedar. PINS, Whister and Lee 2393. Shrub or small tree.

**TYPHACEAE**

Typha domingensis Pers., Tule. PINS, Whister and Lee 2439.


**URTICACEAE**

Parietaria floridana Nutt., Pellitory. NSA; McAtee (1975), Rabalais (1975).

Parietaria pensylvanica Muhl. ex Wild. var. obtusa (Ryd. ex Small) Shinners, Hammerwort. PINS, Jones 795.

Urтика chamaedryoides Pursh, Ortiguilla. NSA; Jones (1966), Rabalais (1975).
VERBENACEAE

Glandularia bipinnatifida (Nutt.) Nutt. var. bipinnatifida, PINS, Jones 1205.
Lantana urticoides Hayek, Texas lantana, Hierba de cristal, Calico bush. PINS, Jones 7310. Shrub.

Phyla lancozata (Michx.) Greene, Northern frog-fruit. NSA; Rechenthin and Passey (1967).

Phyla nodiflora (L.) Greene, Common frog fruit, Cape-weed, Turkey-tangle, Mar-grass, Hierba de la Virgen Maria. TAIC, Nelson and Soto 3290. FD and BF.

Verbena halei Small, Texas vervain. PINS, Jones 7063.

VITACEAE


XYRIDACEAE

Xyris pipiens Rich., Yellow-eyed grass. PINS, Jones 7396.

ZYGOPHYLLACEAE

Kallstroemia bursatissima Vail ex Small, Carpetweed. C.C. Museum, Jones 7583.

Tribe terrestrial L., Caltrop, Goat head, Puncture weed, Abrujo de flor amarilla, Cadillo. NSA; Rabalais (1975).

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REFERENCES


BOOK NOTICE


From the Introduction: "In broadest terms, this second edition of Principles of Plant Breeding is concerned with the two distinct components of Darwinian evolution: (1) the facts of evolution ("descent with modification") and (2) selection as the chief agent of evolutionary change. However, the narrower focus of the book is on two quite recent and specialized evolutionary events: first, the evolution of crop plants under cultivation, a process that started about 13,000 to 11,000 years ago with the cultivation and ultimate domestication of many wild plant species in various parts of the world; and second, the current scientific phase of plant breeding, a process that started early in the twentieth century as Darwinian and Mendelian principles became firmly established as the framework within which evolutionary changes in living organisms occur."

AN ANNOTATED PRELIMINARY CHECKLIST OF THE DICOTYLEDONOUS LIANAS AND VINES FROM THE LAS CRUCES BIOLOGICAL STATION, COSTA RICA

ALEXANDER KRINGS

Department of Forestry
North Carolina State University
Raleigh, NC 27695, U.S.A.

ABSTRACT

In order to contribute to our understanding of lianas and vines, as well as to facilitate future research, a preliminary checklist of the dicotyledonous lianas and vines from the Las Cruces Biological Station, Costa Rica is presented. Seventy species in sixty genera and thirty-two families are recorded. The largest climbing families at Las Cruces are Cucurbitaceae (11 spp.), Leguminosae (6 spp.), Sapindaceae (5 spp.), and Bignoniaceae (4 spp.).

RESUMEN

Para contribuir al conocimiento de lianas y enredaderas, así como para facilitar otras investigaciones, se presenta una lista preliminar de las lianas y enredaderas dicotiledóneas de la Estación Biológica Las Cruces, Costa Rica. Se citan 70 especies de 60 géneros y 32 familias. Las familias más grandes de Las Cruces son Cucurbitaceae (11 spp.), Leguminosae (6 spp.), Sapindaceae (5 spp.) y Bignoniaceae (4 spp.).

INTRODUCTION

Lianas are important constituents of tropical forests that have, until recently, been largely neglected in both botanical and ecological studies (Gentry 1991). Arguably the most important physiognomic character differentiating tropical and temperate forests (Croat 1978), lianas are woody vines, beginning life as terrestrial seedlings and capable of growth in mature forests (Gentry 1991). Herbaceous vines also start life as terrestrial seedlings, but are typically found in disturbed habitats and lack significant secondary growth. Ninety percent of the liana species of the world occur in the tropics (Walter 1985). Vegetation studies of Central and South American forests indicate that lianas can occur on 42 to 50 percent of forest trees (Montgomery & Sunquist 1978; Putz 1982, 1984). In the last two decades, various lists covering different aspects of the Costa Rican flora have been published (Janzen & Liesner 1980; Hartshorn & Poveda 1983; Haber 1991; Kappelle et al. 1991), how-

1Present address: Zilker Botanical Garden, 2220 Barton Springs Rd., Austin, TX 78746, U.S.A.

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ever, no list has yet been published treating specifically the liana or vine flora of Costa Rica. In order to contribute to our understanding of lianas and vines, and to facilitate future research, the present study sought to document the dicotyledonous lianas and vines of the Las Cruces Biological Station, Costa Rica—a site not previously subjected to systematic liana collections.

**METHODS**

**Site Description**

The forest of the Las Cruces Biological Station is classified as tropical premontane rain forest following the Holdridge Life Zone System (Holdridge 1947; Hartshorn 1983). It is a relatively tall forest (30–35 m) with abundant oaks and an epiphyte load conspicuously less than at similarly classified zones at Monteverde (Hartshorn 1983; Krings, pers. obs.). The vegetation of the site is still incompletely known, especially when compared to the more intensively studied La Selva Biological Station. Hartshorn & Poveda (1983) present a preliminary list of sixty-three tree species known from the site.

The climate of the Station is illustrated in Figure 1 by a Walter climate diagram based on data from the Station’s meteorological station for the years 1996 and 1997. The mean annual rainfall at the Station is 4236 mm and the mean annual temperature 20.6° C. Stiles et al. (1989) show weather data from the Instituto Meteorológico de Costa Rica indicating mean annual precipitation and mean annual temperature for the nearby town of San Vito to be 3988 mm and 21.7° C respectively.

As seen in Figure 1, rainfall is somewhat seasonal with two distinct peaks from May–June and October–November broken by a ‘veranillo’ from July–August. December is the only month in which mean monthly rainfall may drop below 100 mm.

The temperature at the Station fluctuates relatively little throughout the year. As indicated in Figure 1, the highest mean monthly temperature is 21.8° C and the lowest mean monthly temperature 18.7° C. The highest recorded temperature for the two years is 32.4° C and the lowest 15.2° C.

**COLLECTION AND DEPOSIT**

The dicotyledonous lianas and vines of the Las Cruces Biological Station were collected from August to October 1996 and in March 1997. The collections were made between 1000 m and 1200 m elevation.

Specimens were collected using expandable clipper poles and, in some cases, by climbing the host tree. Sometimes mountaineering ropes were used to assist climbing by attaching them to a weighted fishing line and then shooting the line over a host tree branch with a slingshot (see Perry 1978; Moffett 1993; Laman 1995). The fishing line was used to pull up parachute chord, which unlike fishing line, will support the weight of mountaineer-
ing rope. Climbing devices, known as ascenders, were then used to climb into the canopy where samples were collected. Voucher specimens were deposited at CR and F.

RESULTS

Seventy species in sixty genera and thirty-two families are recorded. Taxa are arranged alphabetically by family, genus, and species. An asterisk preceding a name indicates that species to be collected from cultivation. Annotations include the relative rarity (Table 1), habit (liana or vine), diameter at breast height (dbh) or height climbed when known, and any distinguishing characteristics. As the relative rarity descriptions are based on casual observation they are not definitive. A complete census of the lianas and vines at

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
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<td>Uncommon</td>
<td>One to five individuals observed</td>
</tr>
<tr>
<td>Common</td>
<td>Six or more individuals observed</td>
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</table>
Las Cruces will most likely change many of these observations. Unless indicated otherwise, notes on distinguishing characteristics come from the author’s own study of field and herbarium specimens. For the purposes of the annotations, elevations above 700 m are considered 'montane.'

**ACANTHACEAE**

*Mendocia breneesii* Standl. (*Krings* 177)—Uncommon at Las Cruces. Collection taken from liana climbing to 15 m, 50–60 m from forest edge at an elevation of 1100–1200 m. This opposite-leaved liana is recognized by the suberect, glabrous to strigulose, grooved stems and the ovate bracts. The fruit is bilateral.

*Mendocia tonduzii* Turrill (*Krings* 213)—Uncommon at Las Cruces. Collection taken from liana climbing to 11 m at an elevation of 1180–1190 m. Recognized by the 4-angled, hirsute stems and the oblong-elliptic, mucronate bracts, with a rounded apex. The somewhat compressed, purple fruit is asymmetrical near the apex.

**AMARANTHACEAE**

*Chamissoa altissima* (Jacq.) Kunth (*Krings* 156)—Uncommon at Las Cruces; only one individual seen. Collection taken from robust liana, 5.7 cm dbh, climbing to 17 m at an elevation of 1120–1200 m. Relatively non-descript, alternate-leaved climber with small flowers subtended by 1–3 bracts in pyramidal terminal inflorescences.

**APOCYNACEAE**

*Mandevilla hirsuta* (Rich.) K. Schum. (*Krings* 189)—Uncommon at Las Cruces. Collection taken from vine climbing to only 2 m at an elevation of 1050–1095 m. Distinguished from the other collected Apocynac climber, *Prestonia isthmica*, by the cordate leaf bases and glands on the midrib base above.

*Prestonia isthmica* Woodson (*Krings* 139)—Uncommon at Las Cruces; only one individual seen. Collection taken at 1015 m elevation, from flexible vine at forest edge with corky, cream-colored older stem and clear, sticky exudate. Young leaves velutinous above and below (see above for other distinguishing characters).

**BIGNONIACEAE**

*Amphilophium pannosum* (DC.) Bureau & K. Schum. (*Krings* 162)—Common at Las Cruces. Collection taken from liana 4.3 cm dbh, climbing to 25 m at an elevation of 1075 m. Vegetatively easily recognized by the villous, sharply hexagonal stems with long trichomes (to 2 mm) and trifid tendrils. The compressed, ellipsoid, rugose-tuberculate capsule is also unmistakable. Separated from *Pithecoctenium*, the only other wild *Bignon* genus in Costa Rica with hexagonal stems, by the dendroid trichomes of vegetative parts (simple in *Pithecoctenium*).

*Arrabidaea verrucosa* (Standl.) A.H. Gentry (*Krings* 147)—Common at Las Cruces. Collection taken from liana to 4.4 cm dbh. Distinguished from *A. patellifera* and *A. florida*, the only two other *Arrabidaea* species occurring above 700 m elevation in Costa Rica, by the presence of interpetiolar gland fields, a bilabiate calyx usually greater than 1.5 cm, and a verrucose-tuberculate capsule. Separated from the other tuberculate-fruited *Bignon* at Las Cruces, *Amphilophium pannosum*, by the linear fruit, to 2.5 cm wide (ellipsoid in *A. pannosum*, to 8 cm wide).

*Lundia puberula* Pittier (*Krings* 258)—Uncommon at Las Cruces. Collection taken from vine growing over low shrubs at 1075 m elevation. Similar to *Arrabidaea*, but distinguished by the pubescent anthers (glabrous in *Arrabidaea*) and pubescent to velutinous capsules (glabrous, or with scattered trichomes, to tuberculate in *Arrabidaea*).

*Martinella obovata* (Kunth) Bur. & K. Schum. (*Krings* 180)—Uncommon at Las Cruces; only one individual seen. Collection taken from liana climbing to 15 m, 50–60 m from the forest edge at an elevation of 1100–1200 m. Gentry (1973) suggests good field characters include frequently bending or twisting
petiolules, trifid tendrils, and conspicuous interpetiolar swellings. Unrivaled by any other Bignon in Costa Rica, the narrowly linear fruit (to 1.8 cm wide) can exceed 130 cm in length.

**BORAGINACEAE**

**Tournefortia** sp. (Krings 142)—Uncommon at Las Cruces. Collection taken from liana climbing into canopy at the forest’s edge at 1060 m elevation. Somewhat non-descript, but recognized by the scorpoid inflorescences and wintergreen odor to the crushed leaves.

**CAMPANULACEAE**

**Burmeistera cyclostigmata** Donn. Sm. (Krings 179)—Common at Las Cruces. Collection taken from vine climbing to 4 m, 50–60 m from the forest edge at 1100–1200 m elevation. Recognized by the milky latex, purplish corolla, and serrate-tipped calyx.

**Centropogon granulosus** C. Presl (Krings 172)—Common at Las Cruces. Collection taken from vine climbing to 3 m at 1050 m elevation. Recognized by the bright red corolla with yellow lobes.

**COMBRETACEAE**

**Combretum laxum** Jacq. (Krings 165)—Uncommon at Las Cruces. Collection taken from liana climbing into the canopy in closed forest at 1200 m elevation. Recognized by the opposite leaves, parallel, tertiary leaf venation, and distinctive four-winged fruit.

**COMPOSITAE**

**Mikania guaco** Bonpl. (Krings 186)—Uncommon at Las Cruces. Collection taken from liana climbing to 10 m in closed forest at 1050–1095 m elevation. Recognized by the opposite leaves, three-veined from the base, and the glabrate, fistulose stems.

**Mikania skutchii** S.F. Blake (Krings 166)—Uncommon at Las Cruces. Collection taken from liana climbing into canopy of closed forest at 1200 m elevation. Distinguished from *M. guaco* by the densely villous leaves and the villous, never fistulose stems.

**Otopappus verbesinoides** Benth. (Krings 197)—Common at Las Cruces. Collection taken from liana climbing to only 1.5 m at 1075 m elevation. Characterized by asperous stems and opposite leaves (narrower than in the *Mikania* spp. above or the *Sinclairia* sp. below), three-veined from the base. See Hartman & Stuessy (1983) for a revision of the genus.

**Sinclairia polyantha** (Klatt) Rydb. (Krings 187)—Uncommon at Las Cruces. Collection taken from liana climbing to 7 m at 1050–1095 m elevation. Recognized by the serrate, opposite leaves, three-veined from the base, light green above, and glaucous below.

**CONNARACEAE**

**Rourea** sp. (Krings 203)—Uncommon at Las Cruces. Collection taken from liana climbing to 7 m at 1170 m elevation. Recognized by cylindrical pulvini, pinnately compound leaves, with the basal leaflets alternate to sub-opposite, and reflexed branchlets aiding in climbing. *Rourea* has 2 carpels (1 in *Connarus*) and imbricate sepal (valvate in *Cnestidium*) (Woodson et al. 1950).

**CONVOLVULACEAE**

**Maripa** sp. (Krings 277)—Uncommon at Las Cruces. Collection taken from vine climbing to 17 m at the edge of a forest gap at 1030 m elevation. Recognized by the rounded leaf-bases (cordate in *Merremia*), compound, whitish-purple flowers, and often impressed venation. Unlike *Merremia*, the fruit is indehiscent.

**Merremia** sp. (Krings 211)—Uncommon at Las Cruces; only seen in one location. Collection taken from seedlings on forested ridge at 1200 m elevation. Recognized by the distinctive large, rounded-squarish seeds and deeply lobed leaves with typical *Convolvulaceae* venation. Unlike *Maripa*, the fruit is indehiscent.

**CUCURBITACEAE**

*Cionoscys macranthus* (Pittier) C. Jeffrey (Krings 280)—Only known from cultivation at Las Cruces. Collection taken from vine near the Station vegetable garden growing at 1095 m elevation. Recognized by the
patelliform glands crowded near the leaf base below and the anthers condiscplicate or flexuous. The genus is closely related to *Cayaponia* and essentially only differentiated by the fleshy, peponiform fruit (baccate and fibrous in *Cayaponia*).

*Cucurbita moschata* (Duchesne ex Lam.) Duchesne ex Poir. (*Krings* 279)—Only known from cultivation at Las Cruces. Collection taken from vine growing in Station vegetable garden at 1095 m elevation. Recognized by the 4–5-branched tendrils and somewhat irritat- ing leaf hairs.

*Cyclanthera multifoliolata* Cogn. (*Krings* 269)—Common at Las Cruces. Collection taken from vigorous vine taking over a large, tree-fall gap at 1190 m elevation. Easily recognized to genus by the anthers in a horizontal ring. Unique among Costa Rican *Cyclanthera* species in the presence of numerous patelliform glands near the leaf base below.

*Elateriopsis oerstedelii* (Cogn.) Pittier (*Krings* 175)—Uncommon at Las Cruces. Collection taken from vine growing outside the Station, on roadside at 1000–1100 m. Easily recognized by the glabrous to puberulous stems, 3-lobate to angulate leaves, whitish-green campasuanulate flowers with fused filaments and vertically plicate anthers, and smooth, non-echinate, explosively dehiscent fruit.

*Fevillea cordifolia* L. (*Krings* 272)—Uncommon at Las Cruces; only one individual seen. Collection taken from young liana growing on the edge of a ridge-top gap at 1200 m elevation. One of the few Costa Rican *Cucurbit* becoming a canopy-reaching liana, it is recognized vegetatively by the bifid tendrils curling above and below the bifurcation. Differentiated from *Sicydium*, the only other montane (i.e., > 700 m) Costa Rican Cucurbitis exhibiting tendrils curling above and below the bifurcation, by the woody habit, five stamens, and 3-locular ovary (herbaceous, three stamens, and uni-locular in *Sicydium*).

*Gurania makoyana* (Lem.) Cogn. (*Krings* 276)—Common at Las Cruces. Collection taken from robust vine climbing to 17 m at the forest edge between 1000 and 1100 m elevation. *Gurania* is one of only two genera recognized by simple tendrils, inflorescences consisting of several flowers, and orange to reddish corollas, but can be distinguished by the orange or reddish calyx lobes (green in *Psiguria*). Separated from other Costa Rican *Gurania* species by the simple leaves, pedicels of staminate flowers 1 to 3 mm long, stem hairs (if present) less than 4 mm long, and the calyx lobes frequently 2 to 3.5 times as long as the calyx tube.

*Melothria* sp. (*Krings* 206)—Common at Las Cruces. Collection taken from vine climbing to 2 m at 1145 m elevation. Three species of *Melothria* are known from Costa Rica. All are quite similar and cannot be conclusively separated vegetatively. *M. dulcis* is distinguished by a white corolla and yellow to orange fruit. Both *M. scabra* and *M. pendula* exhibit a yellow corolla and are differentiated by the mature fruit (at least 2.5 cm long, light and dark green striped in *M. scabra* versus only to 2 cm long, green to black in *M. pendula*).

*Psiguria triphylla* (Miq.) C. Jeffrey (*Krings* 246)—Uncommon at Las Cruces. Collection taken from vigorous vine climbing to 15 m at 1000–1100 m elevation. Closely related to *Gurania* (see *G. makoyana* for discussion). Separated from *P. warscewiczii*, the only other *Psiguria* species above 700 m in Costa Rica, by the calyx not green-spotted and the coriaceous leaves (green-spotted calyx and membranaceous leaves in *P. warscewiczii*).

*Rytidostylis carthaginensis* (Jacq.) Hook. & Arn. (*Krings* 250)—Uncommon at Las Cruces. Collection taken from slender vine growing on a streamside shrub at 1000–1100 m elevation. The only montane Costa Rican Cucurbit displaying an elongate, narrowly cylindrical calyx tube (to 3 cm long).

*Sechium edule* (Jacq.) Sw. (*Krings* 278)—Known only from cultivation at Las Cruces. Collection taken from vine growing in the Station vegetable garden at 1095 m elevation. The genus is recognized by tendrils 3–5-fid and ten floral nectaries at the base of the hypanthium. *S. edule* is recognized by the combination of the nectaries sunken into the base of the hypanthium (but not protruding conspicuously below) and the filaments only partially connare, the anthers free.

*Selysia prunifera* (Poep. & Endl.) Cogn.
(Krings 155)—Uncommon at Las Cruces. Collection taken from stout liana, 3.2 cm in diameter growing into canopy at 1120–1200 m elevation. The only species of Selysta in Costa Rica, it is distinguished from members of Cuxapponia, Cionoicys, Cyclanthera, and Tecunmanija, the only four other Costa Rican genera exhibiting parcelliform glands on the abaxial leaf surface, by the glands frequently scattered throughout the abaxial leaf surface (not just crowded near the base), the anthers essentially straight or merely slightly curved at the ends, and the arrow-head shaped seeds.

**DICHAPETALACEAE**

Dichapetalum nevermannianum Standl. (Krings 151)—Uncommon at Las Cruces. Collection taken from liana to 2.5 cm dbh, climbing to 17 m at 1075 m elevation. Distinguished from other Mesoamerican Dichapetalum species by the linear-oblong tooblanceolate leaves to only 3 cm wide and the hispid stems and inflorescences (Lundell 1966).

**ERICACEAE**

Psammissia ramiflora Kl. (Krings 160)—Uncommon at Las Cruces. Collection taken from shrubby liana climbing to 17 m at 1120–1200 m elevation. The only lansent representative of Ericaceae observed at Las Cruces, *P. ramiflora* can be recognized by the alternate, plinerved leaves, with swollen petioles.

**EUPHORBIACEAE**

Dalechampia cissifolia Poeppig (Krings 245)—Uncommon at Las Cruces. Collection taken from vine climbing over low shrubs at 1030 m elevation. Recognized by the serrulate, trifoliate leaves, much resembling *Cissus*, but lacking tendrils. Only two other Dalechampia species in Costa Rica are also trifoliate. *D. websteri* has 6 female sepal and involucral bracts 10–14 mm long and, though also displaying 7–11 female sepal and involucral bract less than 5 mm long, *D. heteromorpha* has simple and trifoliate leaves intermixed on the stems (Burger & Huft 1995). Manihot brachyloba Muell. Arg. (Krings 173)—Uncommon at Las Cruces. Collection taken from scrambling liana climbing to 6 m trailside at 1060 m elevation. Distinguished from other Costa Rican *Manihot* species by the climbing habit and the tri-lobed leaves (Burger & Huft 1995).

**GESNERIACEAE**

Capaneca sp. (Krings 214)—Uncommon at Las Cruces. Collection taken from lansent plant climbing to 8 m at 1100–1125 m elevation. Characterized by asymmetric, opposite leaves and campanulate corollas with purple spots.

**HIPPOCRATEACEAE**

Salacia petenensis Lundell (Krings 182)—Uncommon at Las Cruces. Collection taken from robust liana to 7.2 cm dbh, climbing to 20 m at 1060 m elevation. The only liana observed at Las Cruces climbing by stout, leafless, curving branchlets (to 1.5 cm diam.). The large spherical fruits are also distinctive.

**HYDRANGEACEAE**

Hydrangea peruviana Moric. (Krings 167)—Common at Las Cruces. Collection taken from liana climbing with adventitious roots into canopy at 1190 m elevation. Recognized by the opposite, serrulate leaves and the brownish stems with parallel ridges.

**LEGUMINOSAE**

Caesalpinia urophylla (Donn. Sm.) Standl. (Krings 164)—Common at Las Cruces. Collection taken from liana to 3.3 cm dbh, climbing to 15 m at 1190 m elevation. *C. urophylla* is heavily armed with thorns and prickles both along the stems and leaves. Also distinguished from other leguminous climbers at Las Cruces by the large, bi-pinnately compound leaves and the spiny, compressed ellipsoid fruit. Seen in more disturbed areas in the forest. Canavalia oxyphylla Standl. & L.O. Williams (Krings 191)—Common at Las Cruces. Collection taken from vine climbing to 10 m at 1015 m elevation. This trifoliate vine with pinkish flowers is recognized in fruit by an additional suture displaced from the ones on each valve, often appearing medial on the valve.
Machaerium cobanense Donn. Sm. (KTRANS 134)—Common at Las Cruces. Collection taken from liana growing into canopy along trailside at 1015 m elevation. Recognized by the paired spines of stems and the rounded oblong to elliptic leaflets lacking acuminate tips. Stems may exude a red sap when cut.

Machaerium seemannii Benth. ex See. (KTRANS 193)—Uncommon at Las Cruces. Collection taken from liana climbing to 6 m at 1030 m elevation. Recognized by the lanceolate leaflets with acuminate tips and the leading shoots often leafless, but armed with paired spines, and curling much like tendrils.

Mucuna sp. (KTRANS 135)—Common at Las Cruces. Collection taken from vine in forest interior at 1015 m elevation. Generally, unmistakable lianas due to the long pendent flowers and fruits, both often with urticaceous hairs.

Rhyndochia erythrinoides Cham. & Schltdl. (KTRANS 149)—Common at Las Cruces. Collection taken from liana with flattened stem climbing to 15 m at 1075 m elevation. Recognized vegetatively by the somewhat rhombic leaflets of the trifoliolate leaf and the flattened stem (no other liana at Las Cruces has been observed with such a stem).

LOGANIACEAE

Strychnos sp. (KTRANS 183)—Common at Las Cruces. Collection taken from liana climbing to 6 m at 1060 m elevation. Easily distinguished from the only other opposite-leaved, tendrillate liana family in Costa Rica, Bignoniacae, by the simple, often 3-veined leaves. Tendrils in Strychnos also tend to be more hook-like.

MALPIGHIACEAE

Hiraea grandifolia Standl. & L.O. Williams (KTRANS 148)—Uncommon at Las Cruces. Collection taken from liana climbing to 20 m at 1075 m elevation. Recognized by densely ferruginously tomentose stems and samaras with semi-circular lateral wings and reduced dorsal wings. Stipules are often borne above the petiole base.

Tetrapteryx sp. (KTRANS 170)—Uncommon at Las Cruces. Collection taken from liana climbing to 25 m at 1060 m elevation. Recognized by samaras with four oblong, elongate lateral wings and reduced dorsal wings.

MARCGRAVIACEAE

Marcgravia sp. (KTRANS 273)—Uncommon at Las Cruces. Collection taken from material off the forest floor on a ridge at 1200 m elevation as the high-climbing liana was unreachable. A very distinct high-climbing root climber, recognized when young by the often angular stems growing appressed to the trunk of trees with the leaves pressed flat. The somewhat succulent, alternate, frequently dark-punctate leaves, as well as the whorl of flowers harboring a whorl of succulent nectaries in its center, are also unmistakable.

MENISPERMACAE

Anomospermum reticulatum (Mart.) Eichler (KTRANS 184)—Uncommon at Las Cruces. Collection taken from robust liana to 5.3 cm dbh, climbing to 4 m at 1030 m elevation. Sometimes mistaken as a curiously unifoliolate legume due to the swollen pulvini. A. reticulatum is often more readily recognized when dried by the glossy, reticulate leaf venation.

Cissampelos pareira L. (KTRANS 194)—Common at Las Cruces. Collection taken from vine climbing to 4 m at 1030 m elevation. The genus Cissampelos in our area is distinguished from other tropical Menisperm genera, such as Anomospermum, Chondrodendron, Hyperbaena, and Odontocarya, by the staminate flowers with only 4 sepals (6–18 in the afore mentioned genera) and herbaceous habit (Rhodes 1962). C. pareira is distinguished from C. tropacolifolia in that the leaves are not peltate.

Cissampelos tropacolifolia DC. (KTRANS 268)—Uncommon at Las Cruces. Collection taken from vine growing over low shrubs on trailside at 1150 m elevation. A more or less weedy vine, C. tropacolifolia is distinguished from C. pareira by the peltate leaves and sericeous indument of the leaves.

NYCTAGINACEAE

Pisonia aculeata L. (KTRANS 168)—Uncommon at Las Cruces. Collection taken from stout
liana to 5.2 cm dbh, climbing to 20 m at 1190 m elevation. This opposite-leaved liana is armed with stout, axillary, recurved spines and is recognized in fruit by the stalked glands arranged linearly along the angles of the fruit.

PASSIFLORACEAE

Passiflora costaricensis Killip (Krings 271)—Uncommon at Las Cruces. Collection taken from a small liana climbing through trailside thickets at 1170 m elevation. Distinguished from the other two collected Passiflora species, by the bilobate leaves, small, subulate stipules, and triangular stems. Distinguished from other bilobate montane Passiflora species, by the leaves not peltate, 1 1/2 times as long as wide (or nearly so), and the lateral leaf lobes generally 1/3 the length of the midrib (1/2 or more in P. capularis). The fruit is reddish, ellipsoid, and asymmetrical in cross-section.

Passiflora menispermifolia Kunth (Krings 150)—Uncommon at Las Cruces. Collection taken from a small vine climbing to 4 m in the understory at 1075 m elevation. Distinguished from other Costa Rican Passiflora species with trilobate leaves by the leaves essentially entire, not peltate, not glandular-ocellate below, villous with straight hairs (puberulent with hooked hairs in P. lobata), and petioles with 2 or more gland pairs.

Passiflora oerstedii Mast. (Krings 215)—Common at Las Cruces. Collection taken from vine climbing to 4 m in understory between 1100–1125 m elevation. Distinguished from other montane Costa Rican Passiflora species with unlobed leaves and cordate leaf bases, by the petioles with 3 or more, linear to filiform, gland pairs, and the stipular venation reticulate (parallel in P. ligularis).

PIPERACEAE

Sarcorhachis naranjoana (C. DC.) Trel. (Krings 144)—Common at Las Cruces. Collection taken from liana climbing to 6 m at 1060 m elevation. Recognized by alternate, often cordate leaves, swollen nodes, and solitary, axillary, spicate inflorescences (leaf-opposed in Piper).

RANUNCULACEAE

Clematis dioica L. (Krings 195)—Uncommon at Las Cruces. Collection taken from vine climbing to 5 m at 1030 m elevation. Easily recognized by the opposite, pinnately-compound leaves (3–5 leaflets) and the racem often curling around objects, much like a tendril, while climbing.

RHAMNACEAE

Gouania sp. (Krings 138)—Common at Las Cruces. Collection taken from sterile vine growing in forest edge tangle at 1015 m elevation. Recognized to genus by the tendril axillary to a terminal leaf or inflorescence at apex of short branch and often coiled like a butterfly proboscis. Leaves usually have three basal veins. The collection is probably either G. polygama or G. lupuloides, the former distinguished by the floral disc somewhat pubescent with relatively long, conspicuous trichomes (glabrous or minutely, appressed puberulent in G. lupuloides).

RUBIACEAE

Manettia sp. (Krings 264)—Common at Las Cruces. Collection taken from young vine growing over low shrubs in a forest gap at 1070 m elevation. These herbaceous vines are recognized by the opposite leaves with distinct arcuate venation. Corollas are tubular to salverform.

Randia vazquezii Lorence & Dwyer (Krings 190)—Uncommon at Las Cruces. Collection taken from liana climbing to 12 m at 1050–1095 m elevation. Recognized by the subterminal, more or less stout, spines in groups of 3 to 4. Uncaria spines occur in pairs at the nodes.

SAPINDACEAE

Paulinia alata (Ruiz & Pav.) G. Don (Krings 140)—Common at Las Cruces. Collection taken from liana growing into canopy at 1030 m elevation. Distinguished from other pinnately compound-leaved montane Paulinia species by the leaves 2-jugate, the leaflets of the lowest pair simple, stipules only to 0.8 mm
long, the unwinged, red fruit to 2 cm long, and the stem cross-section showing 3–6 peripheral vascular cylinders surrounding a central one.

Paulinia bracteosa Radlk. (Krings 145)—Common at Las Cruces. Collection taken from stout liana to 4 cm dbh at 1075 m elevation. Easily distinguished from other pinately compound-leaved montane Paulinia species by the large stipules (2–5 cm long) and the stem cross-section showing a single vascular cylinder.

Paulinia grandifolia Benth. ex Radlk. (Krings 163)—Common at Las Cruces. Collection taken from liana climbing into canopy at 1180 m elevation. Distinguished from P. malleophylla and P. ingaeifolia, the only other montane Paulinia species with the lowest leaflets of the 3–5 jugate leaves trifoliolate or pinnate, by the unwinged fruit (winged in P. malleophylla) and narrowly triangular stipules, to 8 mm long (ovate to broadly lanceolate, 1.5 to 4 cm long in P. ingaeifolia).

Paulinia pterocarpa Triana & Planch. (Krings 158)—Uncommon at Las Cruces. Collection taken from liana to 2.6 cm dbh, climbing into canopy at 1120–1200 m elevation. Distinguished from other winged-fruited montane Paulinia species, by the pinately compound leaves with the lowest leaflet pair simple (all others are either trifoliolate or with the lowest leaflet pair trifoliolate).

Serjonia valcrii Standl. (Krings 154)—Uncommon at Las Cruces. Collected from liana to 3.2 cm dbh, climbing to 15 m into canopy at 1120–1200 m elevation. Distinguished from S. lobulata, the only other pinately 5-foliolate montane Serjonia species, by the densely hirsute stems and petioles (hairs 1–2 mm long) and the conspicuous stipules, to 5 mm long (inconspicuous, to 3 mm in S. lobulata).

Solanaceae

Solanum sp. (Krings 176)—Uncommon at Las Cruces? Collection taken from liana climbing near forest edge at 1100–1200 m elevation. The genus is recognized by calyces with 5 vascular ribs or lobes and anthers dehiscing by terminal pores (D’Arcy 1973).

ULMACAE

Celtis iguanae Jacq.) Sarg. (Krings 181)—Uncommon at Las Cruces. Collection taken from robust liana to 4.3 cm dbh, climbing to 10 m at 1025–1075 m elevation. Although the leaves are somewhat reminiscent of Gnania (serrulate to serrate at tip, 3-veined from base), C. iguanae is easily recognized by the lack of tendrils, the presence of spines, the more or less asymmetrical leaf bases, and the asperous leaf surfaces.

VITACEAE

Cissus rhombifolia Vahl (Krings 192)—Common at Las Cruces. Collection taken from vine climbing to 3 m at 1060 m elevation. Distinguished from other trifoliolate Costa Rican Cissus species by the more or less rhombic terminal leaflet, and the small fruits (ca. 1 cm long and wide).

Cissus verticillata (L.) Nicolson & C.E. Jarvis (Krings 141)—Common at Las Cruces. Collection taken from liana growing into canopy at 1030 m elevation. Perhaps the most common of the Costa Rican simple-leaved Cissus species, C. verticillata is distinguished by the leaves not strongly dimorphic (dimorphic in C. biforionifolia), broadly ovate (narrowly elliptic to lanceolate in C. brevipes), and the pedicels glabrous (hirtellous in C. cacuminis).

Vitis tiliifolia Humb. & Bonpl. ex Roem. & Schult. (Krings 210)—Common at Las Cruces. Collection taken from vigorous liana to 7 cm dbh, climbing to 17 m at 1120 m elevation. The only representative of Vitis in Costa Rica, V. tiliifolia is distinguished from Cissus by the 5-merous flowers, the panicule inflorescence, and the leaves densely floccose-tomentose beneath.

DISCUSSION

This list should be treated as a working checklist. Included are only collections that have been assigned with confidence to either genus or species.
A complete collection list, including unknowns, has been deposited at F.

Nine of the eleven tendrillate climbing families of Costa Rica (see Krings 1997), are represented at Las Cruces, although the Leguminosae are represented by only non-tendrillate species. No climbing, tendrillate Polemoniaceae (Cobaea) or Polygonaceae (Antigonon, introduced) have been found. This is not surprising as Cobaea vines are generally found above 1600 m in Costa Rica, well beyond the upper limits of Las Cruces. Only C. gracilis and C. scandens are known to have been collected as low as 700–1000 m (Krings 1997).

Although incomplete, I hazard that the list includes the majority of the lianescent taxa of Las Cruces. Currently, the largest climbing families are Cucurbitaceae (11 spp., incl. 3 cultivars), Leguminosae (6 spp.), Sapindaceae (5 spp.), and Bignoniaceae (4 spp.)—together comprising 37.1% of the recorded species. Most additional species records are likely to come from the following, mostly vining families: Asclepiadaceae, Convolvulaceae, Loganiaceae, and Solanaceae. Among monocotyledons, more work is needed for all taxa, but especially Smilax L. and Dioscorea L., both of which have been seen on the grounds.

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REFERENCES


**GAMOCHAETA SIMPLICICAULIS** *(ASTERACEAE: GNAPHALIEAE) IN FOUR SOUTHEASTERN STATES AND NEW FOR NORTH AMERICA*

**GUY L. NESOM**

*Biota of North America Program—North Carolina Botanical Garden*
*Coker Hall CB 3280*
*University of North Carolina*
*Chapel Hill, NC 27599-3280, U.S.A.*

**ABSTRACT**

The presence of the South American native *Gamochaeta simplicicaulis* (Willd. ex Spreng.) Cabrera is documented for North Carolina, South Carolina, Florida, and Alabama, based on specimens in NCU and US. It has not previously been included in accounts of the North American flora. The species apparently is abundant on the coastal plain of the Carolinas, where first collected in 1957, and may be expected to occur with frequency in other regions of the Atlantic and Gulf Coastal plain. A morphological description, illustration, and specimen citations are provided.

**RESUMEN**

Se documenta la presencia de la planta nativa de Sur América *Gamochaeta simplicicaulis* (Willd. ex Spreng.) Cabrera en Carolina del Norte, Carolina del Sur, Florida, y Alabama, basada en especímenes depositados en NCU y US. No había sido incluida previamente en los informes de la flora norteamericana. La especie es aparentemente abundante en la llanura costera de las Carolinas, donde fue colectada por primera vez en 1957, y puede que se dé con frecuencia en otras regiones de la llanura costera del Atlántico y del Golfo. Se ofrecen una descripción morfológica, una ilustración y citas especímenes.

The South American native *Gamochaeta simplicicaulis* (Willd. ex Spreng.) Cabrera was noted to occur in Florida by Pruski (1997) in his account of the Asteraceae of the Venezuelan Guayana. The distribution of this species, otherwise unreported for North America, is further documented here for North Carolina, South Carolina, and Alabama, based on specimens housed in NCU. It was not included in accounts of *Gamochaeta* (Nesom 1990) for the United States or the southeastern United States (Godfrey 1958; Arriagada 1997). *Gamochaeta simplicicaulis* apparently is relatively widespread on the coastal plain of the Carolinas, where it is known from five coastal and near-coastal counties of North Carolina and every South Carolina county adjacent to the Atlantic Ocean, except one. The localities in Walton Co., Florida (eastern panhandle), and Mobile Co., Alabama, are immediately adjacent to the Gulf coast.

The first collections of *Gamochaeta simplicicaulis* from the United States...
apparently were made in 1957 from six South Carolina counties in connection with preparation of the Flora of the Carolinas. Judging from the already relatively abundant distribution of the species by the mid 1960s, at least in the Carolinas, it is probable that its current distribution is broader than the present report indicates. The species almost certainly occurs in Georgia and should be sought in Mississippi and Louisiana. It has been collected from one county nearly contiguous with southeastern Virginia (Pasquotank Co., NC).

The native range of Gamochaeta simplicicaulis is South America, where it is known from Argentina, Chile, Bolivia, Uruguay, Paraguay, Brazil, Guyana, Venezuela, and Colombia (Cabrera 1961, 1963; Pruski 1997). It also has become naturalized in New Zealand (Drury 1971; Webb 1988).

Gamochaeta simplicicaulis in NCU collections has been identified as Gamochaeta purpurea (L.) Cabrera and Gamochaeta americana (P. Mill.) Wedd. but is consistently distinguished from both, as in the following key.

1. Upper surface of leaves loosely and lightly but persistently tomentose, dull; involucral bracts lightly villous-tomentose on the lower third; biennial. ................................................................. G. purpurea

1. Upper surface of leaves completely glabrous, shiny; involucral bracts glabrous from base to apex; annual or biennial. ................................................................. 2

2. Plants (50–)50–85 cm tall, usually basally and strictly erect; basal and lower cauline leaves on elongate internodes, commonly withered and deciduous at flowering, relatively even-sized to above midstem, the upper cauline linear-lanceolate to linear-oblancoate and apically long-acute, clusters of small leaves produced in the cauline axils; capitula in small glomerules in an elongate, interrupted capitulescence, sometimes with well-developed lateral branches, the glomerules usually subtended by linear, spreading bracts longer than the glomerules; outer involucral bracts ovate, apically acute-acuminate, hyaline, without color; annual or biennial, flowering mostly July-August. ................................................................. G. simplicicaulis

2. Plants 15–35–(50) cm tall, basally decumbent-ascending; basal leaves in a rosette, persistent at flowering, the cauline leaves quickly reduced in size above the basal, the upper mostly oblancoate and apically rounded, axillary clusters of small leaves absent; capitula in a narrow, elongate, generally compact but sometimes interrupted capitulescence, the bracts few and shorter than the glomerules; outer involucral bracts elliptic-ovate, apically obtuse to rounded, often slightly purplish; biennial, flowering mostly April-June. ................................................................. G. americana


Annuals or biennials, strictly erect, (30–)50–85 cm tall, fibrous-rooted, the stems commonly simple, strictly erect, and single from the base or with
Fig. 1. Habit and involucre of *Gamochaeta simplicicaulis* (Ables 32138).
2–5 basally ascending stems, densely and closely white-tomentose. Leaves densely and closely white-felty-matted beneath, completely glabrous and shiny above at maturity, flat, the midrib not depressed, with margins closely undulate and appearing nearly crenulate, the basal and lower cauline leaves oblanceolate to oblanceolate-spatulate, 5–9 cm long, 0.6–1.8 cm wide, on somewhat elongated internodes (not in a rosette), the basal leaves usually withered and deciduous by flowering, gradually becoming smaller above mid-stem, the upper cauline leaves linear-lanceolate to linear-oblanceolate and apically long-acute; clusters of small leaves produced in the axils of mid and upper cauline leaves. Capitula in small glomerules in a narrow, elongate, interrupted capitulescence (8–)16–30 cm long, sometimes with well-developed, ascending, lateral branches, the glomerules usually subtended by linear bracts longer than the glomerules and usually spreading at right angles; involucres cylindric-campanulate, 3–3.5 mm high, the involucral bracts ovate to oblong, scarious and brownish to tan, without red or purple pigments, glabrous from base to tip, apically acuminate-apiculate. Achenes 0.5–0.6 mm long. Flowering (June–)July–August(–October).

*Gnaphaeta simplicicaulis* apparently grows in open sites, as the habitats are described from the southeastern US, but they otherwise are variable (roadsides, fields, open woodlands, dunes), except that a sandy substrate may be constant. Pruski (1997) noted that habitats for the species in the Venezuelan
Guayana are "savannas, roadsides, forest borders, tepui meadows, rock outcrops, 800–2100 m." The late summer to fall flowering of *G. simplicicaulis* also distinguishes it from all other eastern North American *Gamochaeta*, which flower primarily in the spring.


The NCU collections were variously annotated in 1997 as *Gamochaeta purpurea* and *G. americana* by Dr. J.E. Arriagada, as part of the complete NCU collection of southeastern US Inuleae (*sensu lato*) studied for the Generic Flora of the Southeastern United States (Arriagada 1997). His annotations for the entire set, however, without exception, merely repeat the most recent previous identification, except to update the generic name or replace putative synonyms. A discussion of unresolved taxonomic and nomenclatural complexities regarding *G. purpurea* and *G. americana*, as well as other previously unreported species of *Gamochaeta* for the North American flora, is forthcoming (Nesom in prep.).

**ACKNOWLEDGMENTS**

I am grateful to John Pruski (Dept. of Botany, Smithsonian Institution) for providing collection data and a photocopy of the Florida collection at US (first identified correctly by Harold Robinson), as well as various com-
ments on the manuscript, Ted Barkeley and Lowell Urbatsch for comments on the manuscript, Jim Massey and Mary Felton (NCU at UNC-CH) for help in herbarium studies, Bill Burk and Jeff Beam (UNC Couch Botanical Library) for help in obtaining literature, and, especially, to Susan Whitfield (Dept. of Biology, UNC-CH) for the fine illustration.

REFERENCES


Vicia lutea L. (yellow vetch) has not been reported for Texas by Correll and Johnston (1970), Hatch et al. (1990), Jones et al. (1997), or Diggs et al. (1999). This species is easily distinguished from the other vetches found in Texas by its axillary sessile flowers, large yellow corollas, unequal calyx lobes, and pustulate-pilose fruits. Isely (1998) provides a key to separate this Vicia from others in the United States.

Vicia lutea is a weedy annual native to the Mediterranean region. However, the species is known to occur sporadically in North Carolina and Louisiana, and is seemingly naturalized in California (Hickman 1993). Thomas and Allen (1998) mapped it in nine northern Louisiana parishes. Personal communications with other herbaria have revealed additional collections:


During field work for a county flora in east central Texas, Vicia lutea was collected in Madison County. A single, dense population of Vicia lutea was found in full anthesis along seven meters of a dry, sandy slope. The slope was along a roadside, in full sun, and adjacent to a gravel pit. Two weeks later the plants were leafless, yet held a large amount of ripening fruit. Other herbaceous species on the site included Polygala polygama, Coreopsis basalis, Lathyrus hirsutus, Helianthemum georgianum, Schizachyrium scoparium, and Paspalum plicatulum. Woody vegetation along the nearby fenceline was composed of Quercus marilandica, Q. falcata, and Pinus taeda.

The plants at the Madison County site were found at a relatively undisturbed roadside area that is not mowed. The presence of this population may be attributed to traffic associated with a nearby gravel pit, or to cattle and hay transport through this rural area. Upon inspection of previous Madison County collections not yet identified, another specimen of Vicia lutea was found. That individual [Madison Co.: 11 April 1998. A.K. Neill 1458 (TAMU)] was collected at anthesis approximately 27 miles southwest of the voucher specimen, but the reproductive success of that population has not been established.

*Vicia lutea* may remain a waif in humid, non-Mediterranean climates. One
visible effect of humidity on the Madison County population was an infection with powdery mildew fungus; the mycelial layer imparted a silvery cast to the leaf surfaces. Additional collections of this species may be expected from Texas and other warm-climate states. Images of the voucher specimen are available at Texas A&M’s Bioinformatics Working Group Image Gallery page (http://www.csdl.tamu.edu/FLORA/imaxxfab.htm).


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I am grateful to the following curators and institutions who supplied collection data: Bonnie Amos (SAT), Anne Bradburn (NO), Steve Broich (OSC), Larry Brown (SBSC), Richard Halse (OSC), Robert Haynes (UNA), Leigh Johnson (NCSC), Jim Massey (UNC), Mark Mayfield (LSU), Scott Sundburg (OSC), Jerome Ward (AUA), Tom Wendt (LL, TEX), Donna Ford-Werntz (WVA), Robert Wilbur (DUKE), and Lindsay Woodruff (BRIT). Monique Reed (TAMU) provided assistance in identifying this species, and Hugh Wilson, my advisor, gave support and encouragement during my thesis work in Madison County.

REFERENCES


IPOMOEA ASARIFOLIA (CONVOLVULACEAE), ANOTHER POTENTIAL EXOTIC PEST IN THE UNITED STATES

KATHLEEN CRADDOCK BURKS
Florida Department of Environmental Protection
3915 Commonwealth Blvd., MS 710
Tallahassee, FL 32399, U.S.A.
kathy.burks@dep.state.fl.us

DANIEL F. AUSTIN
Florida Atlantic University
777 Glades Road
Boca Raton, FL 33431, U.S.A.
daustin@fau.edu

Known in Brazil as "salsa," Ipomoea asarifolia (Desr.) Roem. & Schult. is currently distributed in both the New and Old World but is of uncertain origin; recent research suggests Asia as the most likely native region (Austin, unpubl. data). In 1994, a population of this species was discovered in Broward County, Florida, the first known occurrence in the United States. Based on herbarium specimens collected at the time and identified by the second author, the species was subsequently recorded by Wunderlin (1998). In this note, we wish to formally report details of the discovery and provide additional information on the species' characters and habits, which have raised concerns about its potential as a pest plant in this country.

Following up on a report to the first author from a wetlands botanist inspecting a delineation project, aquatic regional biologist Jackie (Jordan) Smith investigated in October 1994 a suspected population of Ipomoea aquatica Forssk., a prohibited species in Florida (Florida Administrative Code, DEP 62C-52). Though the suspect vine was found growing across the surface of a pond, as I. aquatica commonly grows, it was not that species and did not match any other Ipomoea known for Florida. A small sample was identified in November 1994 by the second author as a species new to the United States. In August 1996, the site, located along a canal maintained by the South Broward Drainage District (SBDD), was revisited, and fresh flowering specimens were collected for verification. The vine was well-established around and in a small pond at a pasture edge and clambered up adjacent shrubs (Myrica cerifera L.); it also appeared to have spread farther by runners among the mowed grasses down and along the canal bank.

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The site has been dramatically altered since 1996 by urban development activities. By June 1999, much of the SBDD Canal No. 5 had been filled in and paved over with the opening of the divided, four-laned Dykes Road. A large residential subdivision, Silver Shores, occupies much of the former pastureland just north of the earlier-visited small pond, a remnant of which still exists in the remaining low, wet area, which itself is slated for residential development and has experienced some preliminary bulldozer work. The *I. asarifolia* survived this massive disturbance; in fact, the population has spread considerably along the new roadway and away from the pond area, creeping across bare lime rock, floating across shallow pools of water, and clambering over native and exotic herbs and shrubs. The population extends about 800 m along Dykes Road and as far as 300 m westward from it, between Silver Shores and Miramar Parkway. It does not appear to have been carried east of Dykes Road or south of Miramar Parkway, areas also undergoing considerable earth-moving activity.

Voucher specimens: U.S.A. FLORIDA. Broward Co.: W side right-of-way, SBDD Canal No. 5, just NW of I-75 and Miramar Parkway interchange, within Miramar city limits, in mowed area and around small adjacent pond, on sandy soil, 17 Oct 1994, Jackie Jordan s.n. (FAU, FSU); 21 August 1996, Barks 1074 (FAU, FLAS, FSU, USF), along W side of Dykes Rd., in disturbed wet ground, thin muck or sand over limestone or bare limestone, to 300 m W of roadside, between southern boundary of Silver Shores subdivision and jet of Dykes Rd. and Miramar Parkway, just NW of I-75 and Miramar Parkway interchange, within Miramar city limits, SE 1/4 of NE 1/4 Sec 29, T51S R40E, Lat. 25° 59.158' N, Long. 80° 21.669' W, 25 Jun 1999, Barks 1159 (FAU, FLAS, FSU, USF).

A vector for this introduction is unknown, but the possibilities are numerous. The site has a long history of disturbance: cattle pasture, canal bank, roadside, housing development; the stand first noted in 1994 may have been overlooked for some time. Seed or stem fragments could have arrived on farm or canal-maintenance equipment; as a contaminant in feed, straw, or grass seed; or in the gut of imported cattle (or migratory birds—little is known about the consumption/dispersal of *I. asarifolia* by animals). Dumping of imported packing material or horticultural material (“yard trash and white goods”) was also a common practice in the area. The species is not known in cultivation in the United States, but is cultivated for ornament in Brazil, as “salsa” or “salsa-brava” (Lorenzi & Moreira de Souza 1999). Yet another possibility is introduction for use in traditional herbal remedies (Austin, unpubl. data).

Although *I. asarifolia* may not be New World in origin, it is found widely in Tropical America, from the Carribbean to Paraguay (Adams 1972; Austin 1975, 1982a-c, 1997, 1998a-b; Austin & Cavalcante 1982; Austin & Huaman 1996; Austin & Staples 1981; Leon & Alain 1974; McDonald 1994). It is also known in Africa (Heine 1963; Rendle 1905), and in Asia, from Bali,
East Java, India, and West Pakistan (Austin & Ghazanfar 1979; Matthew 1995; Ooststroom 1953).

Documented habitats for this perennial species are largely wet sites—marshes, swamps, roadside ditches, and in wet-cultivated crops such as rice (Austin 1982a). While little has been reported in the literature about *I. asarifolia* as a pest plant across its range, it is a recognized agricultural weed in Venezuela and Brazil (Austin 1982c, 1998a; Kissman & Groth 1992; Lorenzi 1991; Moacyr et al. 1995). The plant is sensitive to frost, but grows in a wide range of moist soils and is easily propagated by stem fragments or seeds (Lorenzi & Moreira de Souza 1999). It apparently produces viable seed in Florida; a few seedlings were observed at the Miramar site, along with extensive mats of vines freely rooting at the nodes. Those vines seen in 1999 on drier ground and mixed with other herbaceous vegetation [e.g., *Setaria parviflora* (Poir.) Keriggelen, *Eupatorium capillifolium* (Lam.) Small] often had leaves noticeably damaged by insects, while vines growing on more open, saturated ground showed no damage. A 1996 sample of unrooted vine was floated in a vat of well water in a quarantine greenhouse (Tallahassee, Florida); it sprouted roots at the nodes and sustained itself under those conditions for several months, until it was moved to a frequently watered pot of soil, where it still grows.

The species has been placed taxonomically in the same section of *Ipomoea* [subg. *Eriospermum* (Hall f.) Verdc. ex D.F. Austin sect. *Eripomoea* Choisy] as *I. aquatica* and *I. pes-caprae* (L.) R. Br., species similarly known for their proclivity to spread vegetatively by long, adventitiously rooting, runners. *I. asarifolia* resembles *I. pes-caprae* in habit, flower color, and general leaf form; however, the former is a species of freshwater habitats whereas the latter is confined to saline conditions near seacoasts. Also, *I. asarifolia* never has the emarginate to bilobed leaf apex characteristic of *I. pes-caprae*.

Diagnostic characters for identifying *I. asarifolia* in the field include its habit of horizontal stems and alternate, smooth, dark-green, cordate leaves, these often with purplish venation and with tips obtuse to mucronulate. The stems, whether clambering or horizontal, may have small, sparse, fleshy trichomes. The plant's showy morning-glory flowers have a campanulate to funnelform corolla of deep rose-lavender with a purple throat (Fig. 1).

Given the spreading habit of this species, its apparent preference for wetlands, its adaptability to disturbance, its recognition as a weed in some locales, and our experience with the Florida population, we view this introduction with alarm and will continue to monitor its occurrence. Steps are immediately being taken to confine any excavated fill to the current site and to plan a control effort.

We gratefully acknowledge John Tobe for noticing the suspect morning
Fig. 1. *Ipomoea asarifolia* in Florida. Top: Flower, leaf form; Bottom: Creeping habit over water, bare ground, other plants.
glory and Jackie Smith for initially investigating the report, and providing, along with Joe Certain of SBDD, assistance in the field. We also thank Loran Anderson for helpful comments on an earlier draft of this note.

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During the summer of 1998, *Paederia foetida* L. (Rubiaceae) (Fig. 1) was discovered growing at the North Carolina Zoological Park, five miles south of Asheboro, North Carolina, in Randolph County. The plant apparently is naturalized in its location from an unidentifiable source. The native vegetation around the collection location, adjacent to a zoological exhibit building, is composed of hardwood, deciduous forest species. The landscape is supplemented with additional plantings of native species to highlight the state’s piedmont and mountain geographic regions.


While often encountered in horticultural reference materials and select floras as *Paederia scandens* (Lour.) Merr. (Hillier Nurseries 1991; Krüssman 1977; Walker 1976), *P. foetida* L. is currently recognized as the correct scientific name (Kartesz 1999). Synonymous names include *P. chinensis* Hance and *P. tomentosa* Maxim. (Kartesz 1999).

*Paederia foetida* is a twining, deciduous vine capable of nodal rooting and notable for the rank odor it releases on warm, humid days and when parts of the plant are bruised. In Japan, the plant is referred to as “Flatulent Vine” (Walker 1976), while in the U.S. it has earned the name “Skunk-vine” (Weakley 1998). The genus comprises about 20 species of climbing shrubs native to temperate and tropical Asia and South America. Leaves of *P. foetida* are ovate to broadly ovate, truncate, cordate or subcordate, opposite, the veins on both surfaces with appressed pubescence, the upper surface also bearing short hirsip or papillose-hirsip hairs. Panicles are axillary; calyx lobes < 1 mm long at flowering; corolla white, tubular, cc. 1 cm long, with deep red throat. Fruit orange, globose, a 2-locular berry.

Documentation of the occurrence of *P. foetida* in North America is limited. Radford et al. (1964) noted it was “collected spreading from its site of cultivation in Darlington, Co., SC,” after the manuscript for the *Manual of*
The Vascular Flora of the Carolinas had gone to press. There is little documented change in the distribution of *P. foetida* in the Carolinas during the past 30 years. Conferring with Radford, Weakley (1998) reports *P. foetida* is limited to disturbed areas of the South Carolina coastal plain and rarely spreads from plantings. Nelson (personal communication, 1998) notes that *P. foetida* is fairly widespread and naturalized in warmer, Gulf coastal states of the U.S., notably Florida. There also are documented reports of *P. foetida* in Louisiana (Thomas & Allen 1997) and Texas (Brown 1998). The species was first recorded as naturalized from O‘ahu, Hawaii, in 1854 (Wagner et al. 1990).

Among three varieties of *P. foetida* recognized by Walker (1976, as *P. scandens*), the North Carolina plants are apparently closest to *P. scandens* var. mairei (Lév‘l) Hara, based on the leaf shape and vestiture. In var. *mairei*, Walker noted that “lower leaf surfaces are glabrous except for tufts of hairs in vein axils,” while in var. *villosa* lower leaf surfaces are villous. Leaves of the North Carolina plants are sparsely hairy but not distinctly villous.

A record of *Paederia foetida* in North Carolina is noteworthy not only to document the spread of this exotic species but also to confirm its ability to tolerate severe winter temperatures. In North Carolina the plant is probably near the limit of its northern hardiness range. This species is reportedly capable of surviving minimum winter temperatures of 0 to 10 degrees Fahrenheit (Huxley 1992), although Krüssman (1977) suggests a cold hardiness of −10 to 0 degrees Fahrenheit.

*Paederia foetida* has proved hardy in North Carolina, surviving as an herbaceous perennial through the winter of 1998/1999 and, in all likelihood, several previous winters as well. Efforts were made in October 1998 to limit the spread of this species by pulling out or cutting back stems, largely to keep the plant from establishing itself and becoming invasive. Pruned stems, however, were resprouting and leafing out by mid-April 1999.

The single plant discovered at the North Carolina Zoological Park was extensive, climbing through nearby shrubs and low branches of trees and scrambling over the ground up to four meters in length. Because of the propensity for nodal rooting, the main stem is difficult to determine. The most likely point of origin, however, appears near the trunk of a beech tree (*Fagus grandifolia*). This tree was planted during early landscaping around the building in December 1993. Deliveries of 14 balled and burlapped *F. grandifolia* were received at the Park in mid-November from two separate nurseries in the vicinity of McMinnville, Tennessee. While there are currently no reports of *P. foetida* occurring in Tennessee, one possibility is that *Paederia* was already growing in the root ball of one of these trees. The plant may also have sprouted from a seed deposited by migratory birds or, possibly, from purchased com-
mercial birdseed of unknown origin that was scattered in the vicinity. Because the plant was growing at the Park for an undetermined amount of time, any theories relating to its original source are inconclusive.

Several fruits were observed in October 1998, but reproduction appears low. Herbarium specimens collected from the NC Zoological Park indicate that only two berries were produced from more than two dozen panicles, suggesting the occurrence of a low frequency of successful self-pollination. By contrast, fruiting specimens (NCU) collected in Japan in 1985, show heavy berry production.

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LAPSANA COMMUNIS (ASTERACEAE)
NEW FOR TEXAS AND NOTES ON INVASIVE EXOTICS

ROBERT J. O’KENNON,1 THEODORE M. BARKLEY,1
GEORGE M. DIGGS, JR.,1,2 BARNEY LIPSCOMB1

1Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, TX 76102, U.S.A.

2Department of Biology
Austin College
Sherman, TX 75090, U.S.A.

okennon@brit.org, barkley@brit.org
gdiggs@austin.edu, barney@brit.org

Lapsana communis L., nipplewort or succory dock-cress, is a native of Europe (Vuilleumier 1973; Sell 1976; Stebbins 1993) naturalized in a variety of localities in the United States. It is usually described as a weed inhabiting roadsides, disturbed places, and waste areas, often in shady situations. A genus of nine species, Lapsana (Asteraceae: Lactuceae) is native to the extratropical regions of Europe, Asia, and northern Africa. The only truly weedy member of the genus, L. communis is also adventive in at least Africa, Polynesia, the West Indies, and South America (Vuilleumier 1973). In North America the species is known from Ontario, Quebec, and the northeast U.S. south to North Carolina and west to North Dakota, Missouri and Arkansas; it is also found from British Columbia south to Oregon and California (Robinson & Fernald 1908; Britton & Brown 1898, 1913; Fernald 1950; Gleason 1952; Gleason & Cronquist 1963, 1991; Steyermark 1963; Radford et al. 1968; Strausbaugh & Core 1978; Cronquist 1980; Barkley 1986; Smith 1988; Stebbins 1993). Voss (1996), for example, cited the species for Michigan, indicating it had been found sparingly in the past and largely overlooked until very recently, with it now being very abundant in some localities. Lapsana communis was not reported from Oklahoma (Taylor & Taylor 1994); however, it was reported from three western counties of Arkansas (Smith 1988). Despite this proximity, the species has not been previously reported from Texas (Correll & Johnston 1970; Stanford 1976; Hatch et al. 1990; Jones et al. 1997; Diggs et al. 1999).

A collection made in 1999 in Fort Worth (Tarrant County) is apparently the first documented occurrence of this species for Texas. The identification

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was determined by Theodore M. Barkley of BRIT (formerly, Kansas State University).

Voucher specimens: TEXAS. Tarrant Co.: shady area in landscape, 301 Crestwood, Fort Worth, 25 Jan 1999, O’Kennon 14377 (BRIT, TEX).

At the collection locality a single individual was observed as a landscape weed. The plant was 70 cm tall and 25 cm wide. This yard has incurred a large number of weedy species after a truckload of compost, from a large compost operation run by a local nursery, was dumped and spread in 1997. Seeds of various weedy species, including Lactuca saligna (O’Kennon et al. 1998a), Plantago coronopus (O’Kennon et al. 1998b), and Lapsana communis, were apparently introduced in this manner. Other populations of Lapsana have not been found in North Central Texas, and it is unclear whether the species will become more widely established. However, it would not be surprising that the species has been spread to other landscapes by the same method.

The generic name Lapsana is derived from Greek, lápsane or lápsane, a name given by Dioscorides to a vegetable, apparently a species of Raphanus (Vuilleumier 1973). According to Vuilleumier (1973), Bentham and Hooker (1873) allied Lapsana with Apogon Ell. (now included in Krigia L.), but Stebbins (1953) considered Lapsana (because of its lack of a pappus) to be a specialized offshoot of the Youngia-Ixeris line of the Crepidinae. Jeffrey (1966) indicated a similar relationship, putting Lapsana in his “Crepis-series” with Crepis, Ixeris, and Youngia. Small (1917, cited in Vuilleumier 1973) reported that when stamens of this species are touched, the filament nearest the stimulus contracts and the entire anther tube faces the visitor as the style pushes out the pollen toward it. Vuilleumier (1973) noted that the milky juice of the plant is soothing to sensitive skin, particularly on the nipples of nursing mothers (hence the common name nipplewort).

Lapsana communis (Fig. 1), the flowers of which resemble a Lactuca, Crepis, Hieracium, or Youngia, can be recognized by the following description (modified from Cronquist 1980 and Barkley 1986); the absence of a pappus is particularly noteworthy. Erect, branching to single-stemmed annual herb [acting as a biennial in our area], 1.5-10(-15) dm tall, hirsute to glabrescent, with milky juice; leaves alternate, petiolate, thin, ovate to subround, obtuse to rounded, variously dentate, or the lowermost lanceolate [somewhat resembling basal leaves of members of the mustard family], 2.5-10 cm long, to 7 cm wide, progressively shorter-petiolate upward, the uppermost blades distinctly narrowed; heads few–numerous in a corymb-like to somewhat elongate paniculiform capitulum; involucre 5–8 mm tall, cylindric to campanulate-spreading; principal phyllaries ca 8, subequal, uniseriate, subtended by minute calyx-campanulate bracts; receptacle naked; florets 8–15 per head, all ligulate and fertile, corollas yellow; achenes 3–5 mm long, ± terete to weakly flattened,
curved, glabrous, with numerous nerves (ca. 18–30); pappus none; (n = 6, 7, 8). Jun–Sep. The accompanying illustration is reprinted from Gleason (1952) and Strausbaugh and Core (1978) with the permission of the publishers.

NOTES ON INVASIVE EXOTICS

*Lapsana communis* is one of a continuing string of introduced species (defined here as those originating outside the United States) introduced into the flora of Texas. These taxa are variously referred to as alien, exotic, or foreign. In a recent floristic study on North Central Texas (Diggs et al. 1999), it was determined that 17.7% (or 394 species) of the flora consisted of such introduced species. This is roughly what would be expected based on data from other parts of the United States. For example, the level of exotic species in the northeastern states has been estimated at 22% (Elias 1977) and 20–30% (Stuckey & Barkley 1993). Comparable figures for introduced species for other states include California (17.5%) (Rejmánek & Randall 1994), Colorado (16%), Iowa (22.3%), Kansas (17.4%), and North Dakota (15%) (Stuckey & Barkley 1993). Considering how recently North Central Texas was settled and converted from almost totally native habitat, the 17.7% figure is quite striking.

Some of these exotics are extremely invasive taxa capable of becoming serious agricultural pests or of destroying native habitats. Particularly problematic are those that aggressively invade native ecosystems, reproduce extensively, and occupy the small remaining areas of natural habitat used by indigenous species. A few of the many problematic species currently spreading in North Central Texas include *Carduus nutans* L. subsp. *macrocephalus* (Desf.) Nyman (musk-thistle or nodding-thistle), *Hydrilla verticillata* (L.f.) Royle (water-thyme), *Pueraria montana* (Lour.) Merr. var. *lobata* (Willd.) Maesen & Almeida (kudzu), and *Scabiosa atropurpurea* L. (pincushions, sweet scabious). *Scabiosa*, for example, is now known from at least seven counties (Collin, Dallas, Fannin, Grayson, Hopkins, Hunt, and Lamar) and will almost surely be found in many more. In Collin County, it lines some roadsides (e.g., Hwy. 75) and virtually forms monocultures. Given the ease with which it moves into adjacent fields, there is real concern that sweet scabious may be able to invade native prairie remnants. Likewise, native habitats (e.g., forests, prairies) are being invaded by a host of other exotics, including *Lonicera japonica* Thunb. (Japanese honeysuckle), *Ligustrum* species (privets), *Sorghum halapense* (L.) Pers. (Johnson grass), and *Festuca arundinacea* Schreb., (tall fescue).

In many areas, a high percentage of the plants encountered will be of introduced species. Given the speed with which exotics have invaded, and the percentage of habitat they now occupy, after habitat destruction, inva-
sion by exotics may be the most serious threat facing native plants in North Central Texas (Diggs et al. 1999). Problematically, this is not a short-term concern. According to Cronk and Fuller (1995), the introduction of exotics is "...a lasting threat because when exploitation or pollution stops, ecosystems often begin to recover. However, when the introduction of alien organisms stops the existing aliens do not disappear; in contrast they sometimes continue to spread and consolidate, and so may be called a more pervasive threat." Unfortunately, there is a continuing lack of recognition of the problem. For example, the Federal noxious weed *Salvinia molesta* Mitchell has recently been found in abundance at Toledo Bend Reservoir, on the Texas-Louisiana border (Jacono 1999). This native of Brazil (Forno 1983) can grow rapidly and cover the surface of lakes and streams, and the floating mats shade and crowd out native plants. Additionally, the thick mats reduce oxygen content, degrade water quality, and can cause physical problems including hindering boats and clogging water intakes (Jacono 1998). In Texas, it is considered a "harmful or potentially harmful exotic plant" and it is illegal to release, import, sell, purchase, propagate, or possess this species in the state (Harvey 1998). Nonetheless, likely sources for the introduction are local nurseries...
found distributing the species as an ornamental water garden plant (Randy Helton, pers. comm., in Jaco 1999).

Another example, *Lythrum salicaria* L. (purple loosestrife), can also be found for sale in Texas nurseries and is even planted on local college campuses. In some parts of the northeastern United States, *L. salicaria* aggressively invades native marshlands eliminating native species. Dense stands covering thousands of acres are sometimes formed with even tenacious natives such as *Typha* (cat-tail) species being excluded. Purple loosestrife is often cited as one of the most detrimental cases of habitat alteration by an exotic species in the U.S. It was introduced in New England in the early 1800s and by 1995 was known in every state but Florida. Because of its potential as a pest, it has been declared a noxious weed in several states with laws banning its distribution and cultivation; this species should not be planted (Stuckey 1980; Graham 1986; Yatskievych & Spellenberg 1993; Flack & Furlow 1996; http://plants.usda.gov/).

A final example for Texas is *Lapsana sebifera* (L.) Roxb., (Chinese tallow tree, vegetable tallow tree). This rapidly growing tree was introduced into the U.S. in South Carolina in the late 1770s and is now widespread; it displaces native vegetation and is considered one of the most serious invasive exotics in the U.S. It apparently releases compounds that modify soil chemistry and affect the establishment of native species (Flack & Furlow 1996). In Texas, it is extremely problematic in invading areas of native coastal prairie and East Texas forest (e.g., Big Thicket National Preserve). While the seriousness of the threat of exotics is still significantly underrealized, at least some increase in awareness is occurring. Examples of recent articles in the popular press on exotics include one in the *Nature Conservancy Magazine* (Flack & Furlow 1996) and a just published report in Scientific American discussing the serious invasion of *Lygodium microphyllum* (Cavanilles) R. Brown (Old World climbing fern) in Florida and the threat it poses to the Everglades (Mirsky 1999).

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Stanford, J.W. 1976. Keys to the vascular plants of the Texas Edwards Plateau and adjacent areas. Published by the author, Brownwood, TX.
BOOK REVIEWS


This is an identification guide to the marvelous vascular flora of Florida, a state whose plant diversity is surpassed in the U.S. only by California and Texas. Of Florida's 227 families, 1306 genera, and 3834 species, four genera and 155 species are endemic to the state. About 44% of the species are exotics. Genera and species appear alphabetically under each family, but the families are in phylogenetic order. No descriptions or illustrations are given except for a county map of Florida on cover 2 and a drawing of Tillandsia pruinosa ("fuzzywuzzy airplant") on the title page. The indexes are three: common names, scientific names, and family names; a family index is on cover 3 and the facing page, a helpful arrangement. The 17 literature citations are largely to major floristic works; no generic revisions are listed. A glossary defines about 600 terms. Data for each species are scientific name, common name, habitat, frequency, brief notes on in-state range, flowering time, and sometimes a limited synonymy. (An "Atlas of Florida Vascular Plants" is available on the Internet at http://www.usf.edu/~isb/projects/hb-atlas.html.) The keys to groups and families occupy 27 pages. I tested them with 17 species; 13 worked well enough, but four were problematical: Erigenia bulbosa and Galium aparine (sepalas obsolete, but Apiaceae and Rubiaceae key out under "calyx and corolla present"); aculescent violets (Violaceae key out under "leaves alternate"); and Najas, with its single-veined leaves (stopped at "leaves with parallel veins"). (This is not the only flora with this problem.) The book is well made and sturdy. Up to now, visitors to Florida have had to take along three guides to the flora (Long & Lakela 1971; Wunderlin 1982; Clewell 1985), but now one will suffice. At $35.00 the book is a bargain. Kudos to Dr. Wunderlin and the University Press of Florida.—John W. Thieret.
BOUTELOUA RIGIDISETA (POACEAE) NEW TO LOUISIANA

CHARLES M. ALLEN, CHRIS S. REID, and CHRIS H. DOFFITT

Department of Biology
The University of Louisiana at Monroe
Monroe, LA 71209, U.S.A.
biallen@alpa.nlu.edu

A recent grass collection from Fort Polk, in west central Louisiana, is apparently the first record for Bouteloua rigidiseta (Steud.) Hitchc. for the state. It is not in Allen (1993) nor Thomas and Allen (1993). In Gould (1975), the distribution is Texas, Oklahoma, and Mexico, while Smith (1994) includes this species in the Arkansas flora. The other two species of Bouteloua in Louisiana are rare, with B. hirsuta Lag. recorded only from Calcasieu Parish, and B. curtipendula (Michx.) Torr. from Caldwell, East Baton Rouge, Natchitoches, and Rapides parishes. The Caldwell and East Baton Rouge collections are recent, but the other three are more than 50 years old.

Voucher specimens: LOUISIANA. Vernon Parish: roadside at corner of Entrance Road and Avenue A, ca 1 mi E of La 184 on North Fort section of Fort Polk, ca 5 mi ESE of Leesville, Section 34 T2N R8W, 27 May 1999, Reid, Allen, and Doffitt 423 (NLU); same locality, 25 Sep 1999, Allen 18400 (NLU).

REFERENCES


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BOOK REVIEWS


Conservation Biology with RAMAS Ecolab is an excellent resource for beginning students of applied ecology or conservation biology. It has been designed to complement most major Conservation Biology texts, as highlighted in a chart that cross-references book chapters with relevant lab activities. The manual and accompanying software are well written and provide a collection of exercises that introduces students to the theories and analytical techniques that are the foundation for these fields. Students begin with the basics of sampling techniques, the use of biological indices, and describing population dynamics. In later chapters they explore techniques for facilitating biological management through sensitivity analyses, determining Maximum Sustainable Yields, reserve design and more.

The RAMAS software that accompanies the manual is very easy to use and is a valuable teaching tool that greatly enhances the learning potential from labs. In each exercise students use computer simulations and models to explore the various topics. Questions and straightforward activities guide the user through the computer program and help them understand the significance of each of the model parameters. The manual not only provides the beginner with training in techniques and model use, but it encourages thoughtful evaluation and analysis of more difficult issues. The background information accompanying each activity exposes students to current dilemmas facing conservation biologists ranging from the shortcomings of population estimations to the controversy over conservation versus preservation, to the problems associated with reserve size and number. The data and dilemmas used for the activities are representative of the diversity of issues and organisms that conservation biologists work with, and will easily spark the interest of students new to the field.


This book is one in a series of horticultural taxonomic works published by A.A. Balkema, of the Netherlands. The genus Mautuana belongs to the Cactaceae tribe Trichocereae subtribe Borzicactinae, and contains 19 species comprised of 27 taxa, including infraspecific varieties and forms, all endemic to the Western Andean Cordillera in Peru. Differences between the taxonomic philosophies of this work and that of Backeberg from the 1930s to the 1960s, specifically as interpreted by Ritter (1981) are clearly evident throughout the text. This work, specifically oriented toward horticultural as well as taxonomic users, is markedly different from a standard taxonomic revision, owing to the recognition of four informal “species groups” recognized on the basis of seed morphology, the review of pollination and dispersal biology, cultivation information.

The book is divided into 13 chapters, including: 1) taxonomy and systematics, 2) morphology, 3) geography and ecology, 4) reproduction, 5) cultivation, 6) systematics inside Mautuana-grouping of species, 7) key to all species of Mautuana, 8) the haynei group, 9) the aurantiaca group, 10) the interretexa group, 11) the paucicostata group, 12) checklist, and finally 13) complete list of field numbers.

The general chapters one through five are carefully done, with a lot of evidence obviously collected from living material in cultivation. In the systematics section, it becomes obvious that the author follows the taxonomic species concept, but unfortunately, no clear discussions are included to justify why a certain species a particular group of synonyms. Statements like (page 50) “To summarize, the differences between all taxa listed here as synonyms of M. haynei are too small to treat them as species,” are found in discussions after many of the species. While the author gives extensive synonymy lists, type specimens are not listed directly under the basionym, nor for any of the synonyms. The reader is left without knowing if types exist for all the names, if any or all have been lectotypified, etc. Listing of the numerous nomina nuda is ill-advised, and I would have left that portion out unless they were actually published. There is no formal generic description, nor citation of a type, although references to M. haynei as the oldest name in the group and the discussion of its former monotypic circumscription give us the idea.

While the author has obviously devoted years to the study of this group, I think the systematic value of the monograph is compromised by its very non-standard format. One is not sure if all historical specimens have been re-studied, nor synonyms typified, and the phylogeny portion of each species’ discussion gives no clear picture of the salient features that determines the author’s placement of the taxon. It is abundantly clear that seed morphology is employed to delimit the four infrageneric groups, but the illustrations on page 36 lead this reader to think that the groups are difficult to recognize, especially because the seeds must be mature, and all portions of the seed must be intact for one to recognize the characters.

In summary, while this monograph is not a standard systematic treatment, it is an important contribution to a poorly understood, but important group of cacti. It will be a
must for all concerned with the Cactaceae, with the Flora of Peru and the dynamics of the vegetation in the Peruvian Western Cordillera. The SEM photos, color photographs, and line drawings are helpful, as are the indices. It should certainly form part of any botanical or horticultural library. —John J. Pipoly III.


Having recently watched again the movie, Mary Poppins, I am reminded of a phrase (no, not "supercalifragilisticexpialidoceous") that can be applied to this new text for undergraduate courses in plant systematics—"practically perfect in every way." This is the first such text that is a product of teamwork and is the best to come along since George Lawrence's Taxonomy of Vascular Plants of 1951. The authors, all recognized leaders in plant systematics, are former students and associates of Drs. Carroll Wood and Richard Howard. In fact, the book was conceived while most of them were fellow graduate students at Harvard. They wisely and fortuitously waited until they had professionally matured and macromolecular techniques became widely applied before making the idea a reality. The result is a textbook that is easily digested by students who have already mastered basic botany, portrays the vitality and uncertainties of the current state of knowledge in the field, and introduces both the principles of systematics and plants families of worldwide importance. Because the authors are strong advocates of the use of cladistic methods in both research and teaching, phylogenetic concepts are integrated from the introduction to the last family treatment. The goal is not the indoctrination of the conviction that cladistic approaches are better than others. Rather, they hope to make students conversant with the current research paradigm and to understand the rationale used to justify the taxa presented.

I find the sequence of topics follows a logical progression. After a brief introduction of plant systematics in Chapter One, the second chapter provides a thorough primer of cladistic methods and a comparison of cladistic, phenetic, and evolutionary schools. Here, the distinction between grouping, naming, and ranking taxa is lucidly explained. The historical background in Chapter Three is arranged topically and then chronologically, i.e., the development of understanding relationships vs. development of the formation of higher taxa. The next two chapters survey the data synthesized by systematists. Categories of morphological, anatomical, and chemical structures are introduced and important terms are defined. However, jargon is minimal (e.g., leaf shapes are reduced to four with auxiliary modifiers such as "narrowly"), many terms are introduced only in defining diagrams, and others are introduced and defined only in the family treatments (e.g., unique cucurbitoid teeth, which are diagnostic for Cucurbitales). Pollination, dispersal, breeding systems, and chromosomes are discussed with specific examples from the literature to illustrate how these data are used. Professors, especially those not trained in molecular systematics, will appreciate the thorough overview of genome structure, laboratory methods, data types, data analysis, and problems such as species trees versus gene trees. Chapter Six focuses on theoretic as-
pects of species—the evolution of biodiversity, speciation, and species concepts. Case studies present the problems of applying species concepts to real plant groups. Constituting over half the book, the family treatments are given in the Chapters Seven (nonflowering tracheophytes) and Eight (angiosperms). The text ends with two appendices covering botanical nomenclature and the preparation and identification of specimens.

The book is designed to be "student friendly." The early introduction and integration of cladistics will prepare talented students to launch into the recent literature and attend professional conferences. The simplification of terminology will allow them to concentrate on concepts instead of memorization. The family treatments include not only concise, parallel descriptions (general diagnostic features highlighted in Italics with synapomorphies in bold) but also discussions of geographically and economically important genera and unsolved research problems. Learning family characteristics is aided by the use of floral formulas and full-page diagnostic drawings of representative species taken from the Generic Flora of the Southeastern United States. Only families, orders, and higher taxa are fully recognized that are strongly supported by structural and molecular analyses as monophyletic. Paraphyletic groups or those lacking sufficient study and evidence of monophyly are referred to in quotes, e.g., "Paleoherbs" and "Flacourtiaceae." Students need only learn the characters that unite formerly confusing, closely related family pairs, e.g., Apocynaceae vs. Asclepiadaceae and Brassocaceae vs. Capparaceae. The major families chosen for full treatment include both tropical and temperate ones, preparing the student for fieldwork in the tropics. The extensive color photographs on the CD-ROM provide the serious student opportunities to reinforce an understanding of the family characteristics.

"Practically perfect" of course implies some imperfection. There are some points the authors may want to consider including in subsequent editions. I was surprised to find no mention of punctuated equilibrium and related theoretical problems of higher taxa. Also, the text would have wider appeal in the Desert Southwest (and arid South America) if conspicuous families such as Fouquieriaceae, Frankeniaceae, and Tamaricaceae were mentioned and briefly characterized in the discussions of treated families to which they are related. Among the photos on CD-ROM, I would like to see even greater taxonomic representation and close-up dissections to enhance this already excellent resource.

Families are arranged by the ordinal classification proposed by the Angiosperm Phylogeny Group (APG). Thus, some taxa are supported, though strongly, only by molecular data but cannot be easily characterized. For example, Malpighiales sensu APG includes Malpighiaceae, Clusiaceae, Rhizophoraceae, Euphorbiaceae, Chrysobalanaceae, Violaceae, Passifloraceae, and Salicaceae, but not Polygalaceae; only dry stigmas, a fibrous exotegmen, and trilacunar nodes possibly unite the order morphologically. Some instructors may find this disconcerting. However, one should keep in mind that the suprafamilial taxa presented in the book are only those strongly supported such that this classification is likely to change minimally in the future. Although higher taxa in traditional classifications (e.g., those of Cronquist and Thorne, both provided as appendixes on the CD-ROM) can be characterized morphologically, current evidence shows many of the taxa in those classifications to be incorrect. Why reach outdated systems to students, who can surely accommodate uncertainties in the system?

The overall quality of Plant Systematics is outstanding. Instructors should eagerly adopt this text (and keep it on their reference shelf). I think that it will lead students to appreciate plant systematics as a field and prepare them for a career in biology better than any other available for a one-semester, undergraduate course.—Roger W. Sanders, Botanical Research Institute of Texas, 509 Pecan St., Fort Worth, TX 76102-4060, U.S.A.
GEORGE YATSKIEVICH. 1999. Steyermark's Flora of Missouri-Volume 1. Revised Ed. (ISBN: 1-887247-19-X, hbk). Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65201-0180; in cooperation with The Missouri Botanical Garden Press, P.O. Box 299, St. Louis, MO 63166. $38.00, xii + 991 pp., 194 plates of black and white line drawings; 20 figures, including 27 individual black and white photographs; 798 distribution maps.

The long awaited and much anticipated revision of volume one of Julian Steyermark's 1963 classic *Flora of Missouri (Flora)* was finally published during the first quarter of 1999. Given the outstanding quality of the Yatskievich's treatment of the monocots in volume one, it was well worth the wait! The book is so well written, organized, researched, illustrated, thorough, and scholarly done, that one must struggle to find fault. In the dedication to Julian Steyermark, the author humbly asks if Steyermark had still been present with us, would he have approved the book's contents? Not only do I believe that Steyermark would have answered with a very enthusiastic and resounding, 'Yes!', but I am confident that he would agree that this will surely be recorded as one of the greatest treatments of monocots ever written!

Volume one of the *Flora* consists of two parts: 1) and introduction, and 2) the *Flora* itself. The first part is so well written and enjoyable to read, that it delivers like a 91-page natural history novel. Printed separately, this part would probably be a number one best seller! The introduction includes: 1) a history of floristic botany in Missouri; 2) an analysis of changes in the state's native and introduced plant taxa since Steyermark's original treatment; 3) a description of the different natural divisions and plant communities within the state; and 4) a discussion on how the evolutionary history, geography, climate, geology, landscape features, and anthropogenic affects of man in Missouri have influenced the distribution and ecology of the state's flora.

The second part, a 900 page *Flora*, is nothing short of a masterpiece that will undoubtedly set a high standard of excellence for similar treatments in the future! Although space would not allow a listing of all the highlights of this section, a few are worth mentioning. The first and most obvious is the thoroughness, accuracy, and comprehensiveness of the treatments of the families, genera, and species discussed. It should be obvious to any reader that several sources of information were used in compilation of the written text. These included: 1) an exhaustive review of the published and unpublished literature (an incredible 694 references cited!) involving the taxonomy, systematics, ecology, distribution, and description of the taxa discussed; 2) an examination of thousands of museum specimens; 3) communication with numerous professional and amateur botanists who actively collect in the state; 4) correspondence and cooperation with leading experts and authorities of the groups covered; and 5) hundreds of hours of field investigations that were necessary to clarify the distribution of numerous species.

I found the keys easy to use and follow, especially those of the larger or more difficult groups (e.g., Carex, Cyperus, Elenchus, Eragrostis, Panicum, Poaceae, and Pteridophytes). One plus for the keys is that the author painstakingly covered numerous exceptions found in many groups by lengthening the keys to cover such variations often typical for different monocot taxa.

Another obvious highlight is the exquisite detail displayed in the numerous illustrations, all of which were newly produced for this portion of *The Flora*. The line drawings of
each species depicted are some of the most accurate and detailed illustrations I have ever observed. Although the overall quality of the illustrations of the nine different artists used are excellent, I would do this review a great injustice if I did not separately mention the outstanding quality of the drawings provided by Paul Nelson (Acoraceae, Araceae, Carex) and Phyllis Bick (Agavaceae, Alismataceae, Cupressaceae, Cyperaceae (in part), ferns & fern allies, Marantaceae, Najadaceae, Orchidaceae, and Poaceae (in part)). Nelson’s illustrations are so accurate and complete that any reader will easily fall victim to modification of a recent commercial, ‘bet you can’t view just one’. His line drawings are so stunning in their detail and accuracy that he is one artist who would actually become very successful if he should ever decide ‘to quit his day job’. Likewise, Bick’s drawings provide exceptionally accurate depictions of groups many artists have a challenging time correctly illustrating such as difficult species within the Cyperaceae and Poaceae. It is always refreshing to find a recent flora that has been newly illustrated, especially when the drawings are as well done as with this work.

Another high point of the book is that a separate description, county distribution map, and habitat affinities are provided for well over 99% of the taxa discussed. The only exceptions are for those few species that were recovered just as the book was being finalized before going to the printer.

No review of this book’s highlights would be complete without a comment on how inexpensive it is, especially for a well bound hard copy with 991 pages. At $38, the book is a steal and easily affordable, even for those on a tight budget.

Although negative points about the book are hard to find, a few should be discussed. The most obvious short coming is that it is difficult to find individual species of Carex without knowing ahead of time what Section they are in, or similarly locating genera of grasses without prior knowledge of their tribal affiliation. While this will not be a hindrance to experts working with Carex and the Poaceae, it will be problematic for anyone who lacks the necessary expertise for such groups. Although there is an excellent index following the literature cited section, it is very cumbersome to move back and forth through such a heavy book. A simple solution would have been to provide an index to Carex species and grass genera at the beginning of each respective treatment.

The author’s designations for abundance for some species are hard to comprehend. It is difficult to understand how species that are known from only one or two records in the state (e.g., Carex atterodes, Carex laxiflora, Carex reniformis, Carex serrulata, Carex straminea, and Carex wildeowynai) can be given the same ‘uncommon’ designation as species known from multiple counties (e.g., Carex bachmannii, Carex modestiformis, Carex viscaria) and in some cases, represented by tens of thousands of plants in specific populations (e.g., Carex arkansana).

Although overall the illustrations for the Poaceae are extremely accurate, the depiction of only portions of some species prevents a full appreciation of the general habit for certain taxa (e.g., Poa trivialis, Oryzopsis racemosa, Elymus riparius, Miscanthus spp., and Erianthus spp.).

One noteworthy error is that the last sentence in the discussion of Bantelona hirsuta on page 678 applies to B. gracilis as the latter is the rarer of the two in the state that is currently only known from one extant site in Archison County. Another is associated with the key to the Section Griseae and discovered by the author himself — the second parts of couplet three, “lowermost pistillate scales with the bodies much shorter than the associated perigynia (vs. as long as or longer than the associated perigynia)” should be moved to become the respective second parts of couplet five because Carex oligocarpa and C. planispicata have the bodies of the lowermost pistillate scales shorter than the associated perigynia. As currently written in the key, C. oligocarpa and C. planispicata would incorrectly key out

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to *C. flaccosperma* or *C. glaucodact.* Additionally, it would have been helpful if the artist would have illustrated a lowermost pistillate scale for *C. grisea* and *C. amphibola* (rather than one situated farther up the pistillate spike) so that the illustrations on pages 245 of these two species would correspond with the key on page 247 and the text on pages 247 and 252.

The following items are examples of minor errata: 1) the total introduced taxa on page 83 should read 820 rather than 20, 2) the achene of *Carex oklahomensis* illustrated on page 355 should show two stigmas rather than three, 3) the illustrations for *Bothriochloa laguroides* and *B. bladhii* on page 593 are reversed, 4) the word 'fertile' in the last couplet of the key to *Ophiolepis* on page 140 should be replaced with 'sterile', 5) five or six leaves are listed in the genus description of *Isotria* but only four leaves are depicted in the illustration of *Isotria medeoloides*, 6) Section *Intermediae* should be listed in the legend of Plate 41 for *Carex cartwelli*, and not *Hymenochlaenae*, and 7) Section *Laxiflorae* should be listed in the legend of Plate 41 for *Carex blanda*, and not *Hymenochlaenae*.

The negative points listed above are so minor and insignificant compared to the overall excellence of this book, that they are nearly not worth mentioning. Given the quality and price of this masterpiece, Steyermark's *The Flora of Missouri - Volume I* should be on the shelf of every botanist, naturalist, and plant enthusiast in the Midwest! Additionally, it will be a welcomed reference that will undoubtedly be in high demand throughout botanical circles in North America and abroad. Along with Diggs et al. 1999 excellent *Illustrated Flora of North Central Texas* (see Marshall Johnston's complimentary review in the September 1999 issue of Sida), Steyermark's *The Flora of Missouri - Volume I* is definitely a "must buy" botanical reference!—Paul M. McKenzie


Here are two more tree books for your library. The Idaho volume (8" x 10") treats 88 species plus 19 shrub species not known to reach tree size in Idaho. It has 33 pages of introductory text, including 10 pages of description of the vegetation of the state and a "chronology of Idaho vegetation history" (Triassic to present), useful additions. The "Picture keys to tree leaves" leads to the usual groups of species (e.g., broadleaf trees with alternate, simple leaves), each with a list of common names. (There are no generic keys.) Thus, if the plant in hand has simple, alternate leaves, you are lead to 19 common names. Then you turn to the main part of the book and begin checking these 19 until you find a match for your specimen. Each species is illustrated with black-and-white photocopies of leafy twigs or with drawings from elsewhere. Additionally, 80 color photos—some as small as a square inch—are grouped onto eight full-page plates. Range is shown on maps of northwestern U.S. The book has a glossary and indexes to common names and to scientific names.

Overlapping the Idaho book in the southern third of that state, the Utah volume (4.5" x 8") describes all native and most introduced species, 219 in all. The descriptions of morphology are well made; notes on habitat, uses, and cultivation are given. The black-and-white illustrations are from various sources. Eight plates of color photos show 12 species, half of them introduced. The introductory material considers nativity, common vs. scientific names, tree parts, and tree morphology. A 26-page "selection guide" summarizes data that should be useful for people—both in Utah and in surrounding states—looking for a tree species to plant in their front yard. The key to trees works well. The book closes with a glossary and an index to scientific and common names.
SIDA, CONTRIBUTIONS TO BOTANY AND REVIEWERS FOR VOLUME 18, 1998–1999

The following individuals kindly supported SIDA through their time and expertise in reviewing manuscripts published in volume 18, the largest published to date. Your support is deeply appreciated.

Subscriptions.—SIDA is distributed in over 90 countries. There are 869 subscriptions, 380 domestic and 489 foreign. Brazil has the most subscribers outside of the U.S.A. Subscriptions for 2000: $27 for individuals, $50 for domestic institutions, and $60 for foreign institutions.

We thank all authors, reviewers, subscribers, and readers for your continued interest and support.—Barney Lipscomb (BRIT), Editor, John W. Thieret (NKU), Associate Editor; Félix Llamas (LEB), Contributing Spanish Editor.
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