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A Synopsis of the Central Asian *Rhammatophyllum* (Brassicaceae)

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ABSTRACT. The genera *Koeiea* and *Prionotrichon* are reduced to the synonymy of *Rhammatophyllum*. The new combinations *R. afghanicum*, *R. erysimoides*, *R. flexuosum*, *R. gaudanense*, *R. ghoranum*, *R. kamelinii*, and *R. pseudoparrya* are proposed. A key to all nine species of the central Asian *Rhammatophyllum* is presented.

Key Words: Asia, Brassicaceae, *Koeiea*, *Mitophyllum*, *Prionotrichon*, *Rhammatophyllum*.

During work on the Brassicaceae for the forthcoming volume of Kubitzki's *Families and Genera of Vascular Plants*, it became evident that the limits of several genera need adjustment and that some nomenclatural changes are necessary. A case in point is the delimitation of the genera *Rhammatophyllum* O. E. Schulz, *Prionotrichon* Botschantsev & Vvedensky, and *Koeiea* K. H. Rechinger.

Schulz (1933a) proposed the genus *Mitophyllum* to accommodate a species previously placed in *Arabis* L., *A. pachyrhizum* Karelin & Kirilov, which is endemic to Kazakhstan. He (Schulz, 1933b) renamed the genus *Rhammatophyllum* because he discovered that his *Mitophyllum* is a later homonym to that of Greene (1904). *Mitophyllum* Greene is now recognized as a synonym of *Streptanthus* Nuttall (Al-Shehbaz, 1985; Rollins, 1993). *Rhammatophyllum* remained monotypic until Botschantsev (1952) and Vassiljeva (1969) each added another species.

Botschantsev and Vvedensky (1948) proposed the genus *Prionotrichon* and separated it from the closely related *Rhammatophyllum* by flower color, lack of the septum venation, and the type of indumentum. The flower color is said to be yellow in *Prionotrichon* and white in *Rhammatophyllum*, but the type species of the latter genus has creamy white to yellow flowers. The trichomes in both *R. pachyrhizum* and *R. frutex* are medifixed, sessile, and their two rays are rather soft and often crisped. Typically malpighiaceous trichomes, which are found in *Erysimum* L., *Lobularia* Desvaux, *Farsetia* Turra, and many other genera of Brassicaceae, are also medifixed and 2-rayed, but their rays are always rigid and straight. In the two original species that Botschantsev and Vvedensky (1948) assigned to *Prionotrichon*, *P. pseudoparrya* and *P. erysimoides*, the trichomes strongly resemble those of *Rhammatophyllum* in having soft, crisped rays, but their two rays have a few minute lateral branches. Finally, Botschantsev and Vvedensky (1948) indicated that the septum in *Rhammatophyllum* is 3-veined, while that of *Prionotrichon* is not veined. However, the septum in species of *Prionotrichon* has a broad central band sometimes marked by the presence of either a distinct midvein or three faint veins. Veined septa are rare in the Brassicaceae, and their occurrence in both *Rhammatophyllum* and *Prionotrichon* further supports the union of the two genera. Therefore, we believe that the differences in flower color, indumentum, and septum, which were claimed by Botschantsev and Vvedensky (1948) to support the recognition of two independent genera, are artificial and only one genus is represented.

Botschantsev (1966, 1987) expanded the limits

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of *Prionotrichon* to include most of the species that Rechinger (1954, 1964, 1968) placed in *Koeiea*. It is interesting to note that Rechinger (1954) assigned *Koeiea* to the tribe Alysseae but later he (Rechinger, 1968) assigned it to the tribe Matthioleae. By contrast, Botschantsev (1966, 1987) placed the combined genus in the Arabideae, whereas Schulz (1936) placed *Rhammatophyllum* next to *Erysimum* in the tribe Hesperideae. The placement by these three authors of what we consider one genus in four tribes clearly shows the difficulties in the evaluation of generic and tribal relationships in the Brassicaceae based on few morphological characters. Without molecular studies on this complex, it is uncertain what the nearest relatives of *Rhammatophyllum* (including *Koeiea* and *Prionotrichon*) are. On the basis of habit, leaf and fruit morphology, and indumentum, it appears that *Rhammatophyllum* is perhaps more related to *Erysimum* than to any other genus.

Rechinger's (1968) account of *Koeiea* for *Flora Iranica* included a heterogeneous assemblage of species now assigned to different genera. For example, *K. altimurana* K. H. Rechinger was shown by Botschantsev (1987) to be a synonym of *Arabis fruticulosa* C. A. Meyer, a species also treated in that same flora (Hedge, 1968) in a different tribe, Arabideae. It is highly unlikely, however, that *A. fruticulosa* would eventually be retained in *Arabis* because the genus, as presently delimited, is clearly polyphyletic and needs to be divided into several segregates (Koch et al., 1999).

Polatschek and Rechinger (1968) retained *Erysimum gaudanense* Litvinov in *Erysimum* despite their observation that the trichomes are not typical of that genus because they have soft, crisped rays with minute lateral branches. On the basis of trichome morphology and other aspects of the plant, Botschantsev (1987) was correct in placing the species in *Prionotrichon* and in considering it to be closely related to the species we recognize herein as *Rhammatophyllum erysimoides*, *R. ghoranum*, *R. kamelinii*, and *R. pseudoparrya*.

Rechinger (1968) transferred *Parrya karatavica* Lipschitz to *Koeiea*, but because of its typically stellate, sessile, rigidly rayed trichomes and dentate, canescent, closely overlapping leaves, the species does not resemble any member of *Parrya* or *Rhammatophyllum* (including *Koeiea* and *Prionotrichon*). Nabiev (1972) placed the species in his monotypic genus *Botschantzevia* and indicated that it differs from *Arabis*, *Prionotrichon*, and *Rhammatophyllum* in having different trichomes. However, the placement of this species in a monotypic genus is inappropriate, and we believe that it shows more affinities to *Erysimum* than to any of the genera above.

As delimited herein, *Rhammatophyllum* includes nine species distributed from eastern Turkmenistan eastward through Afghanistan, northern Tajikistan, southern Kyrgyzstan, eastern Kazakhstan, and the Altay region of westernmost Mongolia. The genus has not yet been collected from western Xinjiang (China), but it is likely to be found at least in the western parts of Dzungaria. *Rhammatophyllum* consists of shrubs or subshrubs with linear to filiform, entire leaves that are attenuate into a persistent base, often slightly swollen nodes, minutely stalked, softly submalpighiaceous, or rarely subdendritic trichomes, yellow, creamy white, or rarely purple petals, latiseptate, torulose fruits, distinctly veined fruit valves, and flattened, winged, margined, or rarely wingless seeds. We consider the presence of incumbent cotyledons in the species originally placed in *Rhammatophyllum* and accumbent ones in those assigned to *Prionotrichon* to be a minor character insufficient to support the maintenance of two genera.

Rhammatophyllum O. E. Schulz, Repert. Sp. Nov. Regni Veg. 33: 190. 1933. Based on *Mitophyllum* O. E. Schulz, Notizbl. Bot. Gart. Berlin-Dahlem 11: 872. 1933, non Greene, Leafl. Bot. Observ. Crit. 1: 88. 1904. TYPE: *Rhammatophyllum pachyrhizum* (Karelin & Kirilov) O. E. Schulz.

Prionotrichon Botschantsev & Vvedensky, Bot. Mater. Gerb. Inst. Bot. Zool. Akad. Nauk Uzbekst. S.S.R. 12: 8. 1948. Syn. nov. TYPE: *Prionotrichon pseudoparrya* Botschantsev & Vvedensky.

Koeiea K. H. Rechinger, Anz. Österr. Akad. Wiss., Math.-Naturwiss. Kl. 91: 60. 1954. Syn. nov. TYPE: *Koeiea afghanica* K. H. Rechinger.

Plants subshrubs or shrubs. Trichomes unicellular, eglandular, softly malpighiaceous, submalpighiaceous with a few lateral minute branches, rarely subdendritic. Stems erect to ascending, branched, slightly swollen at nodes. Basal leaves absent. Cauline leaves sessile or rarely petiolate, filiform to linear or lanceolate, not auriculate, entire. Racemes several flowered, ebracteate, corymbose, elongated in fruit. Fruiting pedicels slender, ascending to divaricate. Sepals oblong, deciduous, ascending, subequal, base of lateral pair not saccate, margin membranous. Petals yellow, creamy white, or rarely purple, longer than sepals, distinctly clawed; blade obovate to spatulate, apex obtuse. Stamens 6, tetradynamous; filaments not dilated or slightly flattened at base; anthers oblong, apiculate at apex. Nectar glands confluent and subtending bases of all stamens; median glands present or absent; lateral glands often annular. Ovules 16–40 per ovary. Fruit dehiscent siliques, linear, latiseptate, sessile or shortly stipitate; valves leathery, with a distinct midvein, hairy as leaves, torulose; replum rounded in cross section, visible; septum complete, membranous, veinless or with 1–3 longitudinal veins; style obsolete or distinct and to 2 mm long; stigma capitate, entire or 2-lobed. Seeds uniseriate, winged, margined, or wingless, oblong, strongly flattened; seed coat not mucilaginous when wetted; cotyledons accumbent or rarely incumbent.

1. **Rhammatophyllum pachyrhizum** (Karelin & Kirilov) O. E. Schulz, Repert. Sp. Nov. Regni Veg. 33: 190. 1933. *Arabis pachyrhiza* Karelin & Kirilov, Bull. Soc. Imp. Naturalistes Moscou 15: 144. 1842. *Mitophyllum pachyrhizum* (Karelin & Kirilov) O. E. Schulz, Notizbl. Bot. Gart. Berlin-Dahlem 11: 872. 1933. TYPE: [Kazakhstan. Dzungaria], Bischtas Mts., between Ayaguz and Donsyk, 1841, *G. S. Karelin & I. P. Kirilov 1193* (holotype, LE; isotypes, P, TK).

Distribution. Kazakhstan, Kyrgyzstan.

We have not seen the type collection of *Rhammatophyllum krascheninnikovii* A. N. Vassiljeva (Vassiljeva, 1969), and based on its similarity in flower color and other characters to *R. pachyrhizum*, we follow Czerepanov (1995) in reducing the former to synonymy of the latter.

2. **Rhammatophyllum frutex** Botschantsev & Vvedensky, Bot. Mater. Gerb. Inst. Bot. Akad. Nauk Uzbeksk. S.S.R. 13: 9. 1952. TYPE: [Kazakhstan]. W Betpak Dala, vicinity of Kenderlik, red clay slopes, 24 May 1936, *B. Mironov & V. Pazi 353* (holotype, TAK).

Distribution. Endemic to Kazakhstan.

3. **Rhammatophyllum erysimoides** (Karelin & Kirilov) Al-Shehbaz & O. Appel, comb. nov. Basionym: *Arabis erysimoides* Karelin & Kirilov, Bull. Soc. Imp. Naturalistes Moscou 15: 145. 1842. *Prionotrichon erysimoides* (Karelin & Kirilov) Botschantsev & Vvedensky, Bot. Mater. Gerb. Inst. Bot. Zool. Akad. Nauk Uzbekst. S.S.R. 12: 8. 1948. TYPE: [Kazakhstan. Dzungaria], between Chulak and Ai rivers, 1841, *G. S. Karelin & I. P. Kirilov 1192* (holotype, LE; isotypes, B, P).

Distribution. Endemic to Kazakhstan.

4. **Rhammatophyllum gaudanense** (Litvinov) Al-Shehbaz & O. Appel, comb. nov. Basionym: *Erysimum gaudanense* Litvinov, Trudy Bot. Muz. Imp. Akad. Nauk 1: 33. 1902. *Prionotrichon gaudanense* (Litvinov) Botschantsev, Novosti Sist. Vyssh. Rast. 3: 125. (1966). TYPE: [Turkmenistan]. "in declivibus herbosis montium prope Gaudan," 28 Apr. 1898, *D. I. Litvinov 518* (holotype, LE; isotype, WU).

Distribution. Turkmenistan and Afghanistan.

5. **Rhammatophyllum ghoranum** (K. H. Rechinger) Al-Shehbaz & O. Appel, comb. nov. Basionym: *Koeiea ghorana* K. H. Rechinger, Anz. Österr. Akad. Wiss., Math.-Naturwiss. Kl. 101: 425. 1964. *Prionotrichon ghoranum* (K. H. Rechinger) Botschantsev, Novosti Sist. Vyssh. Rast. 24: 97 (1987). TYPE: Afghanistan. Prov. Ghorat: Shutar Khan Kotal ridge, between Qala Ahangaren and Qala Sharak, ca. 34°20′N, 64°55′E, ca. 2725 m, 27 July 1962, *K. H. Rechinger 18866* (holotype, W; isotype, MO).

Distribution. Endemic to Afghanistan.

6. **Rhammatophyllum kamelinii** (Botschantsev) Al-Shehbaz & O. Appel, comb. nov. Basionym: *Prionotrichon kamelinii* Botschantsev, Novosti Sist. Vyssh. Rast. 24: 98. 1987. TYPE: Mongolia. Altay Mts., Uljastyjn-Gol, Bulgan-Gol, 10 July 1984, *R. V. Kamelin & S. Darijmaa 331* (holotype, LE; isotype, MO).

Distribution. Endemic to the Altay region of Mongolia.

7. **Rhammatophyllum pseudoparrya** (Botschantsev & Vvedensky) Al-Shehbaz & O. Appel, comb. nov. Basionym: *Prionotrichon pseudoparrya* Botschantsev & Vvedensky, Bot. Mater. Gerb. Inst. Bot. Zool. Akad. Nauk Uzbekst. S.S.R. 12: 8. 1948. TYPE: [Tajikistan]. Alaisky Range, Karategen, near river Kizil-Su, above Sarigul, 10 Sep. 1927, *I. A. Raikova 1563* (holotype, TAK).

Distribution. Northern Tajikistan and southern Kyrgyzstan.

8. **Rhammatophyllum flexuosum** (K. H. Rechinger) Al-Shehbaz & O. Appel, comb. nov. Basionym: *Koeiea flexuosa* K. H. Rechinger, Anz. Österr. Akad. Wiss., Math.-Naturwiss. Kl. 101: 426. 1964. *Prionotrichon flexuosum* (K. H. Rechinger) Botschantsev, Novosti Sist. Vyssh. Rast., 24: 99. 1987. TYPE: Afghanistan. Prov. Kabul: Sanglakht, above Jalrez, ca. 34°30′N, 68°32′E, ca. 2400 m, 12 July 1962, *K. H. Rechinger 18027* (holotype, W).

Distribution. Endemic to Afghanistan.

9. Rhammatophyllum afghanicum (K. H. Rechinger) Al-Shehbaz & O. Appel, comb. nov. Basionym: *Koeiea afghanica* K. H. Rechinger, Anz. Österr. Akad. Wiss., Math.-Naturwiss. Kl. 91: 60. 1954. *Prionotrichon afghanicum* (K. H. Rechinger) Botschantsev, Novosti Sist. Vyssh. Rast. 3: 125. 1966. TYPE: Afghanistan. Bend-i Amir, 2800 m, 19 Aug. 1948, *M. Köie 2845* (holotype, C; isotype, W).

Distribution. Endemic to Afghanistan.

KEY TO THE SPECIES OF *RHAMMATOPHYLLUM*

1a. Trichomes subdendritic, rarely mixed with fewer submalpighiaceous ones; fruits (2.5–)3–4.5 mm wide; seeds broadly winged all around; Afghanistan . . . . 9. *R. afghanicum*

1b. Trichomes malpighiaceous or submalpighiaceous; fruits 1–2(–2.5) mm wide; seeds wingless, margined, or narrowly winged all around, rarely broadly winged distally.

2a. Trichomes exclusively malpighiaceous with unbranched 2 rays; cotyledons incumbent; seeds wingless, rarely obscurely margined.

3a. Petals purple; shrubs ca. 50 cm tall; leaves 0.5–2.5 cm × 0.9–1.2 mm; Kazakhstan . . . . 2. *R. frutex*

3b. Petals creamy white; plants subshrubs 10–30 cm tall; leaves (2.5–)3–7 cm × ca. 0.5 mm; Kazakhstan and Kyrgyzstan . . . . 1. *R. pachyrhizum*

2b. Trichomes submalpighiaceous, with minute lateral branches on the 2 rays; cotyledons accumbent; seeds winged, rarely margined.

4a. Leaves with a distinct petiole 0.5–2 cm long; fruits 5–8 cm long; replum straight between the seeds in mature fruit.

5a. Petals 10–13 × 5–7 mm; leaves 2–7 mm wide; petiole 1–2 cm long; Altay of Mongolia . . . 6. *R. kamelinii*

5b. Petals 7–8 × 3–4 mm; leaves to 1 mm wide; petiole rarely to 1 cm long; Kazakhstan . . 3. *R. erysimoides*

4b. Leaves sessile; fruits 1.5–4(–5) cm long; replum often constricted between the seeds in mature fruit.

6a. Gynophore 1–3 mm long; racemes flexuous in fruit; sterile shoots often well developed, with leaves to 2–3 cm long; Afghanistan 8. *R. flexuosum*

6b. Gynophore obsolete, rarely to 0.7 mm long; racemes not flexuous in fruit; sterile shoots absent, if present then with leaves rarely to 1.5 cm long.

7a. Leaves flat; seeds distinctly winged all around; Afghanistan . . . . 5. *R. ghoranum*

7b. Leaves longitudinally plicate; seeds narrowly margined at least distally.

8a. Petals pilose outside; gynophore obsolete; style to 1 mm; Afghanistan and Turkmenistan . . . . 4. *R. gaudanense*

8b. Petals glabrous outside; gynophore distinct, to 0.7 mm; style 1–2 mm; Tajikistan and Kyrgyzstan . . . . 7. *R. pseudoparrya*

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Cardaria, Coronopus, and *Stroganowia* are United with *Lepidium* (Brassicaceae)

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ABSTRACT. The genera *Cardaria* (including *Hymenophysa*), *Coronopus,* and *Stroganowia* are hardly distinct morphologically from the larger *Lepidium,* and the distinctions of all four genera are based solely on a few fruit characters of doubtful value. Recent molecular data strongly suggest that the genera *Coronopus* and *Stroganowia* are polyphyletic and, together with *Cardaria,* are nested within *Lepidium.* Therefore, they are herein formally united with *Lepidium,* the earliest published generic name in this group. The new names *L. appelianum, L. botschantsevianum, L. buschianum, L. karelinianum,* and *L. mummenhoffianum* are proposed because the transfer of their replaced names to *Lepidium* would create later homonyms. The following 20 new combinations are proposed: *L. brachyotum, L. cardiophyllum, L. englerianum, L. lepidioides, L. litwinowii, L. longifolium, L. minor, L. navasii, L. paniculatum, L. rhytidocarpum, L. robustum, L. sagittatum, L. saravschanicum, L. serratum, L. tianschanicum, L. tiehmii, L. tolmaczovii, L. trautvetteri, L. violaceum,* and *L. zambiensis.*

Key words: Brassicaceae, *Cardaria, Coronopus, Hymenophysa, Lepidium, Stroganowia.*

During work by two of us (Al-Shehbaz and Appel) on the forthcoming account of the Brassicaceae (Cruciferae) for K. Kubitzki's *Families and Genera of Vascular Plants,* and on the basis of molecular studies on the genus *Lepidium* L. and relatives, such as *Cardaria* Desvaux, *Coronopus* Zinn, and *Stroganowia* Karelin & Kirilov (Bowman et al., 1999; Brüggemann, 2000; Mummenhoff, 1995; Mummenhoff et al., in press; Mummenhoff, unpublished), it has become amply evident that only one genus is involved, and that nomenclatural adjustments are needed to make the names available for several floristic works in progress.

Lepidium is a cosmopolitan genus of about 175 species distributed on all continents except Antarctica (Al-Shehbaz, 1986). It is one of the most natural and readily distinguished of all genera in the family. As presently delimited, all species have angustiseptate fruits with two subapical ovules (one in each locule), and the trichomes (when present) are always simple. The flowers in more than half of the species have just two stamens, and the petals in most of those are rudimentary or lacking. In the remaining species of *Lepidium,* the flowers are always petaliferous and have either six or four stamens (Thellung, 1906; Al-Shehbaz, 1986). For the reduction of stamen number in *Lepidium,* the interested reader should consult Bowman and Smyth (1998) and Bowman et al. (1999).

The genera *Cardaria, Coronopus,* and *Stroganowia* resemble *Lepidium* in having similar fruit structure, two ovules per ovary, and simple trichomes. Most of them have six stamens, but a few species of *Coronopus* have two stamens, just like the majority of *Lepidium.* As shown below, the principal characters used to distinguish these genera from *Lepidium* are based solely on minor differences in fruit morphology. However, recent molecular studies (Mummenhoff et al., in press) have clearly shown that the genera *Cardaria, Coronopus,* and *Stroganowia* are nested within *Lepidium,* that *Coronopus* and *Stroganowia* are definitely polyphyletic, and that *Lepidium* is paraphyletic.

CARDARIA

Cardaria is said to differ from *Lepidium* by having indehiscent instead of dehiscent fruits, and both genera were recognized in most of the major floristic or monographic works, including those by Schulz (1936), Hedge (1968), Hewson (1982), Al-Shehbaz (1986), Schultze-Motel (1986), Rollins (1993), and Tutin et al. (1993). However, as indicated by Thellung (1906), there are some species of *Lepidium* with tardily dehiscent or even indehiscent fruits. In fact, some authors (e.g., Thellung, 1906; Busch, 1939a; Rich, 1991) reduced *Cardaria* to synonymy of *Lepidium*, though Busch (1939a, 1939b) also recognized *Hymenophysa* C. A. Meyer as a related genus with two species. By contrast, Schulz (1936) recognized *Cardaria* as a monotypic genus that he placed with *Lepidium* in the tribe Lepidieae and treated *Hymenophysa* as a monotypic genus that he placed in the tribe Euclidieae. The single character that Schulz (1936) used to separate *Cardaria* from *Hymenophysa* (and the two tribes in which he placed them) is the presence of angustiseptate (flattened at a right angle to the septum) vs. inflated fruits. The example of *Cardaria-Hymenophysa* shows that heavy reliance on the type of compression of fruit led to the artificial delimitation of genera and tribes. For another example, the vast majority of the approximately 170–190 species of *Alyssum* L. have latiseptate fruits (flattened parallel to the septum), and only a few species (e.g., *A. turgidum* T. R. Dudley and *A. globosum* Grossheim) have distinctly inflated fruits (Dudley, 1964; Avetisian, 1980). *Alyssum globosum* was placed in the monotypic genus *Takhtajaniella* V. E. Avetisian (Avetisian, 1980), but we believe that it is perfectly at home in *Alyssum*.

Molecular data (Mummenhoff, 1995; Brüggemann, 2000; Mummenhoff et al., in press) clearly demonstrated that *Cardaria* is nested within *Lepidium*, and that it is most closely related to *L. campestre* L. and its relatives, which Thellung (1906) assigned to *Lepidium* sect. *Lepia* (Desvaux) DC. The cpDNA data (Mummenhoff et al., in press) indicate monophyly of *C. draba* (L.) Desvaux and *C. pubescens* (C. A. Meyer) Jarmolenko, whereas the ITS data (Brüggemann, 2000) suggest polyphyly of *Cardaria* because *C. pubescens* appears to be more closely related to members of *Lepidium* sect. *Lepia* than does *C. draba*. However, both the cpDNA and ITS data show that *Cardaria* is nested well within *Lepidium* next to section *Lepia*. It is interesting to note that the type species of *Cardaria* was initially described by Linnaeus (1753) as *Lepidium draba* L.

There is disagreement as to the number of species recognized in *Cardaria*. Mulligan and Frankton (1962) and Czerepanov (1995) recognized as many as five and six species, respectively. By contrast, other authors (e.g., Hedge, 1968; Al-Shehbaz, 1986) recognized two, while Rollins (1993) recognized three. We believe that only two species merit recognition, and both should be placed in *Lepidium*. These are *L. draba*, which consists of subspecies *draba* and *chalapense* (L.) Thellung, and *L. appelianum* Al-Shehbaz, a new name proposed herein because the transfer of *Hymenophysa pubescens* C. A. Meyer to *Lepidium* would create a later homonym of the South American *L. pubescens* Desvaux.

CORONOPUS

Coronopus consists of 10 species native to South America, Africa, Southwest Asia, and adjacent Europe (Al-Shehbaz, 1986). It differs from *Lepidium* primarily by having didymous fruits with thickened, reticulate, rugose, to tuberculate (rarely smooth), indehiscent fruit valves. In three species (*C. navasii* Pau, *C. squamatus* (Forsskål) Ascherson, and *C. violaceus* (Munby) Kuntze) the fruits are not didymous while in the remaining seven (*C. didymus* (L.) Smith, *C. integrifolius* (DC.) Sprengel, *C. niloticus* (Delile) Sprengel, *C. lepidioides* (Cosson & Durieu) Kuntze, *C. serratus* (Poiret) Desvaux, *C. rhytidocarpus* (Hooker) Macloskie, and *C. zambiensis* Jonsell) they are distinctly didymous. *Coronopus wrightii* H. Hara (Japan, Taiwan) was reduced by Cheo et al. (2001) to synonymy of *C. integrifolius* (herein as *L. englerianum*). The valve orifice that faces the replum is usually smaller than the seed and, therefore, the seeds are not readily released, and these valves act as the dispersal unit. In *Lepidium* the fruit is not didymous, and the valves are generally thin and with orifices often wider than the seeds. Therefore, the seeds are easily released from the valves. However, in the southern Argentinian and Chilean *L. pseudodidymum* Thellung, the fruits somewhat approach *C. didymus* in their reticulation and thickness. In fact, *L. pseudodidymum* was treated by Muschler (1908) as *C. didymus* subsp. *australis* (J. D. Hooker) Muschler and was later redescribed by Boelcke (1975) as *Coronopus leptocarpus* Boelcke. This shows that *Lepidium* and *Coronopus* can hardly be delimited on morphological grounds. In our opinion, features of the fruit valves in *Coronopus* are adaptations for dispersal and are insignificant in the delimitation of the genus. The development of thick, reticulate, rugose, or tuberculate fruit walls apparently evolved independently within *Lepidium* (including *Coronopus*). Molecular data by one of us (Mummenhoff, unpublished) clearly show that *Coronopus* is polyphyletic and nested within *Lepidium*.

Although molecular studies have not yet been done on the monotypic *Delpinophytum* Spegazzini, it is very likely that *D. patagonicum* (Spegazzini) Spegazzini is only a dwarf, pulvinate species of *Lepidium.* The species was subsequently treated by Muschler (1908) as *Coronopus patagonicus* (Spegazzini) Muschler. Both *C. didymus* and *C. squamatus* were originally described as *L. didymum* L. and *L. squamatum* Forsskål, respectively. *Coronopus niloticus* is known in *Lepidium* as *L. niloticum* (Delile) Sieber ex Steudel. For the remaining seven species of *Coronopus,* new combinations are proposed herein to accommodate their transfer to *Lepidium.*

STROGANOWIA

Both Pavlov (1933, 1939) and Botschantsev (1984) provided brief synopses on *Stroganowia,* and the latter author recognized 21 species in the genus. The characters used to distinguish *Stroganowia* from *Lepidium* are the perennial habit and slightly angustiseptate or nearly quadrangular fruits. However, these features are tenuous at best, and many species of *Lepidium* (e.g., *L. latifolium* L. and relatives) resemble *Stroganowia* in habit. The degree of the fruit flattening is not a reliable feature either, and there are no other differences between the two genera. In fact, some species recognized by Botschantsev (1984) as *Stroganowia* (e.g., *S. affghana, S. subalpina*) were treated by Thellung in *Lepidium,* who (1906: 157) suggested that *Stroganowia* is best treated as a section of *Lepidium.* Molecular data available so far for seven species (Mummenhoff, unpublished) show that the Old World *Stroganowia* forms separate groups nested within *Lepidium.* What was explicitly mentioned by Botschantsev (1984) about the dubious merit of *Stroganowia* has now been substantiated by Mummenhoff's molecular studies. As for *S. tiehmii* Rollins, Price (pers. comm.) indicated that the species falls within the American species of *Lepidium* based on molecular studies. Therefore, *Stroganowia* is polyphyletic, and the alleged relationship of *S. tiehmii* with its nearest disjunct relatives in Central Asia (Rollins, 1982) has not been supported by molecular data.

All of Botschantsev's (1984) 21 species of *Stroganowia* merit recognition as species of *Lepidium.* Three species, *S. affghana* (Boissier) Pavlov, *S. bupleuroides* (K. H. Rechinger) Botschantsev, and *S. subalpina* (Komarov) Thellung ex Pavlov, were originally described in *Lepidium,* and their retention in that genus poses no nomenclatural problems. The transfer to *Lepidium* of *S. angustifolia* Botschantsev & Vvedensky, *S. intermedia* Karelin & Kirilov, *S. persica* N. Busch, and *S. rubtzovii* Botschantsev would create later homonyms, and the following new names are proposed herein to accommodate them in *Lepidium: L. botschantsevianum* Al-Shehbaz, *L. karelinianum* Al-Shehbaz, *L. buschianum* Al-Shehbaz, and *L. mummenhoffianum* Al-Shehbaz, respectively. Upon its transfer to *Lepidium, S. puberula* Kitamura would become an illegitimate later homonym of *L. puberulum* Bunge. Therefore, *S. puberula* should be recognized in *Lepidium* as *L. altissimum* K. H. Rechinger, which is the earliest legitimate name for the species in *Lepidium.* New combinations in *Lepidium* are proposed herein to accommodate the remaining 13 species of *Stroganowia: S. brachyota* Karelin & Kirilov, *S. cardiophylla* Pavlov, *S. litwinowii* Lipsky, *S. longifolia* (Boissier) Botschantsev & Vvedensky (originally described as *Heldreichia longifolia* Boissier), *S. minor* Botschantsev & Vvedensky, *S. paniculata* Regel & Schmalhausen, *S. robusta* Pavlov, *S. sagittata* Karelin & Kirilov, *S. saravschanica* Bulgakova, *S. tianschanica* Botschantsev & Vvedensky, *S. tiehmii* Rollins, *S. tolmaczovii* Junussov, and *S. trautvetteri* Botschantsev.

Lepidium L., Sp. Pl. 2: 643. 1753. TYPE: *Lepidium latifolium* L. (lectotype, designated by Britton & Brown, 1913).

Coronopus Zinn, Cat. Pl. Hort. Gott. 325. 1757, nom. cons. TYPE: *Coronopus squamatus* (Forsskål) Ascherson.

Cardaria Desvaux, J. Bot. Agric. 3: 163. 1815. TYPE: *Cardaria draba* (L.) Desvaux.

Stroganowia Karelin & Kirilov, Bull. Soc. Imp. Naturalistes Moscou 14: 386. 1841. TYPE: *Stroganowia sagittata* Karelin & Kirilov (lectotype, designated by Botschantsev, 1984).

Although Greuter et al. (1993, 2000) listed the type species of *Coronopus* as *C. ruellii* Allioni, which is based on *Cochlearia coronopus* L., both of these specific epithets are synonyms of *Lepidium squamatum* Forrskål. *Cochlearia coronopus* and *Coronopus ruellii* are correctly listed as synonyms of *L. squamatum* by Hedge (1968) and Greuter et al. (1986), respectively.

Lepidium appelianum Al-Shehbaz, nom. nov. Replaced name: *Hymenophysa pubescens* C. A. Meyer, in Ledebour, Icon. Pl. 2: 20. 1830, non *Lepidium pubescens* Desvaux, J. Bot. Agric. 3: 180. 1815, nec *L. pubescens* Tineo, Cat. Pl. Hort. Panorm. 150. 1827. TYPE: [Kazakhstan.] "Locis humidis subsalsis deserti Soongoro-Kirghisici orientalis versus montes Arkaul," 14 May 1826, *C. A. Meyer s.n.* (lectotype, designated here, LE).

The choice of *C. A. Meyer s.n.* as the lectotype was based on the fact that *L. appelianum* is a new name replacing the later homonym *L. pubescens*, and this collection was among those cited in the original publication.

The species is named in honor of Oliver Appel, one of the authors of the present paper and an expert on the Brassicaceae.

Lepidium botschantsevianum Al-Shehbaz, nom. nov. Replaced name: *Stroganowia angustifolia* Botschantsev & Vvedensky, Bot. Mater. Gerb. Inst. Bot. Zool. Akad. Nauk Uzbekst. S.S.R. 12: 11. 1948, non *Lepidium angustifolium* Rusby, Descr. S. Amer. Pl. 23. 1920. TYPE: [Uzbekistan.] Samarkand: Zarafshon, Katta Gorgansky, Mt. Actao, near village Shamani, 24 May 1925, *M. G. Popov 349* (holotype, TASH).

The new name commemorates Victor Petrovich Botschantsev (1910–1990), an outstanding expert on the Brassicaceae of the former Soviet Union.

Lepidium brachyotum (Karelin & Kirilov) Al-Shehbaz, comb. nov. Basionym: *Stroganowia brachyota* Karelin & Kirilov, Bull. Soc. Imp. Naturalistes Moscou 14: 387. 1841. TYPE: "In montosis deserti Soongoro-Kirghisici prope Ajagus," June 1840, *G. S. Karelin & I. P. Kirilov s.n.* (holotype, LE).

Lepidium buschianum Al-Shehbaz, nom. nov. Replaced name: *Stroganowia persica* N. Busch, Zhurn. Russk. Bot. Obshch. Akad. Nauk S.S.S.R. 11: 225. 1926, non *Lepidium persicum* Boissier, Ann. Sci. Nat. ser. 2, 17: 196. 1842. TYPE: N Iran. Tabris (Atropatania): Mt. Scher-Dara, between Sofian and Sejvan, 1430–1500 m, 18 June 1924, *A. Grossheim s.n.* (holotype, LE).

The new name commemorates Nicolai Adolfowitsch Busch (1869–1941), an outstanding expert of the Brassicaceae of Asia and the author of most of the accounts of Brassicaceae for the Flora of the former Soviet Union (see Busch, 1939a, 1939b).

Lepidium cardiophyllum (Pavlov) Al-Shehbaz, comb. nov. Basionym: *Stroganowia cardiophylla* Pavlov, Bot. Zhurn. S.S.S.R. 18: 364. 1933. TYPE: [Turkmenistan.] "Turkestania Ross., prov. Syr-Darja, montes Maschat-tau (praemontorium Alatau Talassici), in decliviis glareosis pratensibus ad trajectum Dau-baba, 1200 m," 31 Aug. 1931, *N. V. Pavlov 1226* (holotype, MW; isotype, LE).

Lepidium englerianum (Muschler) Al-Shehbaz, comb. nov. Basionym: *Coronopus englerianus* Muschler, Bot. Jahrb. Syst. 41: 139. 1908. TYPE: Mozambique. Mouth of Zambezi River, *Peters s.n.* (holotype, B).

The earliest name for the species is *Senebiera integrifolia* DC. (Mém. Soc. Hist. Nat. Paris 1: 144. 1799), but the transfer of its specific epithet to *Lepidium* would create a later homonym of *L. integrifolium* Nuttall ex Torrey & A. Gray. The second earliest name for the species is *Senebiera linoides* DC., but the transfer of its specific epithet to *Lepidium* would create a later homonym of *L. linoides* Thunberg. According to Marais (1970), the last species is a synonym of *Lepidium divaricatum* Aiton. Jonsell (1974) was the first to reduce *Coronopus englerianus* to synonymy of *S. integrifolia*, and the epithet "*englerianus*" is the earliest available name that can be used for the species in *Lepidium*.

Lepidium karelinianum Al-Shehbaz, nom. nov. Replaced name: *Stroganowia intermedia* Karelin & Kirilov, Bull. Soc. Imp. Naturalistes Moscou 15: 162. 1842, non *Lepidium intermedium* A. Richard, Tent. Fl. Abyss. 1: 21. 1847. TYPE: "In montosis apricis Alatau inter fluvios Baskan et Sarchan," July 1841, *G. S. Karelin & I. P. Kirilov s.n.* (lectotype, designated by Pavlov (1933), LE; isolectotype, MW).

The new name honors Grigorij Siliovitsch Karelin (1801–1872), one of the famous botanical explorers of central Asia.

Lepidium lepidioides (Cosson & Durieu) Al-Shehbaz, comb. nov. Basionym: *Senebiera lepidioides* Cosson & Durieu, Bull. Soc. Bot. France 2: 245. 1855. TYPE: Algeria. "In ditione Mzab prope Guerrara," 3 Nov. 1854, *V. C. Reboud s.n.* (holotype, P).

Lepidium litwinowii (Lipsky) Al-Shehbaz, comb. nov. Basionym: *Stroganowia litwinowii* Lipsky, Trudy Imp. S.-Peterburgsk. Bot. Sada 26: 121. 1910. TYPE: Turkmenistan. Mountains near Gaudan, 30 May 1898, *D. Litwinow 625* (holotype, LE).

Lepidium longifolium (Boissier) Al-Shehbaz, comb. nov. Basionym: *Heldreichia longifolia* Boissier, Ann. Sci. Nat. ser. 2, 17: 187. 1842. TYPE: Iran. Mount Zerdakou [Zard Kuh], *Aucher 320* (holotype, G).

Hedge (1968) had correctly questioned the inclusion of the species in *Heldreichia* Boissier because of its habit, non-fleshy leaves, and toothless filaments. He indicated that the species should either be placed in a monotypic genus or in *Stroganowia*. As indicated by Botschantsev and Vvedensky (1948), the species is morphologically very close to *S. angustifolia* (herein as *Lepidium botschantsevianum*).

Lepidium minor (Botschantsev & Vvedensky) Al-Shehbaz, comb. nov. Basionym: *Stroganowia minor* Botschantsev & Vvedensky, Bot. Mater. Gerb. Inst. Bot. Zool. Akad. Nauk Uzbekst. S.S.R. 3: 19. 1941. TYPE: [Tajikistan.] Pamir: [up River Yakabag Darya, around village Tashkorgan], 18 June 1936, *Botschantsev & Butkov 8* (holotype, TASH # 161584).

It is quite possible that the collection was actually made from near Taxkorgan, a town in the southwestern Xinjiang Autonomous region at the Tajikistan-China border, as such town no longer exists in Tajikistan.

Lepidium mummenhoffianum Al-Shehbaz, nom. nov. Replaced name: *Stroganowia rubtzovii* Botschantsev, Novosti Sist. Vyssh. Rast. 21: 79. 1984, non *Lepidium rubtzovii* Vassilczenko, Bot. Mater. Gerb. Inst. Bot. Akad. Nauk Kazakhsk. S.S.R. 4: 40. 1966. TYPE: "Jugum Alatau Dzhungaricus, distr. inter pagos Sarkand et Kopal, locus Bel-Bulak," 20 July 1934, *N. I. Rubtzov s.n.* (holotype, LE).

The species is named in honor of Klaus Mummenhoff, one of the authors of this paper, in recognition for his extensive molecular work on *Lepidium* and related genera.

Lepidium navasii (Pau) Al-Shehbaz, comb. nov. Basionym: *Coronopus navasii* Pau, Butl. Inst. Catalana Hist. Nat. 22: 31. 1922. TYPE: Spain. Sierra de Gádor, 2000 m, *P. Navas s.n.* (holotype, MA not seen).

Lepidium paniculatum (Regel & Schmalhausen) Al-Shehbaz, comb. nov. Basionym: *Stroganowia paniculata* Regel & Schmalhausen, Trudy Imp. S.-Peterburgsk. Bot. Sada 5: 242. 1877. TYPE: Raskrask, "in valle fluvii" Tschirtschik, 8000–9000 ft., Aug. 1876, *A. Regel s.n.* (lectotype, designated by Pavlov (1933), LE).

Lepidium rhytidocarpum (Hooker) Al-Shehbaz, comb. nov. Basionym: *Senebiera rhytidocarpa* Hooker, London J. Bot. 2: 506. 1843. TYPE: Patagonia, *Tweede s.n.* (holotype, K).

Lepidium robustum (Pavlov) Al-Shehbaz, comb. nov. Basionym: *Stroganowia robusta* Pavlov, Bot. Zhurn. S.S.S.R. 18: 367. 1933. TYPE: Turkmenistan. Mt. Boroldaj-tau, summit of Bukuj-tau, 1600 m, 27 June 1931, *N. Pavlov 397* (holotype, MW; isotype, LE).

Lepidium sagittatum (Karelin & Kirilov) Al-Shehbaz, comb. nov. Basionym: *Stroganowia sagittata* Karelin & Kirilov, Bull. Soc. Imp. Naturalistes Moscou 14: 387. 1841. TYPE: "In arenosis ad radicem montium Tarbagati praesertim ad torrentes Dschany-bek et Terekty," May 1840, *G. S. Karelin & I. P. Kirilov s.n.* (holotype, LE).

Lepidium saravschanicum (Bulgakova) Al-Shehbaz, comb. nov. Basionym: *Stroganowia saravschanica* Bulgakova, Bot. Mater. Gerb. Inst. Bot. Akad. Nauk Uzbeks. S.S.R. 20: 8. 1982. TYPE: Uzbekistan. Jugum Seravschanicum, above Sarykol, vicinity of Tillja-Tikan, ca. 1000 m, 13 June 1980, *L. L. Bulgakova s.n.* (holotype, TASH; isotype, MO).

Lepidium serratum (Poiret) Al-Shehbaz, comb. nov. Basionym: *Senebiera serrata* Poiret, in Lamarck, Encycl. 7: 76. 1806. TYPE: [Uruguay]. Montevideo, *Commerson s.n.* (holotype, P-JU).

Lepidium serratum is unrelated to and should not be confused with the Hawaiian *L. serra* H. Mann.

Lepidium tianschanicum (Botschantsev & Vvedensky) Al-Shehbaz, comb. nov. Basionym: *Stroganowia tianschanica* Botschantsev & Vvedensky, Bot. Mater. Gerb. Inst. Bot. Zool. Akad. Nauk Uzbekst. S.S.R. 12: 12. 1948. TYPE: [Kyrgyzstan.] W Tian Shan, Maidantalsky, Chotan-gutsai, 24 July 1940, *V. Makarchuk s.n.* (holotype, TASH).

Lepidium tiehmii (Rollins) Al-Shehbaz, comb. nov. Basionym: *Stroganowia tiehmii* Rollins, Syst. Bot. 7: 215. 1982. TYPE: U.S.A. Nevada: Lyon County, Virginia Range, SE of Talapoosa Peak, T19N, R24E, sect. 34, 5900 ft., 1 June 1980, *A. Tiehm 5783, F. Almeda & M. Williams* (holotype, GH; isotype, MO).

Lepidium tolmaczovii (Junussov) Al-Shehbaz, comb. nov. Basionym: *Stroganowia tolmaczovii* Junussov, Dokl. Akad. Nauk Tadzh. SSR 18(2): 62. 1975. TYPE: W Tajikistan. Karatau ridge, 4 km N of Mt. Chodzha-Maston, 17 May 1960, *A. Meczislavskij & V. N. Zavedeev 675* (holotype, LE).

Lepidium trautvetteri (Botschantsev) Al-Shehbaz, comb. nov. Basionym: *Stroganowia trautvetteri* Botschantsev, in Komarov, Fl. URSS 8: 652. 1939. TYPE: [Kazakhstan.] Ad lacum Balchasch, Betpak-dala, 13 June 1843, *A. Schrenk 399* (holotype, LE).

Lepidium violaceum (Munby) Al-Shehbaz, comb. nov. Basionym: *Senebiera violacea* Munby, Bull. Soc. Bot. France 2: 282. 1855. TYPE: Algeria. Dhaya-Baalis, Ain-Turck, near Oran, *G. Munby s.n.* (holotype, K?).

Lepidium zambiensis (Jonsell) Al-Shehbaz, comb. nov. Basionym: *Coronopus zambiensis* Jonsell, Bot. Not. 127: 116. 1974. TYPE: Zambia. Kalabo District: Liuwa Plain, Paramount Chief's Game Reserve, ca. 45 km N of Kalabo, 14 Sep. 1959, *Drummond & Cookson 6458* (holotype, BM; isotypes, BR, COI, LISC, SRGH; see Jonsell, 1974).

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Two New Species of *Nanuza* (Velloziaceae) from Brazil

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ABSTRACT. *Nanuza almeidae* Alves and *N. luetzelburgii* Alves are described as new species of the previously monotypic *Nanuza* L. B. Smith & Ayensu (Velloziaceae). *Nanuza almeidae* is distinguished from *Nanuza plicata* and *N. luetzelburgii* mainly by leaf blades basally narrowed into a pseudopetiole, linear-lanceolate tepals, triangular filaments with a flattened base, and presence of labdane-type diterpenes. *Nanuza luetzelburgii* is distinguished from both other species by rounded edges on the trigonous caudex, lamina with furrows with abundant, sturdy hairs, vestigial adaxial furrows, and serrulate sheath margins, lacking the filaments typical of the closely related *N. plicata* and *N. almeidae*, and by presence of heptadecenic acid. Xerophytolic acid was found in *Nanuza plicata* but not in both new species.

RESUMO. *Nanuza almeidae* Alves e *N. luetzelburgii* Alves são descritas como espécies novas do gênero até então considerado monotípico, com apenas *Nanuza plicata* (Martius) L. B. Smith & Ayensu (Velloziaceae). *Nanuza almeidae* se distingue de *Nanuza plicata* e *N. luetzelburgii* pelas tépalas linear-lanceoladas, limbo foliar na base estreitado em pseudopecíolo, mais largo e curto, adaxialmente glabrescente, filetes triangulares com base achatada e pela presença de diterpenos do tipo labdano. *Nanuza luetzelburgii* se distingue de *N. plicata* e *N. almeidae* pelas margens arredondadas do caudex trígono, preenchimento dos sulcos no limbo por abundantes pêlos rígidos, sulcos vestigiais na face adaxial, bainhas foliares com margens serreadas, sem as cerdas características de *N. plicata* e *N. almeidae*, bem como pela presença de ácido heptadecênico. *Nanuza plicata* se distingue das espécies novas pela presença de ácido xerofitólico.

Key words: Brazil, heptadecenic acid, leaf anatomy, *Nanuza*, tetracosanoic acid, Velloziaceae.

The Velloziaceae are a predominantly Neotropical family with a major center of diversity in Brazil's savannic vegetation (campo rupestre, cerrado, and caatinga). Many species are known only from their holotypes, duplicates are rare in herbaria, and many populations are narrowly endemic. A few species, such as *Nanuza plicata*, are apparently more widespread, occurring in several populations dispersed as a mosaic throughout their ranges. Though the populations of *Nanuza* are reported by some collectors as dense and common, the genus is poorly represented in herbaria, with the exception of SPF (over 50 specimens) and RB (ca. 20). The material of *Nanuza* sent by VIES (Herbario, Museu de Biologia Mello Leitâo, Santa Teresa, State of Espírito Santo) got lost in the mail during a flood, and no material (even under earlier synonyms) was located in GUA and HB.

The plicate leaves and trigonous caudex led Martius to describe *Vellozia plicata* (Martius, 1823) based on a plant he had collected in 1819 in Bahia. The species was subsequently transferred to *Xerophyta* by Sprengel (1827). A specimen collected in 1820 by Pohl in Minas Gerais was described as *Vellozia triquetra* Pohl (1827). Baker (1875) transferred Pohl's species to *Xerophyta*. The genus *Nanuza* was segregated from *Vellozia* Vandelli by Smith and Ayensu (1976), based on *Vellozia plicata* Martius (Martius, 1823). Smith and Ayensu based the new genus on plicate leaves with more deeply furrowed adaxial surfaces, trigonous caudex, and pollen dispersed in single grains, as opposed to *Vellozia*, which is characterized by terete leaves with furrows restricted to the abaxial surface and pollen in tetrads. The originally proposed differential characters still hold true for *Nanuza* as circumscribed here, with the exception of the relative depth of the furrows on the lamina, which are deeper on the abaxial side in *N. luetzelburgii* and *N. almeidae*.

A further distinctive character of *Nanuza* is the neatly tristichous leaf set (it is spiral in *Vellozia*). Though *Vellozia candida* Mikan has a slightly trigonous stem (Alves, 1994) hidden by a layer of sheaths forming a cylindrical caudex, and tristichous leaf rosettes, the clearly trigonous caudex distinctive of *Nanuza* conceals a cylindrical stem. A distinct pseudopetiole is present in *Nanuza almeidae*, and I have not found a reference to one in other Velloziaceae. Characters such as leaf indument, anatomy, and chemical constituents of epicuticular wax are believed to vary more in widespread species of Velloziaceae (Mello-Silva, 1990a, 1995b, 2000), although it seems early to consider this a rule. Chemical characters were found useful in delimitation of taxa (genera) by Salatino et al. (1989).

A recent phylogenetic study using chloroplast DNA (Salatino, 1999) supports the distinct position of *Nanuza*, still considering it a monotypic genus of *Nanuza plicata* (Martius) L. B. Smith & Ayensu. Though collections are relatively infrequent, the studied material indicates that the variability in *Nanuza* can be partly accounted for by segregation of two species herein described as new, in which morphological, anatomical, and chemical differences are consistent with known geographical distribution. It is probable that, with more collections, additional species will be described from among the specimens left for now within *Nanuza plicata*.

The leaves of all species known so far are conduplicate-plicate and not simply plicate as stated in the description of the genus by Smith and Ayensu (1976). Furthermore, the furrows resulting from the plication in the lamina of all examined *Nanuza plicata* are deeper on the abaxial side, and not the adaxial as postulated by Smith and Ayensu (1976). This is also true for *Nanuza almeidae*, while the inverse occurs in *N. luetzelburgii*. The plication is most evident in dried leaves of *N. plicata* (Fig. 1M, N), and least perceptible in *N. luetzelburgii* (Fig. 1K, L). The leaf blades vary in dimensions, indument, and presence of a pseudopetiole. Leaf sheaths can have filamentous (*Nanuza plicata* and *N. almeidae*) or serrulate (*N. luetzelburgii*) margins.

Flowers are known from a single specimen of both *Nanuza almeidae* and *N. luetzelburgii* and from less than 20% of the *N. plicata* vouchers in the consulted herbaria. All species typically have flowers with white tepals, though purple stripes were reported in buds of one *Nanuza plicata* population (*G. E. Valente 148 & A. Azevedo*, SPF). An apical excavation was found in the hypanthium of all examined herbarium specimens of both new species, though Mello-Silva (1995a) observed a hypanthium entirely filled by the ovary on material from Pico das Almas in the State of Bahia.

The distinguishing characters of both new species herein are based essentially on the same morphological character set used to circumscribe other species of Velloziaceae in recent descriptions (Mello-Silva, 1990b, 1992). Anatomical differences in the transversal sections of leaf lamina and chemical constituents of selected specimens provided valuable additional characters for delimitation of the two new species and their distinction from *Nanuza plicata*.

Nanuza almeidae Alves, sp. nov. TYPE: Brazil. Rio de Janeiro: Município de Magé, Distrito de Piabetá, Fragoso/Tocaia, encosta rochosa de pedra próxima à base do Morro do Urubu, sobre a rocha em local ensolarado, 500 m s. m., tépalas brancas, 12 Nov. 2000 (fl, fr), *Paulo Roberto Almeida de Jesus s.n.* (holotype, R). Figure 1A–J.

Haec species *N. plicata* (Martius) L. B. Smith & Ayensu, tepalis lineari-lanceolatis, filamentis triangularibus basibus applanatis, foliis latioribus, adaxialiter nervis ecristatis ad basim in pseudopetiolum angustatis atque seminum testa profunde foveolata statim diagnoscitur.

Heliophyllous shrubs up to 150 cm tall; caudex basally cylindric, thickened by adventive root penetration, branching along the entire length, upper half and branches trigonous with rounded wedges, consisting externally of 3 series of leaf sheaths and ending in tristichous, apical leaf rosettes. Apical leaves in each rosette up to twice the size of those at the base; leaves deciduous, light green, glabrescent, parchment-like; lamina linear-lanceolate, 8–9 × 90–95 mm, conduplicate-plicate, abaxial furrows slightly deeper than adaxial, margins serrulate with the teeth curved toward the apex, base narrowed to 1–1.5 mm wide, conduplicate, with a curved pseudopetiole furrowed only on the abaxial side; leaf sheaths triangular, conduplicate, 20 mm long, base (when flattened) 5 mm wide, margins of apical half emitting long, vinaceous fibers that interlace with those of adjacent sheaths; inflorescence terminal, subtended by 2 linear-triangular, basally sheathing bracts equaling the tepals and later, by elongation, the apex of the capsule; flower single in each rosette; pedicel glabrous, trigonous, 1.5–2 × 80 mm; tepals 6, white, membranous, glabrous, linear-lanceolate, in 2 whorls, subequal, with acrodromous venation; outer tepals 38 × 7 mm wide, with conspicuous midribs; inner tepals more delicate, 37 × 10 mm wide; hypanthium 34 mm long, glabrous, conspicuously trigonous, basally 2 mm broad and hardly delimited from the pedicel, apically 5 mm diam., with a 2 mm depression; ovary, except for the apical excavation, filling 90% of the hypanthium; style trigonous, in the center of the depression, 1 × 35 mm; stigma capitate, 3 × 4 mm, lobes fleshy; stamens 6, 20 mm long; filaments triangular, 3 mm long, basally 1 mm wide, inserted atop the hypanthium margins; anthers 17 mm long, basally auriculate, thecae subequal; pollen dispersed in monosulcate monads, 35.5 × 25.7 μm, with the aperture at the distal pole, with reticulate

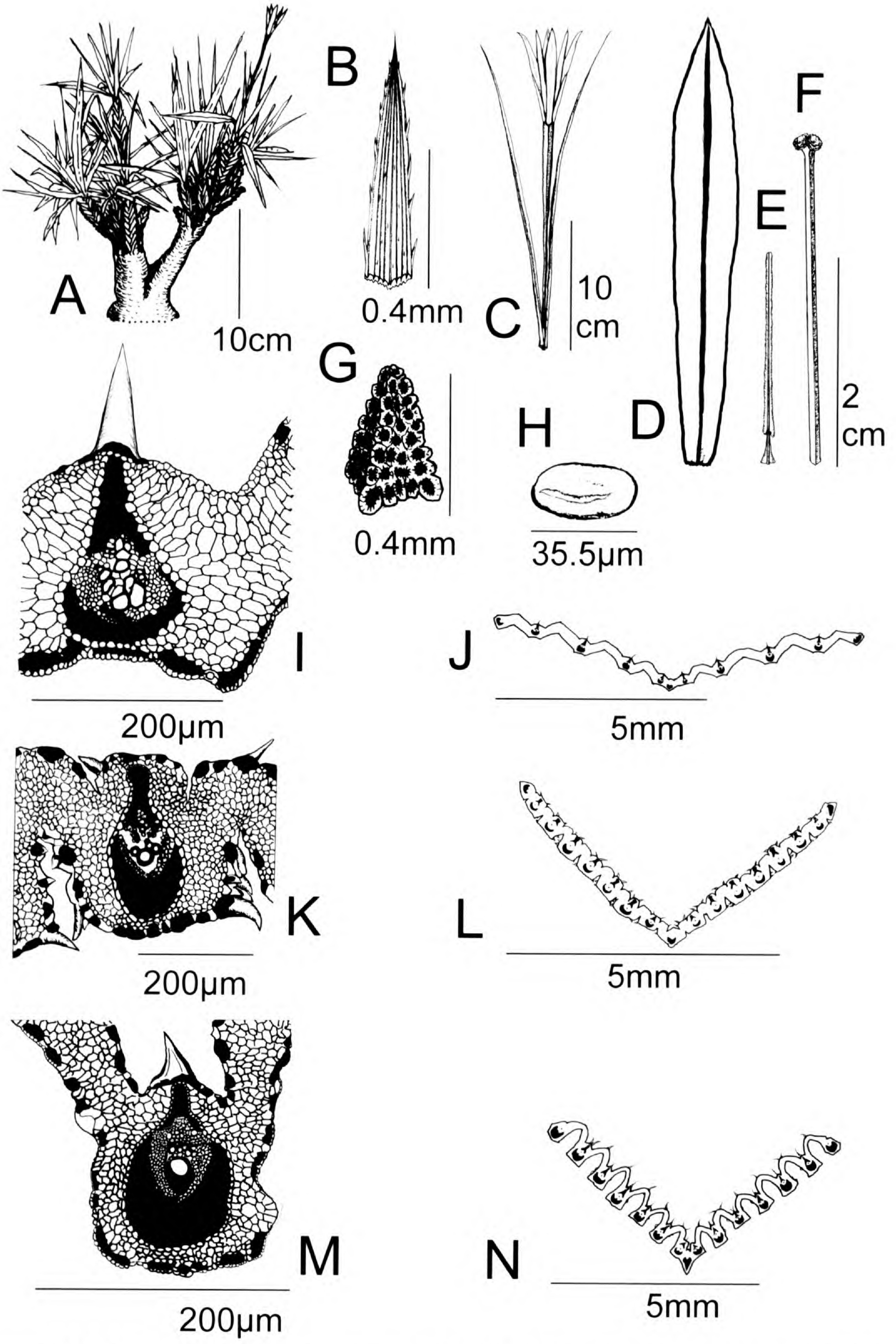

Figure 1. A–J. *Nanuza almeidae* Alves drawn from the holotype *Paulo Roberto Almeida de Jesus s.n.* (R). —A. Habit. —B. Leaf apex. —C. Flower subtended by 2 bracts. —D. Tepal from outer whorl. —E. Stamen. —F. Style. —G. Seed.—H. Pollen monad. —I. Transverse section of vascular bundle topped by sturdy hair. —J. Median transverse

exine; capsule 45 mm long, 8 mm diam., longitudinally dehiscent from apex to ½ length, externally sulcate, similar to, though smaller, than that on examined specimens of *N. plicata*; seeds pale brown, pyramidal, testa reticulate-foveolate, slightly translucent.

Transversal section of lamina. Vascular bundles 11; midvein and the 2 vicinal vascular bundles circular, with sclerenchyma girders only abaxial, the 4 subsequent pairs of bundles pear-shaped, with conspicuous abaxial U-shaped and adaxial sagitttate girders; marginal trace with abaxial girder large and asymmetrical, adaxial girder lacking or vestigial; mesophyll adaxially with palisade grading into spongy tissue. Bundle sheath distinct, in contact with abaxial and adaxial epidermis.

The type specimen was collected on a granitic inselberg known as Morro do Urubu emerging from degraded Atlantic rainforest in the state of Rio de Janeiro, from the municipality of the type citation.

Nanuza almeidae is most easily distinguished in herbarium material by leaf blades with a distinct pseudopetiole, lamina wider than 1 cm lacking serrulate crests on the adaxial surface, and by linear-lanceolate tepals. In contrast, broadly lanceolate tepals are shared by *Nanuza almeidae* and *N. plicata*, and the latter has serrulate crests. The triangular filaments with a flattened base and seeds with deeper pits in the reticulate seed coat distinguish it further from *N. plicata*. The specific epithet refers to the collector of the holotype, Paulo Roberto Almeida de Jesus, an enthusiastic potential field naturalist who frequently surprises us in the herbarium bringing large bags filled with curious plants, arthropods, mollusks, and minerals, which we distribute to specialists and collections. His first collection, now cultivated at our institution, inspired this study and part became the holotype of *Nanuza almeidae*.

Paratypes. BRAZIL. **Bahia:** Pedra Azul, 4 km da cidade na estrada MG-105 para Jequitinhonha, Inselberg à beira da estrada, *R. M. Silva 440 et al.* (SPF). **Espírito Santo:** Vale do Rio Pancas, cultivated in Pedra de Guaratiba, Rio de Janeiro by Burle Marx, *N. L. Menezes s.n.* (SPF); Colatina, BR-259 a 17 km de Colatina para João Neiva, Grande afloramento rochoso, 13 Jan. 1985, *J. R. Pirani & D. Zappi 1117* (SPF); Vitória, Guajurá, Praia do Canto, *A. G. Silva 463* (R); Vitória, Morro do Guajurá, Praia do Canto, 27 Aug. 1984, *A. G. Silva 449* (RB). **Rio de Janeiro:** Mun. Magé, Distrito de Piabetá, Fragoso/Tocaia, base do Morro do Urubu, 500 m s. m., 20 Nov. 2000 (fl), *Paulo Roberto Almeida de Jesus s.n.* (R); s.l., s.d., *Carlos Viana Freire s.n.* (R-50224).

Nanuza luetzelburgii Alves, sp. nov. TYPE: Brazil. Pernambuco: Serra Talhada, Serra da Carnaubeira, Serrote Redondo, Lagedo no Topo da Serra, arbusto 50–80 cm, 22 May 1971 (fr), *E. P. Heringer 826, D. Andrade Lima, J. de P. L. Sobrinho & A. C. Sarmento* (holotype, R; isotype, RB). Figure 1K, L.

Haec species caudice obscure triquetro aristis rotundatis et foliorum vagina serrulata esetosa atque laminae sulcis utrinque trichomatibus brevibus rigidis numerosis instructis abaxialibus, quam adaxialibus 4-plo profundioribus statim distinguitur.

Shrubs to 80 cm tall; caudex branches trigonous with rounded edges, 12–15 mm diam., densely packed with 3 series of leaf sheaths with serrulate margins; leaves rigid; lamina linear-lanceolate, 3–5 mm wide, 14–25 cm long, without pseudopetiole, conduplicate, conspicuously plicate (in dry material plication barely detectable and lamina conduplicate along midrib, then bent back outward along 4th rib), in smaller scale vestigially plicate along all ribs; abaxial and adaxial furrows internally with abundant short and sturdy hairs; flowers solitary; tepals lanceolate-elliptic, 7 mm wide, 27 mm long, white [!*L. Emperaire s.n.*, SPF]; pedicel 0.2 cm wide, 11 cm long, grading into a 70 mm long, 3 mm wide trigonous ovary; stamens 6, erect, yellow; style with stigma exceeds stamens by 5 mm. Capsule (*A. Fernandes s.n.*, SPF) dry, dehiscent, clavate, basal half 3–7 cm long, to 2–3 mm diam., the apical half thickens abruptly to 8–9 mm diam.; surface sulcate-striate as in both other species.

Transversal section of lamina. Spongy tissue filling almost the entire mesophyll; midvein and marginal veins with only abaxial sclerenchyma girder, the remaining 7 pairs with both; the adaxial girder with clavate apex and Y-shaped base. Adaxial furrows vestigial, abaxial four times deeper; midvein distinct with only abaxial sclerenchyma bundle; mesophyll with spongy tissue; bundle sheath distinct, not in contact with either epidermis; cuticle layer discontinuous.

Lamina of material from Pernambuco (*E. P. Her-*

←

section of lamina. K, L: *N. luetzelburgii* Alves drawn from *E. P. Heringer 826, D. Andrade Lima, J. de P. L. Sobrinho & A. C. Sarmento* (holotype, R; isotype, RB). —K. Transverse section of vascular bundle; note hairs in abaxial furrows and on adaxial surface. —L. Median transverse section of lamina. M, N. *N. plicata*. —M. Transverse section of vascular bundle. —N. Median transverse section of lamina with bundle topped by sturdy hair. In I, K, and M, sclerenchyma and cuticle are in black.

inger 826, D. Andrade Lima, J. de P. L. Sobrinho & A. C. Sarmento, R, RB) with 17 vascular bundles and adaxial cuticle 2–3 cells thick; material from Piauí (*L. Emperaire 715*, IPA) has 13 bundles and a thicker cuticle (4–5 cells). This seems related to differences in annual rainfall (ca. 500 mm in Pernambuco and < 300 mm in Piauí).

The specific epithet refers to the first collector, Philip von Lützelburg, a naturalist and important plant collector in northeastern Brazil.

Paratypes. BRAZIL. **Pernambuco:** Serra Talhada, Serra da Carnaubeira, Serrote Redondo, 22 May 1971, *E. P. Heringer, D. Andrade Lima, J. de P. L. Sobrinho & A. C. Sarmento s.n.* (R, RB); Petrolina, July 1974, *D. Andrade Lima s.n.* (SPF); Flores, Serra do Cruzeiro na estrada Triunfo–Sítio dos Nunes, 28 Mar. 1970, *D. Andrade-Lima 70–5848* (IPA). **Piauí:** São Raimundo Nonato, Caldeirão dos Rodrigues, 7 Jan. 1985, *Laure Emperaire s.n.* [fl], Ex Herbário da Missão Franco-Brasileira no Piauí (SPF); Serra da Capivara, 1979, *Laure Emperaire 715* [fr] (IPA, RB); Serra dos Ca_?, 6 July 1912, *Lützelburg 1210* (RB); Serra da Capivara, 1979, *Laure Emperaire 494* (IPA); Guaribas, Parque Nacional da Serra das Confusões, Gruta do Boi, ca. de 20 km de Caracol. 1–15 Oct. 2000 [st], *Percequillo, A. R. & Rodrigues, M. T. U. s.n.* (SPF); Caracol, Serra das Confusões, *Jorge, A. s.n.* [st] (SPF), *A. Fernandes s.n.* [fr] (SPF); Município São Raimundo Nonato, Margem direita da Estrada Canto do Buriti, S. Raimundo Nonato, 13 Oct. 1999, *França, A. R. et al. s.n.* [st], Ex Herbário TEGB (SPF); Piauí?: Nordeste, Excursão com Bigarela, Aug. 1972, *D. Andrade-Lima 72–6958* (IPA).

Gas chromatographic analysis coupled with mass spectrometry of the crude extract obtained in dichloromethane was conducted on samples of all three species. *Nanuza almeidae* revealed diterpenic skeletons of the labdane type not found in the other species and tetracosanoic acid {$C_{25}H_{50}O_2$, molecular mass = 382}; *Almeida s.n.* (R). *Nanuza luetzelburgii* revealed 8-heptadecenic acid {$C_{18}H_{34}O_2$, molecular mass = 282}; *Heringer 826 et al.*, *R Laure Emperaire 715* (IPA). No long-chain acids were found in *N. plicata*, which revealed only a mixture of carbohydrates with chain lengths of 12, 22, 27, and 35 carbons in a recent sample (*Riehl s.n.*, R), from the same population in Nova Friburgo, Rio de Janeiro, from which Riehl et al. (2000) had described xerophytolic acid.

As all species of *Nanuza* are insufficiently represented in collections, their distribution remains insufficiently known. At present, it seems that *Nanuza almeidae* occurs on gneiss-granitic inselbergs composing mountain chains of the first belt parallel to the coast, in the states of Bahia, Espírito Santo, and Rio de Janeiro. *Nanuza luetzelburgii* is known only from basaltic outcrops in the caatinga (dry savanna) of Pernambuco and Piauí in northeastern Brazil. *Nanuza plicata* has a broader range, growing on rock outcrops of various types throughout the Espinhaço and Chapada Diamantina mountain chains.

Color images complementing this article will be available at the internet address ⟨http://acd.ufrj.br/~mndb/nanuza.html⟩ immediately after printing.

KEY TO THE SPECIES OF *NANUZA*

1a. Caudex distinctly trigonous to triquetrous, with sharp edges; abaxial furrows of lamina well developed, without hairs; leaf sheath margins emitting long fibers that interlace on the caudex.
    2a. Lamina linear to lanceolate, without pseudopetiole, tepals elliptic . . . . *N. plicata*
    2b. Lamina with distinct pseudopetiole, adaxially glabrescent, tepals linear-lanceolate . . . . *N. almeidae*
1b. Caudex obscurely trigonous with rounded edges, abaxial furrows of lamina with abundant scabrous hairs; adaxial furrows half the depth of abaxial; leaf sheath margins serrulate, without fibers . . . . *N. luetzelburgii*

Selected additional examined material of N. plicata. BRAZIL. **Bahia:** Mun. Água Quente, Pico das Almas, Vertente oeste, entre Paramirim das Crioulas e a face NNW do Pico, 13°31′S, 42°00′W, 1250 m s. m., *R. M. Harley 27535* (SPF); Mun. Bom Jesus da Lapa, Caatinga sobre afloramentos (lagedos) rochosos, 14 Feb. 1991, *G. M. Hatschbach 55144 & O. S. Ribas* (SPF); Monte Santo, 3 Oct. 1972, *D. Andrade Lima s.n.* (SPF); Monte Santo [localidade típica], 4 Feb. 1972, *D. Andrade Lima s.n.* (RB); Mun. Gentio do Ouro, 27 Nov. 1992, *M. M. Arbo, R. M. Silva & João Vicente 5337* (RB); Mun. Barra da Estiva, 16 km NE de Barra da Estiva, 790 m s. m., 24 Nov. 1992, *M. M. Arbo, R. M. Silva & João Vicente 802* (RB); Mun. Santo Inácio, Serra do Açuruá, Arredores da cidade, 26 Oct. 1970, *D. Andrade-Lima 70–6150* (IPA); Mun. Acobina, Campo Formoso, 21 July 1978, *D. Andrade-Lima 78–8577* (IPA). **Espírito Santo:** Mun. Colatina, Angelo Freschiani, ca. 3 km após Ponte do Pancas, ca. 200 m s. m., veg. campestre em afloramento gneissico, *H. Q. Boudet Fernandes 2684 et al.* (SPF); Mun. Colatina, 15 km N de Colatina, 4 Dec. 1994, *J. R. Pirani, M. A. G. Magenta & A. A. Conceição s.n.* (RB); Colatina, Rodovia ES-080, ca. 15 km a Norte de Colatina, 4 Dec. 1994, *J. R. Pirani et al. s.n.* (SPF). **Minas Gerais:** Juíz de Fora, Linhares, Pedreira Santo Cristo, 15 May 1996, *A. N. Caiafa & G. L. G. Soares s.n.* (SPF); 10 km a Sul de Medina, rodovia BR-116, 20 Nov. 1985, *G. Hatschbach 50013 & J. M. Silva* (SPF); Mun. Itinga, 5 km de Itinga, *R. M. Silva 427 et al.* (RB, SPF); Mun. Itinga, Santana do Araçuari, 28 Aug. 1982, *L. G. Mautone, E. F. Guimarães & C. T. Rizzini s.n.* (RB); Parque Estadual da Serra do Brigadeiro, Serra da Araponga, Fazenda Neblina, Próximo ao laboratório de Campo, trilha subindo morro, 30 Sep. 1995, *J. A. Lombardi 983* (SPF); Mun. Mantena, Rio Preto, Fazenda Boa Vista do Sr. Antonio Ferreira Valente, 14 Oct. 1995, *G. E. Valente 148 & A. Azevedo* (SPF), 14 Oct. 1995, *G. E. Valente 147 & A. Azevedo* (SPF); Pedra Azul, 15 km da cidade, *V. C. Souza 5193 et al.* (SPF); Mun. Carlos Chagas, Rodovia BR418, Rio Quegeme, paredões rochosos, *G. Hatschbach 47086* (SPF); Águas Vermelhas, próximo ao Curral de Dentro, margem da Rodovia 251, 15 Aug. 1974, *D. Andrade Lima s.n.* (SPF); Mun. Varzelândia, Serra da

Caatinga, sobre a Lapa do Varal, 1 Feb. 1985, *J. G. da Silva 1069 & M. Menezes* (R); Mun. Varzelândia, Barreirinho, 7 Feb. 1985, *J. G. da Silva 1143 & M. Menezes* (R); Serra do Torreão, July 1897, *F. Brandão s.n.* (RB). **Rio de Janeiro:** Mun. Petrópolis, Araras, Malta, 8 Nov. 1968, *P. I. S. Braga 1354* (RB); Mun. Petrópolis, Pedro do Rio, Secretário, Nascente do Rio Capim Roxo, 7 Dec. 1986, *G. Martinelli 11985 & C. Alvim* (RB).

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Two New Species of *Phacelia* (Hydrophyllaceae) from the Southwestern United States

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ABSTRACT. *Phacelia filiae* N. D. Atwood, F. J. Smith & T. A. Knight is an undescribed species from Clark, Nye, and Lincoln Counties, Nevada. It is closely related to *Phacelia parishii* of California, Arizona, and Nevada and *Phacelia beatleyae* of southern Nevada. *Phacelia petrosa* N. D. Atwood, F. J. Smith & T. A. Knight from Arizona, Nevada, and Utah is also described as new. It is most closely related to *Phacelia crenulata*, which is known from Arizona, California, Nevada, and Utah. The most prominent differences among these species are the shape of the seeds and appearance of the seed coats.

Key words: Arizona, Hydrophyllaceae, Nevada, *Phacelia*, U.S.A., Utah.

The genus *Phacelia* comprises about 250 taxa mostly native to the New World and is best developed in the western United States and northern Mexico. This genus is known for its large number of endemic taxa. The two species described below are narrow endemics, with *Phacelia filiae* restricted to the Mojave Desert and the transition zone of the Mojave Desert and the Great Basin, and *Phacelia petrosa* to the lower drainages of the Colorado River in southern Nevada, southern Utah, and northwestern Arizona. One of the key characters used to distinguish species of *Phacelia* is seed morphology. Other morphological features that are useful are: size, shape, and color of flowers; duration; leaf size, shape, and pubescence; as well as stamen and style length in contrast to the corolla length. In addition, geographic distributions are useful in distinguishing taxa.

Phacelia filiae N. D. Atwood, F. J. Smith & T. A. Knight, sp. nov. TYPE: U.S.A. Nevada: Clark Co., Nellis Range, 36°38′02″N, 115°30′57″W, Three Lakes Valley, 45 air km NW of Las Vegas, 3080 ft. elev., 2 May 1998, *F. J. Smith & P. Dwyer 4217* (holotype, UNLV; isotypes, ARIZ, ASC, BRY, CAS, GH, MO, NY, NTS, OSU, RM, RSA, UNLV, US, UTC). Figures 1–3.

Similis *Phacelia parishii* sed in floribus et lobis corollarum majoribus foliis caulinum plus numerosis et seminibus grandibus paucioribus differt et a *P. beatleyae* in foliis plerumque basalibus nec vulgo caulinis et planis nec revolutis admodum integris seminibus parvioribus et plus numerosis absimilis.

Plants annual, 2.3–6.0 cm high, branched at or near the base; stems 2.5–7 cm long, curved upward; leaves mostly basal, petiolate, the blade 0.7–3.0 × 0.5–1.5 cm, ovate, elliptic, or oblong, entire to few toothed, the petiole 1.5–15 mm long; inflorescence of terminal secund cymes, 0.6–3.5 cm long; *calyx* united basally, the lobes heteromorphic, of unequal widths with 3 distinct veins, from narrowly spathulate to broadly obovate, 4–5 × 1.2–2.7 mm in flower, fruiting calyx 4.5–8 × 1.2–3.5 mm; corolla tubular-campanulate, 6–7 × 2.5–3.5 mm, the lobes 1.5–2.4 mm long, finely puberulent externally, the tube pale yellow, the limb lavender; stamens and style included, filaments 3–4 mm long, glabrous, attached at the base of the corolla tube; the style 1.1–1.2 mm long, bifid, glabrous; capsules 4.2–5.5 × 3.2–3.5 mm, finely glandular puberulent; seeds 18–26, 1.3–1.8 × 0.5–0.6 mm, angular, and with rounded or narrowed tips, black with evident pits.

Distribution. *Phacelia filiae* occurs in southern Nevada on Nellis Range (Clark County), Nevada

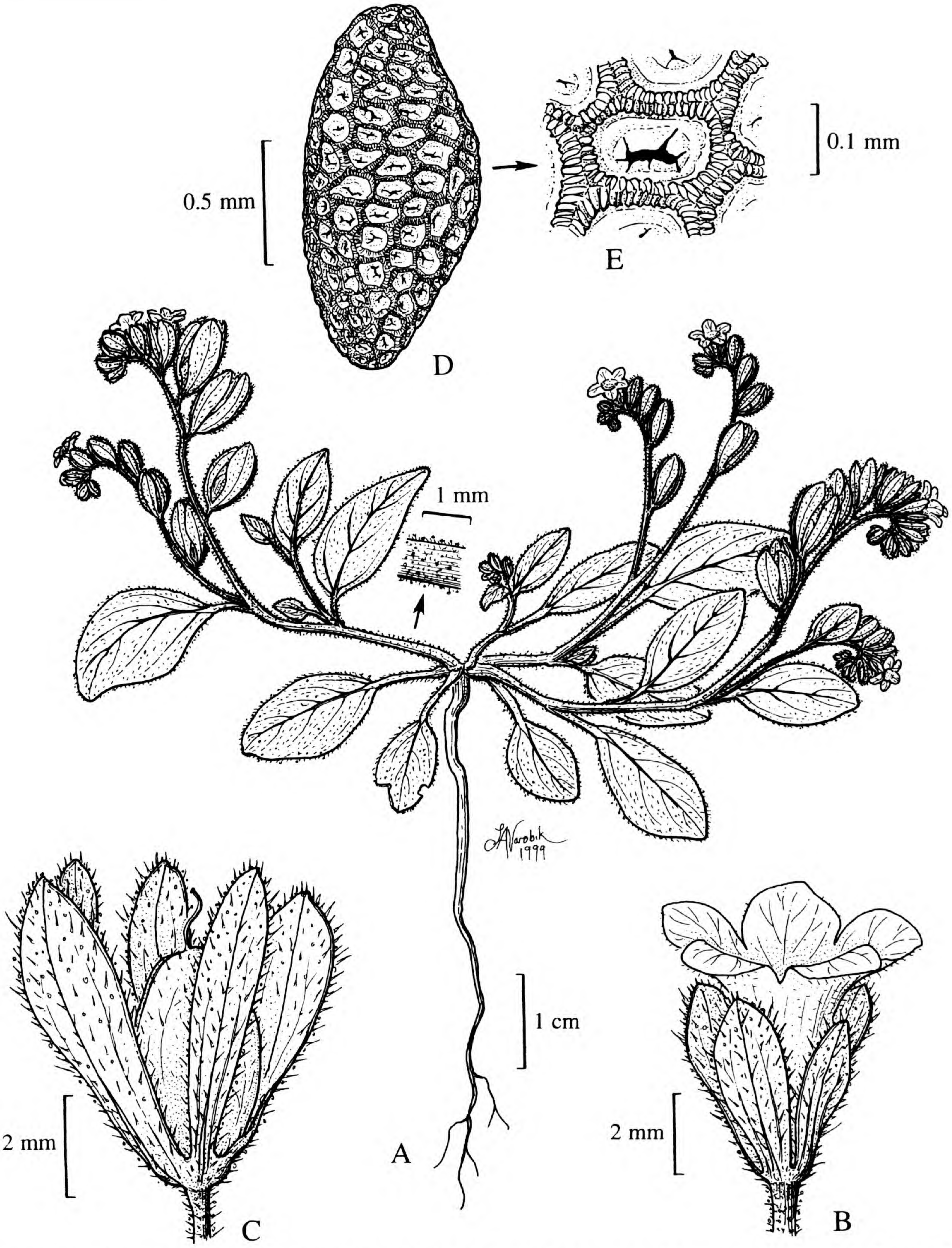

Figure 1. *Phacelia filiae* N. D. Atwood, F. J. Smith & T. A. Knight. —A. Habit. —B. Flower. —C. Fruit and calyx. —D. Seed. —E. Seed detail. Drawn by Linda A. Vorobik (plant based on the holotype *Smith & Dwyer 4217*, seed based on *Smith & Ackerman 3880*).

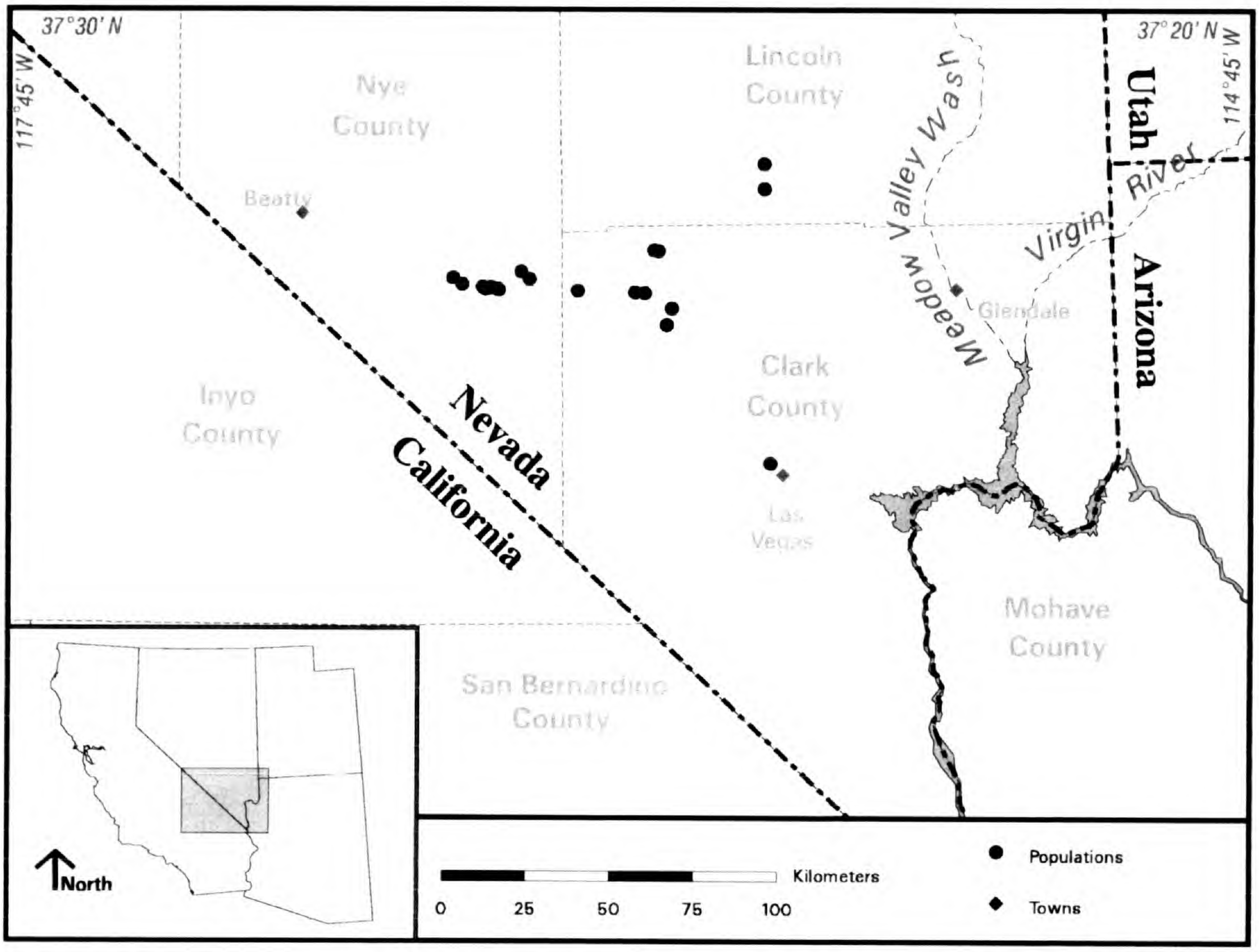

Figure 2. Known distribution (●) of *Phacelia filiae* in Clark, Lincoln, and Nye Counties, Nevada (◆ = towns).

Test Site (Nye County), Desert National Wildlife Refuge (Clark and Lincoln Counties) and in urban Las Vegas (Fig. 2).

Habitat. Plants of *Phacelia filiae* are found on relatively flat areas or on low knolls of the valley floor, mostly above the playas and in the foothills of desert mountains. This species grows in light-colored soils of calcareous sandstone, siltstone, tuffaceous claystone, and limestone substrates. Elevation ranges from 2000 to 4000 feet, where it occurs in shadscale, blackbrush, and creosote bush scrub.

Paratypes. U.S.A. **Nevada:** Clark Co., near Las Vegas, 8 May 1941, *A. Eastwood & J. Howell 8958* (CAS, GH, POM, RM, UTC); foothills of Spotted Range, 13 May 1941, *H. D. Ripley & R. C. Barneby 3425* (CAS, RSA); along Cheyenne Ave. near the drive-in theaters, Las Vegas, 25 Apr. 1979, *P. Leary 2941* (UNLV); Indian Springs Valley, T13S, R57E, S29, 15 May 1993, *F. J. Smith & E. Watkins 3670* (UNLV); Pintwater Range, T15S R56E S1, 3660 ft. elev., 23 Apr. 1995, *F. J. Smith & R. Schofield 3847* (UNLV); Indian Springs Valley, T15S, R56E, S3, 23 Apr. 1995, *F. J. Smith & R. Schofield 3848* (UNLV); Indian Springs Valley, T13S, R57E S29, 6 May 1995, *F. J. Smith & T. Cox 3861* (UNLV); W of Pintwater Range, T13S, R56E S28, 7 May 1995, *F. J. Smith & T. Cox 3862* (UNLV); W of Pintwater Range, T13S R56E S25, 7 May 1995, *F. J. Smith & T. Cox 3863* (UNLV); Spotted Range, T15S, R55E, S5, 28 May 1995, *F. J. Smith, J. Heers & E. Watkins 3893* (UNLV); Three Lakes Valley, T16S R57E S3, 30 Apr. 1995, *F. J. Smith & E. Watkins 3858* (UNLV); Lincoln Co., E side of Desert Lake, 28 May 1983, *T. Ackerman 83–562* (UNLV); SE end of Desert Lake, T11S, R60E, 10 May 1987, *A. Tiehm 10994* (RM, RSA, UNLV, UTC); Desert Lake, T11S, R60E S1, 22 Apr. 1995, *F. J. Smith, R. Schofield & B. Benjamin 3845* (UNLV); E side of Desert Lake, T11S, R60E, 16 May 1995, *F. J. Smith & T. Ackerman 3880* (UNLV); Desert Lake, T11S, R60E, S36, 28 Apr. 1995, *F. J. Smith & S. Sheldon 3854* (BRY, MO, NY, UTC); Nye Co., NW side of Rd. 28–03, 0.8 mi. NE of its junction with Jackass Flats Rd., E Rock Valley, 26 May 1976, *M. Williams 145* (UC); Rd. 28–03, 0.8 mi. NE of junction with Jackass Flat Road, E Rock Valley, 20 May 1976, *M. Williams 120* (NTS); 1 mi. E of Pink Holes Hill W of Frenchman Flat, 8 June 1976, *M. Williams 173* (NTS); W side of low hills 1.0 mi. S of Little Skull Mountain, W of Jackass Flat Road, Rock Valley, 26 Apr. 1978, *S. Cochrane & M. Williams 1010* (UNLV); NW Rock Valley off the W side of Jackass Flats Road S of the pass into Jackass Flats, 26 Apr. 1978, *M. Williams 450* (UNLV); 3.7 mi. W of 28–03 Road, W Rock Valley, 9 May 1978, *S. Cochrane & Timbrook 1092* (UNLV, RENO); E side of Burma Road, 1.4 mi. NW from Mercury Highway at Mercury Pass, NW slopes of Mercury Ridge, Red Mountain, 28 Apr. 1978, *M. Williams 461* (UNLV); Rock Valley, UTM 567482E, 4064091N, 4 May 1995, *G. Lyon 300* (UNLV); Rock Valley, along N and S sides of Jackass

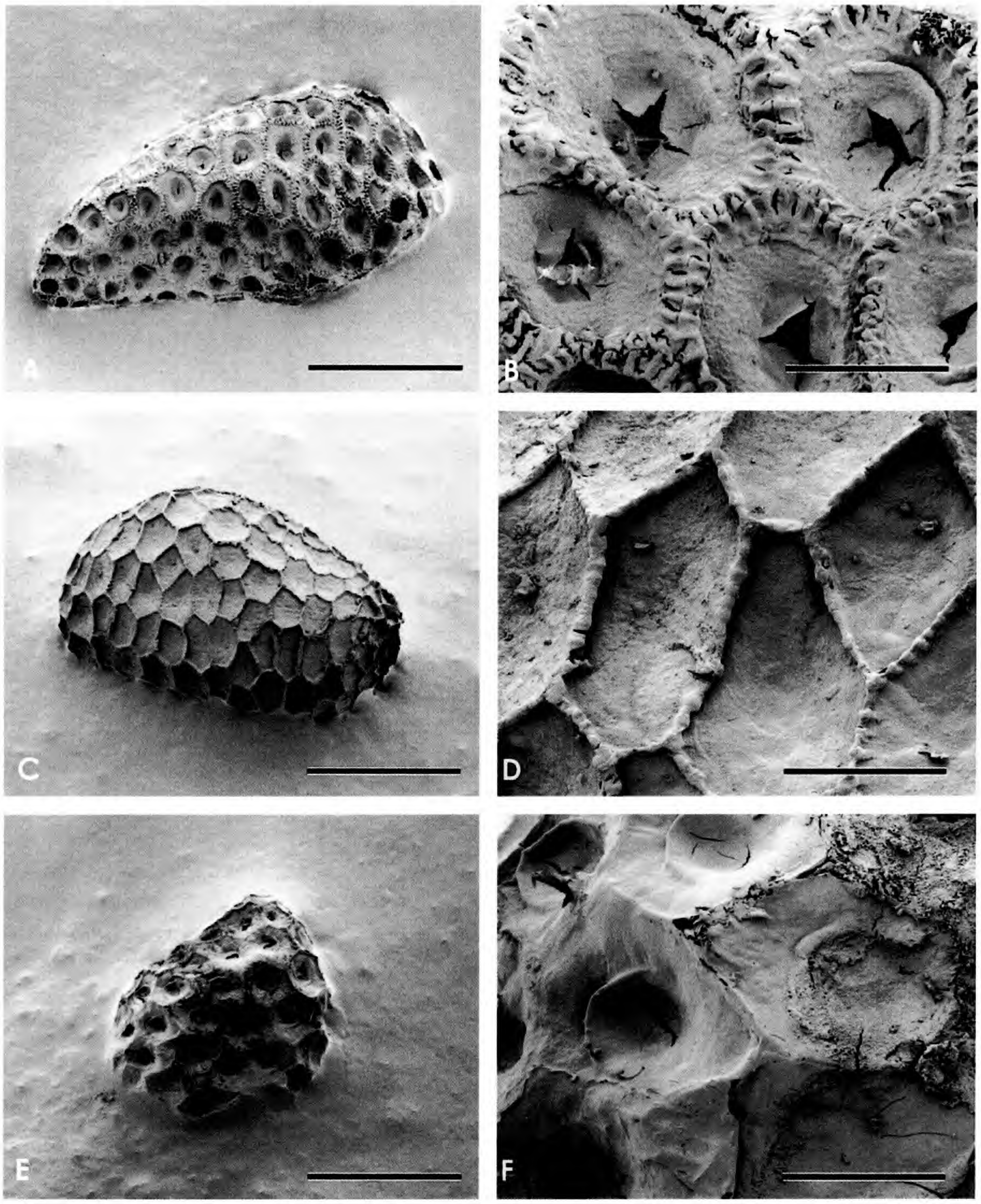

Figure 3. Scanning electron micrographs of seed and seed coat. A, B. *Phacelia filiae* from *Smith & Ackerman 3880* (UNLV). —A. Seed. —B. Seed coat. C, D. *Phacelia parishii* from *Anderson 95–9* (ASU). —C. Seed. —D. Seed coat. E, F. *Phacelia beatleyae* from *Beatley 5585* (UTC). —E. Seed. —F. Seed coat. Scale bar in A, C, E = 0.5 mm. Scale bar in B, D, F = 0.075 mm.

Flats Road, S of Skull Mtn., UTM 570164E, 4062190N, 8 May 1995, *T. Lindemann 47* (UNLV); Rock Valley, UTM 576247E, 4061394N, 8 May 1995, *T. Lindemann 48* (UNLV); Rock Valley, UTM 577080E 4060820N, 8 May 1995, *T. Lindemann 50* (UNLV); Rock Valley, UTM 580561E, 4060888N, 8 May 1995, *T. Lindemann 52* (UNLV); Rock Valley, UTM 581013E 4060575N, 9 May 1995, *G. Lyon 301* (UNLV); Rock Valley, UTM 579200E 4061100N, 1130 m elev., 9 May 1995, *G. Lyon 302* (UNLV); Rock Valley, UTM 578490E 4061200N, 9 May 1995, *G. Lyon 303* (UNLV); Rock Valley, UTM 577820E 4060960N, 9 May 1995, *G. Lyon 304* (UNLV); Frenchman Flat, UTM 590270E 4063720N, 10 May 1995, *G. Lyon 305* (UNLV); Frenchman Flat, UTM 587780E 4065920N, 10 May 1995, *G. Lyon 306* (UNLV).

In the spring of 1995, a new annual species of *Phacelia* was discovered on the Nellis Ranges by the second author. During that same year, the second author was conducting an inventory of *Phacelia parishii* for the Nevada Natural Heritage Program. In May, Smith visited known sites (Fig. 2) of *P. parishii* and *P. beatleyae* on the Nevada Test Site. Plants from there did not match the description or fit the key for *P. parishii* or *P. beatleyae.* They appeared to be the same undescribed *Phacelia* found on the Nellis Ranges. Surveys for this new *Phacelia* continued on Nellis lands through 1999, with populations appearing in high precipitation years. Approximately 30 populations comprise the currently known range.

The most significant differences among these species are the seeds: their number, shape, and the appearance of the seed coats. The seeds of these three species are distinct. The seeds of *P. filiae* are 1.3–1.8 mm long, 18 to 26 per capsule, long-angular in shape and rounded or narrowed to the ends, with more and deeper pits. The seeds of *P. parishii* are smaller, more numerous (30 to 40 per capsule), mostly rounded in shape with round tips and shallow pits; and the seeds of *P. beatleyae* are 40 to 50 per capsule, angular in shape, round at the tips, and deeply pitted. These distinguishing characters are observed readily in the electron micrographs (Fig. 3). In addition, the stems of *P. filiae* and *P. beatleyae* are always leafy, but some stems of *P. parishii* can be leafless. Also, the stems of *P. beatleyae* are erect while those of *P. filiae* and *P. parishii* are decumbent. *Phacelia filiae* differs from *P. parishii* in having larger tubular-campanulate flowers (6–7 mm long vs. 4–5 mm long), larger corolla lobes (1.5–2.4 mm long vs. 0.7–1.3 mm long), and more cauline leaves. It further differs from *P. beatleyae*, which lacks a basal rosette and has strongly revolute and essentially entire leaves.

Phacelia filiae should be placed with *P. parishii* and *P. beatleyae* in the subgenus *Eutoca*. According to Howell (1943), *Phacelia* subg. *Eutoca* is characterized by plants that are chiefly annual (some perennial) with leaves entire to shallowly lobed, corollas tubular or tubular-campanulate, stamens shorter than the corolla, style bifid or at most parted ⅓ its length, and by capsules that are generally elliptic or oblong and obtuse or truncate below the terminal apiculation. The species name *filiae* is used to honor the third author's daughter, with Clarke's phacelia the suggested common name.

The following key separates *P. filiae* from closely related species of *Phacelia* that occur in Nevada.

1a. Leaves essentially entire, revolute, all cauline; seeds 40 to 50 per capsule, 0.6–1.0 mm long, short angular or rounded . . . . *P. beatleyae* Constance & Reveal
1b. Leaves entire-crenate, not revolute, basal and cauline; seeds 40 or fewer per capsule, 1.1–1.8 mm long, roundish oblong or long angular.
  2a. Corolla 6–7 mm long, the lobes 1.5–2.4 mm long; seeds 18–26 per capsule, 1.3–1.8 mm long, deeply pitted (crater-like), long angular with narrowed or rounded ends and deeper pits . . . . *P. filiae* N. D. Atwood, F. J. Smith & T. A. Knight
  2b. Corolla 4–5 mm long, the lobes 0.7–1.3 mm long; seeds 30 to 40 per capsule, 0.9–1.1 mm long, roundish oblong with round ends and shallow pits . . . . *P. parishii* A. Gray

Phacelia petrosa N. D. Atwood, F. J. Smith & T. A. Knight, sp. nov. TYPE: U.S.A. Arizona: Mohave Co., T32N, R9W, S24, Mohave Strip, 1 mi. N of the Colorado River, E of Whitmore Canyon-Colorado River overlook on limestone talus slopes, 22 Apr. 1999, *D. Atwood & B. Furniss 24210* (holotype, BRY; isotypes, ARIZ, ASC, BM, CAS, GH, K, MO, NTS, NY, OSU, POM, RM, RSA, UNLV, US, UTC). Figures 4–6.

A *Phacelia crenulata* in pilis hispidis et glandularibus floribus minoribus et pedicellis longioribus infra, staminibus exsertis minoribus seminibus foveis nullis differt, a *P. ambigua* in seminibus pagina ventrali corrugata intus et cristam latum unum pagina dorsali bruneo pallide e margine stramineo pallido cicatricibus dorsalis rotundatis et elevatis et e radiis stellatis et floribus parvioribus et pubescentibus glandularibus infra inflorescentiis praecipue differt.

Plants annual, 1.0–3.2 dm tall; basal leaves 3.3–7.5 cm long, rounded to oblong, petiole up to 3 cm long, the blade 2.5–5.0 cm long, toothed, pinnatifid; cauline leaves irregularly dentate, reduced upward, 0.8–3 cm long, 0.8–2.0 cm broad, petiole 1.1–2.4 cm long; pubescence densely hispid with spreading, shiny hairs, and glandular villous; inflorescence of paired terminal cymes with capitate multicellular hairs, cymes elongating to 6 cm long in fruit; pedicels 0.8–1.5 mm long in flower, lower pedicel to 5.4 mm long; calyx 3.0–3.4(4.2) mm long, the lobes oblanceolate, separate to near the base, 0.9–1.5 mm wide, not enlarging in fruit; corolla campanulate, 5.8–6.0 mm long and broad, blue, lighter at base, the lobes glabrous to pubescent externally; stamens and style exserted, stamens subequal to the style, 3.7–4.3 mm long, filaments purple and glabrous, style 2.8–4.5 mm long, bifid, lower portion pubescent with glandular hairs; capsule globose, mature capsules 3.0–4.0(4.6) mm broad and long, equaling to exceeding the calyx lobes, finely puberulent with some glandular hairs especially on the upper half; seeds 4, oblong, 3.3–3.8 mm long, 1.5–3.1 mm wide, the ventral surface corrugated along the inside margin and one side of the ridge, dorsal surface with a lighter stramineous margin and light brown surface, dorsal cells round in shape and raised with star-like rays.

Distribution. *Phacelia petrosa* occurs in southwestern Utah (Washington County), southeastern Utah along the San Juan River (San Juan County), northwestern Arizona along the Colorado River in Mohave and Coconino Counties, and southern Nevada in Lincoln and Clark Counties (Fig. 5).

Habitat. The species is generally found on dry limestone and volcanic talus slopes of foothills,

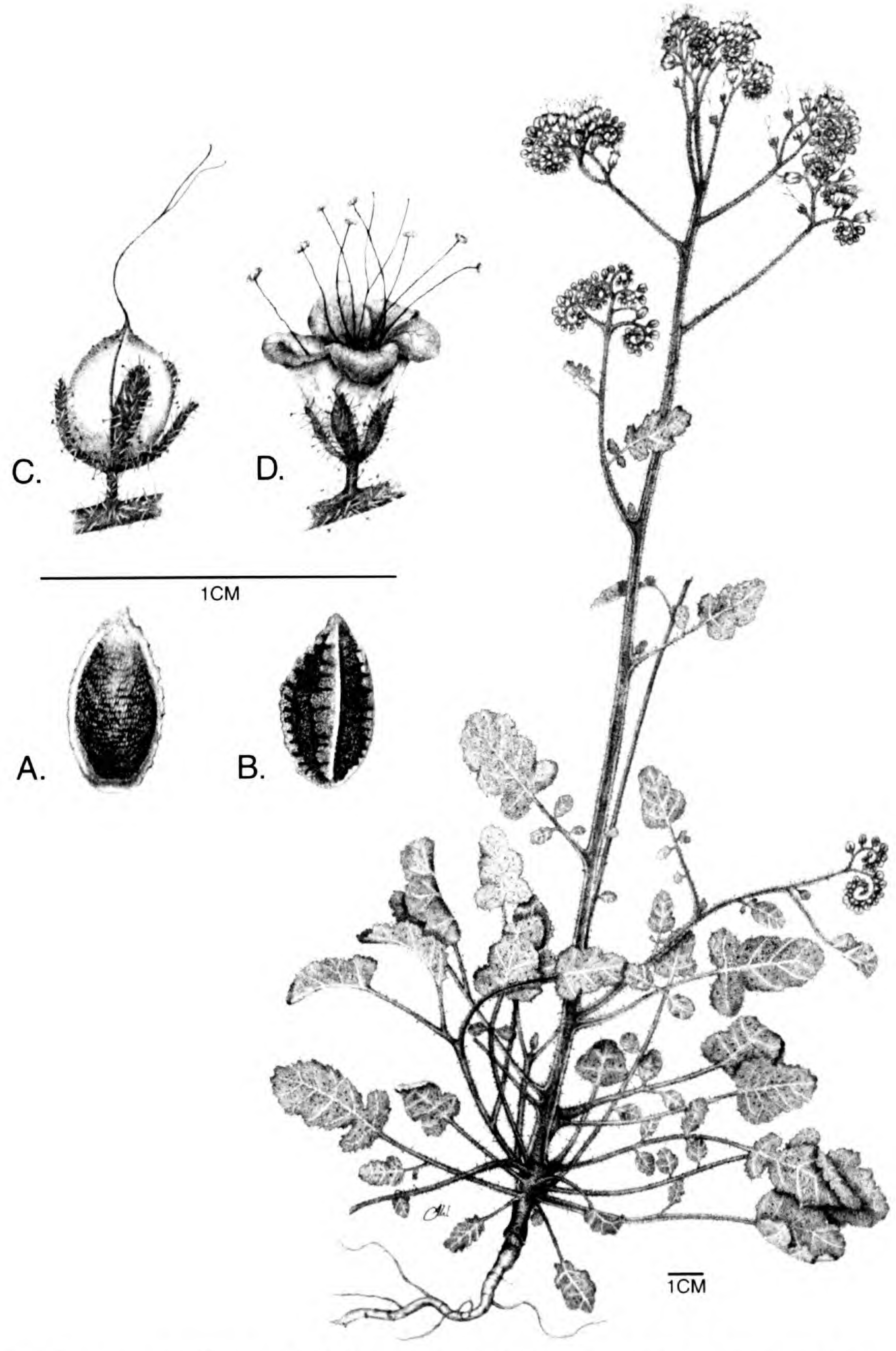

Figure 4. *Phacelia petrosa* N. D. Atwood, F. J. Smith & T. A. Knight. —A. Dorsal surface of seed. —B. Ventral surface of seed. —C. Capsule, sepals, and style. —D. Flower with exserted stamens and style. Drawn by Shannon Workman (based on the type specimen *Atwood & Furniss 24295* (BRY)).

washes, and gravelly canyon bottoms. It grows mostly on calcareous parent material but has been collected on dry volcanic talus slopes. The elevation range is 2500 to 5800 feet, where it occurs in mixed desert shrub, creosote bush, and blackbrush communities.

Paratypes. U.S.A. **Arizona:** Coconino Co., Bright Angel trail, 16 Apr. 1938, *Darrow s.n.* (UC); Bright Angel trail near first creek crossing above river, 9 May 1940, *Bailey & Bailey 1097* (UC); beyond Miner's cabins, Havasu Canyon, 3 May 1947, *Deaver 2085* (ASC); Hualapai Canyon, 28 May 1950, *J. Howell 26588* (CAS); above House Rock Rapids and Hot Na Na Wash, 8 May 1973, *A. Phillips s.n.* (ARIZ); about 1 mi. downstream from House Rock Rapids and Rider Canyon, 9 May 1973, *A. Phillips s.n.* (ARIZ); first canyon downstream from Unkar Canyon on N, 13 May 1973, *A. Phillips s.n.* (ARIZ); 18.5 mi. campground, Colorado River, 18 May 1976, *Hevly s.n.*

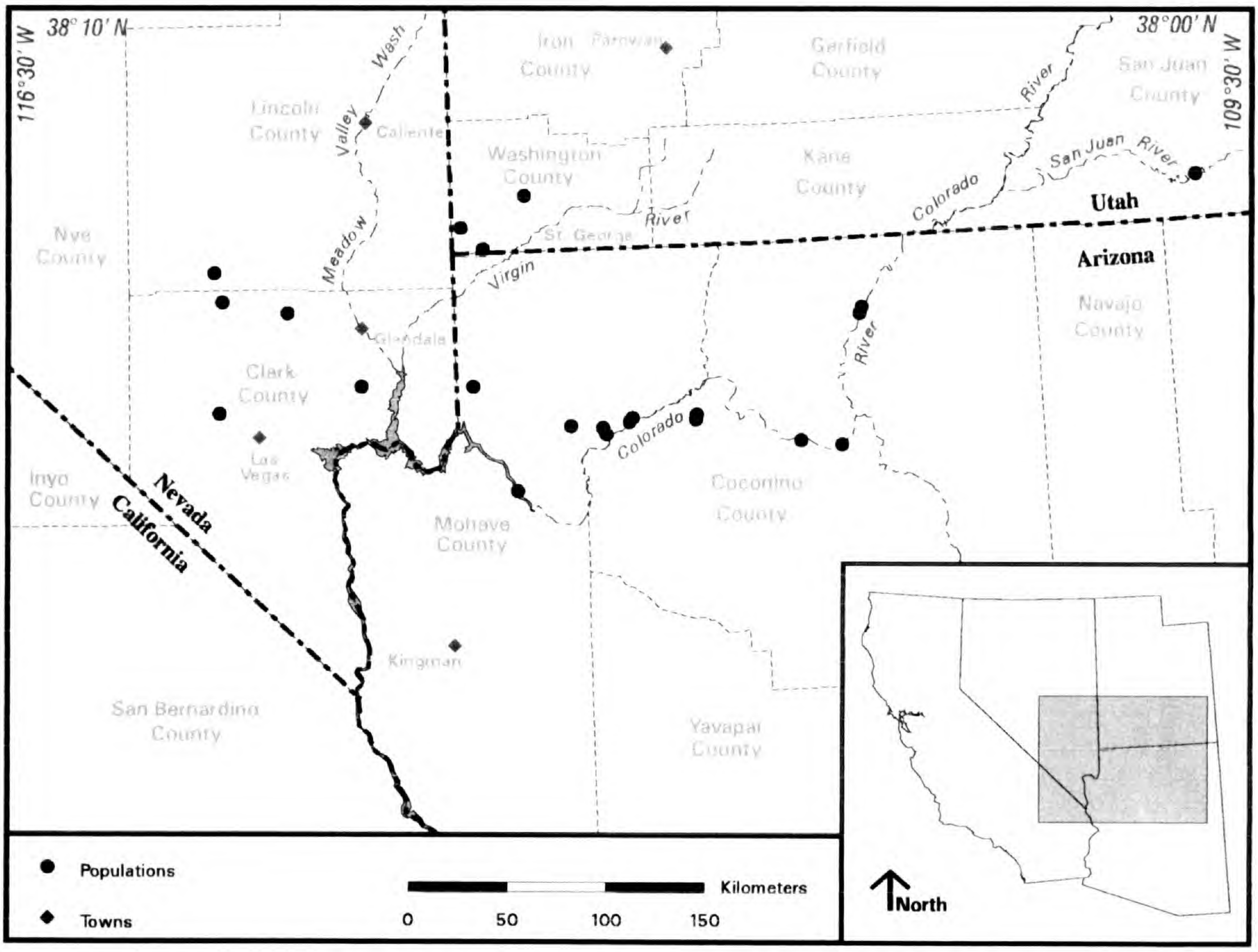

Figure 5. Known distribution (●) of *Phacelia petrosa* in northwestern Arizona, Clark and Lincoln Counties, Nevada, and San Juan and Washington Counties, Utah (◆ = towns).

(ASC); Cottonwood Canyon, 22 Apr. 1979, *Van Devender, Cole, Markgraf & Martin s.n.* (ARIZ); Mohave Co., Toroweap Valley, ca. 4250 ft. elev., 30 Apr. 1952, *E. McClintock 52–277a* (CAS); S of Toroweap Point, halfway between Devil's Bathtub and Burro Canyon, 1 May 1952, *E. McClintock 52–348* (CAS); inner gorge of Grand Canyon, along lava slide on trail to river, 5 May 1952, *E. McClintock 52–406* (CAS); below Emery Falls, opposite Rampart Cave, 8 Apr. 1971, *Martin s.n.* (ARIZ); side canyon at Grand Canyon mile 254.6R, 8 Apr. 1993, *A. Phillips & B. Phillips 9381* (ASC); T35N, R15W, S31 NW ¼, black lava ridge SE of Pakoon Ranch, 15 May 1985, *D. Atwood 10945* (BRY); T32N, R10W, S6, Andrus Canyon 3 mi. W of Andrus Point, 26 Apr. 1999, *D. Atwood & B. Furniss 24295* (BRY, MO, NY, US); T32N, R9W, S11 NWSE, 2 mi. E of Whitmore Point, 22 Apr. 1999, *D. Atwood & B. Furniss 24222* (ARIZ, ASU, BRY, MO, NY, UNLV). **Nevada:** Clark Co., SE end of Las Vegas Range, 14 May 1976, *T. Ackerman 76–56* (UTC); NNW foothills of Charleston Mts., T17S, R56E, S4 SW ¼, 5 air mi. S of Indian Springs, 2 May 1985, *D. Atwood & K. Thorne 10854* (BRY, RENO); Las Vegas Range, Second Canyon S of Peek-a-boo Canyon, 29 May 1976, *T. Ackerman 4996* (UC, UNLV); Desert Range, T13S, R59E S20, 22 May 1993, *F. J. Smith, T. A. Knight & J. Pedrick 3680* (UNLV); Valley of Fire, T18S, R66E, S1, 17 May 1995, *F. J. Smith & T. Ackerman 3882* (UNLV); Lincoln County, Las Vegas Range, Elbow Canyon, T14S, R62E, S1 NE¼, 15 May 1995, *F. J. Smith & T. Ackerman 3877* (UNLV, UTC); Desert Range, T12S, R59E, S6, 1 May 1993, *F. J. Smith & R. Schofield 3634* (UNLV). **Utah:** San Juan Co., Mile 40.6 at the lower end of the Goosenecks of the San Juan River, 6 May 1997, *N. D. Atwood et al. 21911* (BRY, MO); mi. 59.2, 0.7 mi. below Johns Canyon along the San Juan River, 7 May 1997, *N. D. Atwood et al. 21934* (BRY); Washington Co., T42S, R19W, S18, Beaver Dam Wash 3 mi. S of Lytle Ranch, 17 Apr. 1986, *D. Atwood & K. Thorne 12000a* (BRY); SW of Bulldog Canyon, 17 May 1986, *L. C. Higgins 16552* (BRY); Diamond Valley volcano, 26 May 1986, *L. C. Higgins 16665* (BRY), 2 June 1998, *L. C. Higgins 19641* (BRY, GH, MO, NY, OSU, RSA, US); T41S, R16W, S3 SWSE, NE corner of Snow Canyon State Park at Winter Quarters, 20 May 1992, *M. F. Franklin 7484* (BRY); T43S, R18W, S33, S of Bull Dog Canyon, 3 May 1986, *K. Thorne et al. 4505* (BRY); T43S, R18W, S28 SE ¼, Bull Dog Knolls, 1 May 1986, *G. Baird & S. Welsh 2395* (BRY); T43S, T18W, S28, S slope of Bull Dog Knolls, 30 Apr. 1986, *S. Welsh & G. Baird 23698, G. Baird 2323 do* (BRY).

In 1970, the senior author examined collections of this species from the Grand Canyon. An attempt was made to find the species in the field in 1971 without success. The species became a forgotten entity until Smith and Knight discovered it while doing fieldwork on Nellis Ranges in 1993. They collected a *Phacelia* in the Desert Range (Lincoln County, Nevada) with pubescence much different

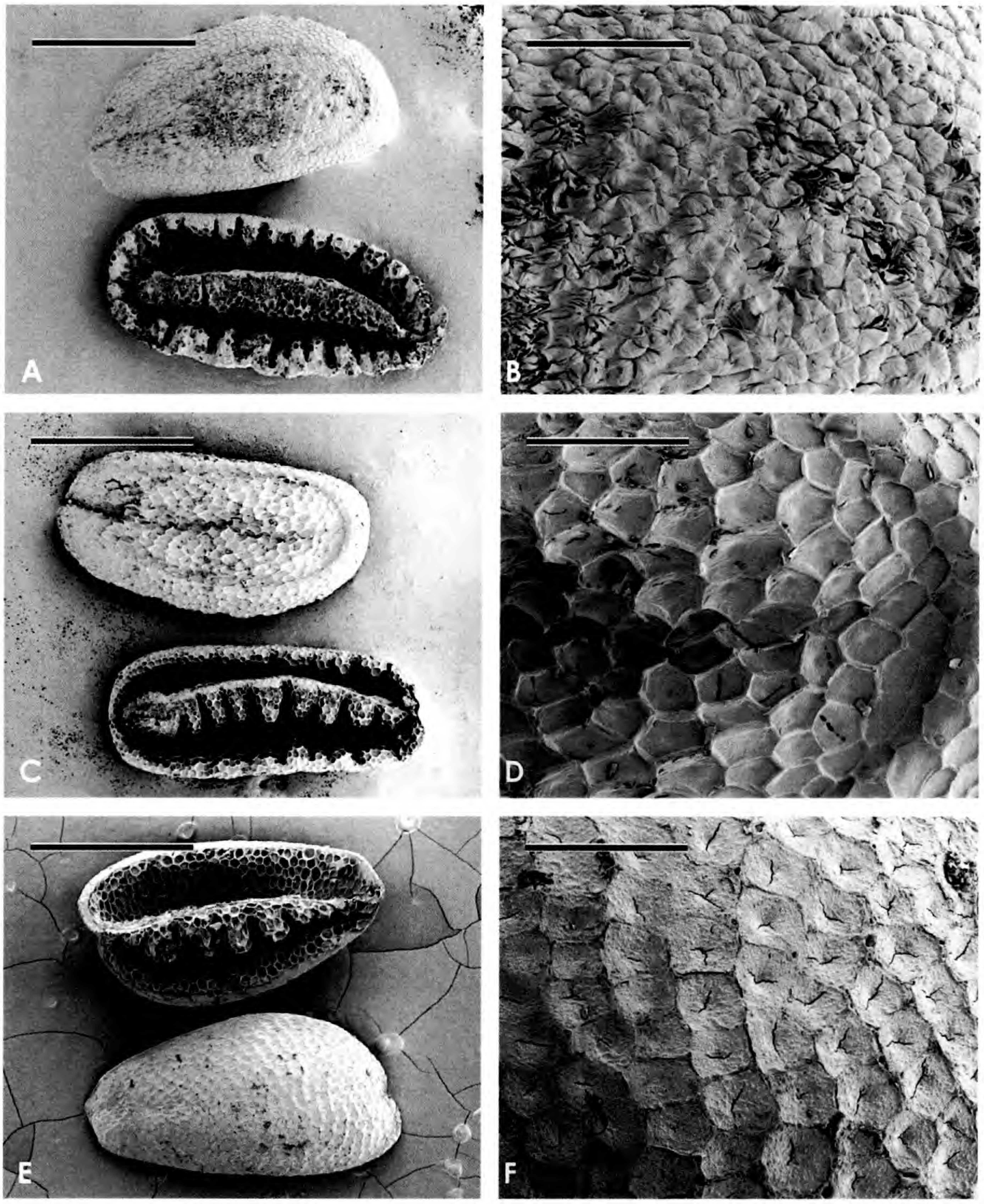

Figure 6. Scanning electron micrographs of seeds and seed coat. A, B. *Phacelia petrosa* from *Atwood 10945* (BRY). —A. Seed. —B. Seed coat. C, D. *Phacelia crenulata* from *Holmgren & Reveal 1031* (UTC). —C. Seed. —D. Seed coat. E, F. *Phacelia ambigua* from *Higgins 15475* (BRY). —E. Seed. —F. Seed coat. Scale bar in A, C, E = 1.5 mm. Scale bar in B, D, F = 0.3 mm.

than typical *Phacelia ambigua* and *P. crenulata*. Based on close examination, the seed morphology of *P. petrosa* differs from that of *Phacelia ambigua* and *Phacelia crenulata*. *Phacelia petrosa* has been identified on herbarium sheets in the past as *P. crenulata*, *P. pedicellata*, *P. ambigua*, *P. minutiflora*, and *P. ambigua* var. *minutiflora*.

Phacelia petrosa belongs to the Crenulatae group of species in the subgenus *Phacelia* in section *Phacelia*. The Crenulatae group is distinguished by the four-seeded capsule and excavated ventral surface of the seeds (Atwood, 1975). *Phacelia petrosa* is most closely related to *P. crenulata* and *P. ambigua*. The most significant differences among these species are the appearance of the seed coat, flower size, and pubescence. As can be seen on electron micrographs, the seed coat morphology for each of the species is distinctive (Fig. 6A–F). *Phacelia petrosa* differs from *P. crenulata* in being more hispid, with shorter and less glandular pubescence, smaller flowers, longer pedicels on the lower flowers, stamens less exserted, and the seeds not foveolate. The new species differs from *P. ambigua* in having the ventral surface of the seeds corrugated along the inside margin and one side of the ridge, dorsal surface with a lighter stramineous margin and light brown surface, dorsal cells round in shape and raised with star-like rays, smaller flowers, and glandular pubescence, especially below the inflorescence. The species is named for the rocky places where it grows on limestone and volcanic substrates. The suggested common name is rock phacelia.

The following key distinguishes *Phacelia petrosa* and its closely related species.

1a. Stems mostly glandular with some short nonglandular hairs (not hispid) . . . . *Phacelia crenulata* Torrey ex S. Watson

1b. Stems with spreading, hispid hairs as well as viscid-puberulent or finely stipitate-glandular pubescence.

  2a. Seeds corrugated only along one side of the ventral ridge, no stramineous margin on the dorsal surface *Phacelia ambigua* M. E. Jones

  2b. Seeds corrugated on the margins as well as along one side of the ventral surface, stramineous margin present on the dorsal surface . . . . *Phacelia petrosa* N. D. Atwood, F. J. Smith & T. A. Knight

Conservation status. *Phacelia filiae* is limited to a small area in southern Nevada from the urban Las Vegas area to lands managed by the Departments of Defense, Energy, and Interior. Populations in or near the urban environment of Las Vegas are threatened by direct loss from development and habitat fragmentation, or are already extirpated. Populations on federal lands (Defense and Energy) are largely protected by their remoteness and restricted access. A few populations occur in valley bottoms and may be vulnerable to defense-related activities. Conservation of these areas is being addressed by Nellis Air Force Base (Keystone Dialogue, 1998). The conservation status of *Phacelia petrosa* is unknown. Since most locations were not visited, an evaluation needs to be made.

Acknowledgments. The authors thank Linda Ann Vorobik and Shannon Workman for ink illustrations of *P. filiae* and *P. petrosa*, respectively, William McManus and Heather Leary for SEM photography, Stanley Welsh and students of the 1999 winter Botanical Latin class for the Latin descriptions, and Marti Aikens and Gerald Hughes of GeoGraphics for production of the distribution maps. Review by Noel Holmgren strengthened the manuscript and is greatly appreciated. Kevin Blomquist donated time, assistance, and access to the Nevada Test Site. Curators at ARIZ, ASC, BRY, CAS, GH, NTS, NY, POM, RENO, RM, RSA, UC, UNLV, and UTC generously loaned specimens for review. Department of Defense funded inventory work by The Nature Conservancy was conducted through a grant from the Legacy Resource Management Program. We are grateful to Colonels Thomas Lillie and Douglas Ripley for their support, advice, and enthusiasm. Nellis Air Force staff, and Eric Watkins in particular, facilitated trips onto the restricted Ranges for over half a decade. Overlapping surveys for the Nevada Natural Heritage Program provided additional support for *Phacelia* inventory in Nevada.

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Ipomoea electrina (Convolvulaceae): A New Name for *Exogonium luteum* House

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ABSTRACT. The history of a southern Mexican endemic *Ipomoea* is summarized, beginning with its publication in 1908 as *Exogonium luteum* House. Because of a previously existing *Ipomoea lutea* Hemsley, the new name *Ipomoea electrina* is proposed to refer to the unique amber-colored flowers of these plants. Since two distantly related congeners, *Ipomoea lutea* and *I. urbinei*, have nomenclatural and misidentification histories interlaced with *I. electrina*, they are also discussed and compared with this taxon.

RESUMEN. Se presenta un resumen de la historia de una *Ipomoea* endémica del sur de México, empezando con su publicación en 1908 como *Exogonium luteum* House. Debido a la previa existencia de una *Ipomoea lutea* Hemsley, se propone el nuevo nombre *Ipomoea electrina* en referencia al característico color ámbar que poseen las flores de estas plantas. Dos congéneres lejanamente relacionados, *Ipomoea lutea* e *Ipomoea urbinei*, con historias de nomenclatura y erróneas identificaciones entrelazadas con *Ipomoea electrina*, también se discuten y comparan con este taxón.

Key words: biodiversity, convergence, Convolvulaceae, *Exogonium*, *Ipomoea*, Mesoamerica, morning glories, New World.

Homer D. House described numerous New World Convolvulaceae (House, 1905, 1906a–d, 1907a–e, 1908a–d, 1909), among them *Exogonium luteum*, a name and species that has proven controversial in recent years (Austin, 1978, 1983; McPherson, 1979). House (1908d) originally put the species in *Exogonium*, a genus that he considered to be distinct and closely related to *Ipomoea*, but distinguishable on the basis of its exserted stamens and style (i.e., *exo-gonia*). New World morning glories of this type, usually presenting yellow, orange, or red, salverform corollas, are generally associated with bird pollination, or the occasional visitations of butterflies (Austin, 1978, 1997; McDonald, 1987, 1991). Subsequent authors have recognized that this ornithophilous syndrome has arisen on numerous occasions within New World Convolvulaceae, especially within the genus *Ipomoea* s.l., including most of the original elements that House assigned to *Exogonium.* Consequently, modern students of the family have considered the exogonioid taxa largely as derivative species that should be accommodated in various sections within *Ipomoea* (Austin, 1997; McDonald 1987, 1991; McPherson, 1979). Some species of *Exogonium* sensu House were retained in *Ipomoea* sect. *Exogonium* (Choisy) Grisebach (McDonald, 1987), while others were transferred to *Ipomoea* sect. *Mina* (Cervantes) Grisebach (Austin, 1978, 1980) and *Ipomoea* sect. *Eriospermum* Hallier f. (Austin, 1980), and yet others to *Turbina* (Austin & Staples, 1991), and even *Ruellia* (Austin & Wasshausen, 1973) of the Acanthaceae. *Exogonium luteum* requires the same consideration, though its legitimate transfer to *Ipomoea* has yet to take place.

TAXONOMIC PROBLEM

Austin (1978) maintained *Exogonium luteum* in *Ipomoea*, but noted that the specific epithet of the basionym could not be applied to the genus due to the priority of *Ipomoea lutea* Hemsley. Austin therefore proposed a new name for the species, *I. shinnersii*, under which was also recognized *Ipomoea shinnersii* var. *woronovii* (Standley) D. F. Austin (1978). Unfortunately, the epithet *woronovii* in fact has priority over the epithet *shinnersii* due to its earlier publication date, and therefore renders *I. shinnersii* as an incorrect name under Article 52.3 of the *Code* (Greuter et al, 2000). Later, Austin (1983) corrected that mistake by creating *I. woronovii* (Standley) D. F. Austin, while still interpreting *E. luteum* as a synonym of *I. woronovii.*

McPherson (1979) also realized the misinterpretation, and proposed *Ipomoea crocea* as a new name for *Exogonium luteum* in his dissertation. Unhappily, he did not formally publish this name. Breedlove (1986), apparently finding the McPherson name on an annotation label, published it as a *nomen nudum*. Thus, the third attempt to provide a name for these Mexican plants created yet another unusable name.

McDonald (1987) later recognized *Ipomoea woronovii* as a synonym of *I. urbinei*, but did not discuss *Exogonium luteum*, having recognized that it referred to a distinct, and indeed, distantly related species. McDonald (1987) did not propose a new name for House's species, as his treatment did not discuss the group to which *E. luteum* belongs. Thus, *E. luteum* has been recognized as an *Ipomoea* by all modern students of the genus, even though it still lacks a legitimate name.

TAXONOMIC RESOLUTION

Because three distinctive species are involved with this confusion, we present the nomenclature and a brief description of each, to help clarify the matter for our upcoming treatment of the Convolvulaceae in *Flora Mesoamericana*.

1. **Ipomoea lutea** Hemsley, Diagn. Pl. Nov. Mexic. 2: 34, tab. 60. 1879, non *Exogonium luteum* House, Bull. Torrey Bot. Club 35: 103. 1908. *Quamoclit lutea* (Hemsley) Hallier f., Bot. Jahrb. Syst. 16: 537. 1893. TYPE: Guatemala. *O. Salvin & C. Godman* (holotype, K not seen, photo).

Ipomoea lutea f. *rubra* O'Donell, Lilloa 29: 67. 1959. TYPE: Mexico. Chiapas: from Chicharras, alt. 3000–6000 ft., 6 Feb. 1896, *E. W. Nelson 3768* (holotype, GH; isotype, US).

Twining herbs, probably perennial, stems climbing or prostrate, probably to 5 m, glabrous or sometimes pilose on the nodes. Leaves 3–15 × 3–15 cm, ovate, entire, with undulate borders, irregularly dentate, 3-lobed or 3-parted, glabrous or pilose on the base, the base cordate, the apex acute to acuminate, at times obtuse, mucronate. Inflorescences in cymes, ± corymbiform. Flowers 4 to 14, rarely solitary; sepals 2–3 mm, the outer ovate to elliptic, glabrous, with subterminal arista 1–8 mm, glabrous or finely pilose, the inner 3–4 mm, ovate, narrowly elliptic to ± orbicular, obtuse to truncate or emarginate, glabrous, borders hyaline, arista 3–7 mm, glabrous or pilose; corolla 4–6 cm, ± tubular, yellow, red, or orange, somewhat curved, the limb 5-lobed, the lobes 4–6 mm long, narrow, obtuse, glabrous; stamens 5.5–7 cm, exserted from corolla tube 1 cm or more. Fruits 8–10 mm, globose, capsular; seeds 1 to 4, 4–4.5 mm, globose, brown, tomentose, with patches of longer clear trichomes.

Distribution. Forests; 1200–1500 m. Endemic to southern Mexico and nearby Guatemala. Flowering December–February.

Following the taxonomic precedent set by O'Donell (1959), we retain *Ipomoea lutea* in *Ipomoea* sect. *Mina* on the basis of its highly diagnostic sepals, which present long and fleshy, subterminal aristae. This taxon is the sister species of *I. hastigera* Kunth, which is distinguished primarily by its smaller corolla and pseudo-umbellate cymes.

Specimens examined. GUATEMALA. *Kellerman 557* (GH, US). MEXICO. **Chiapas:** *Matuda 16190* (F, GH, MEXU, US).

2. **Ipomoea urbinei** House, Muhlenbergia 3: 41, pl. 2, fig. 2. 1907. TYPE: Mexico. Colima: slopes of Volcan de Colima, 1881, *M. Bárcena 214* (plate selected as lectotype by McDonald, 1987: 51).

Quamoclit tubulosa M. Martens & Galeotti, Bull. Acad. Roy. Soc. Bruxelles 12: 270. 1845. *Ipomoea tubulosa* (M. Martens & Galeotti) Hemsley, Biol. Centr. Amer. Bot. 2: 395. 1882, non *Ipomoea tubulosa* Roemer & Schultes, Syst. Veg. 4: 789. 1819. *Exogonium uhdeanum* Fenzl ex Hallier f., nom. illegit., Bot. Jahrb. Syst. 16: 559. 1893. *Ipomoea uhdeana* (Fenzl ex Hallier f.) D. F. Austin, nom. illegit., Ann. Missouri Bot. Gard. 64: 332. 1978. TYPE: Mexico. Michoacán: "dans les champs d'Uruapan, à 4000 pieds, Fl. rouge," *H. Galeotti 1393* (holotype, BR; isotypes, BR, P, W).

Ipomoea woronovii (Standley) D. F. Austin, Taxon 32: 626. 1983. *Exogonium woronovii* Standley, Field Mus. Natl. Hist., Bot. Ser. 11: 171. 1932. *Ipomoea shinnersii* D. F. Austin var. *woronovii* (Standley) D. F. Austin, Ann. Missouri Bot. Gard. 64: 332. 1978. TYPE: Mexico. Michoacán: *G. J. N. Woronow 2906* (holotype, F).

Herbs, perennials; the stems woody at least near the base, to 3 m, often purple-pigmented, mostly glabrous. Leaves 4–7 × 3–5.5 cm, ovate or ovate-elongate, glabrous or densely puberulent with minute yellow trichomes on lower surface, the base cordate and occasionally enveloping inflorescences on fertile branches, the apex attenuate, mucronulate. Inflorescence in monochasial cymes. Flowers 2 to 5, with peduncles 1.4–3.3 cm long, with pubescence like the leaves; sepals unequal, the outer shorter, 3–4 mm, coriaceous, the inner 7–9 mm, membranous, the apex acute to obtuse on outer, obtuse to emarginate on inner, glabrous; corolla 3–4 cm long, ± salverform, red, the tube almost constituting the whole perianth, the limb 5 distinct short triangulate lobes, 5–7 mm long; stamens exserted, exceeding the limb by 3–5 mm. Fruits capsular, conical, 11–12 mm long, 2-locular, 4-valvate; seeds 4, 6–10 mm long, 4–5 mm wide, dark brown, puberulent.

Distribution. Mountain forests; 1300–1640 m. Endemic to Colima and Michoacán, Mexico. Flowering September–January.

Illustrations. House (1907d: 41, pl. 2, fig. 2); McDonald (1987: 80, fig. 9b).

Hallier created an illegitimate superfluous name because he included only indirectly (he did not cite the basionym directly, only the combination based on it) the type of the earlier name *Quamoclit tubulosa* M. Martens & Galeotti. In other words, Hallier should have used the available epithet *tubulosum* instead of adopting the herbarium name written by Fenzl on the sheet as a determination. Therefore, *Ipomoea uhdeana* (Fenzl ex Hallier f.) D. F. Austin was based on the illegitimate basionym *Exogonium uhdeanum* Fenzl ex Hallier f. Since usage of an illegitimate basionym is prohibited by the *Code* (Greuter et al., 2000), we use the next available name. *Ipomoea tubulosa* (M. Martens & Galeotti) Hemsley cannot be used because *Ipomoea tubulosa* Roemer & Schultes has priority over this binomial. In the absence of specimen at MEXU, McDonald (1987) designated the plate as the lectotype.

As indicated by McDonald (1987), *Ipomoea urbinei* is a member of *I.* sect. *Exogonium.* The species shares many traits, including unequal, acute, membranaceous sepals, salverform corolla, and exserted stamens, with *I. dumosa* (Bentham) L. O. Williams and that is surely the sister taxon.

Additional specimen. MEXICO. **Michoacán:** *G. Hinton et al. 12254* (NY, TEX, US).

3. Ipomoea electrina D. F. Austin & J. A. McDonald, nom. nov. Replaced name: *Exogonium luteum* House, Bull. Torrey Bot. Club 35: 103. 1908, non *Ipomoea lutea* Hemsley, Diagn. Pl. Nov. Mexic. 2: 34, t. 60. 1879. *Ipomoea shinnersii* D. F. Austin, nom illegit. sed non superfl. [see Taxon 32: 626. 1983], Ann. Missouri Bot. Gard. 64: 337. 1977 [1978]. *Ipomoea woronovii* (Standley) D. F. Austin var. *lutea* (House) D. F. Austin, Taxon 32: 626. 1983. TYPE: Mexico. Oaxaca: Cuesta de Chiquihuetlan, 3300 ft. alt., 2 Sep. 1895, *C. Conzatti & J. Gonzalez 668* (holotype, GH; isotype, NY).

Herbs, perennial; the stems woody at the base, herbaceous toward the apex, reaching 2–3 m or more, densely or sparsely pubescent. Leaves 4–9 × 2.5–7 cm, ovate, pubescent above, the base cordate, the apex acuminate. Inflorescence in dichasial cymes. Flowers 3–18, with peduncles 1.5–4(10) cm, with pubescence like the leaves; sepals unequal, the outer 5–6 mm, the inner 6.6–8.5 mm, coriaceous, often verrucose at least on the base, the apex acute on the outer, obtuse on the inner; corolla 5–6.5 cm, hippocrateriform, yellow or orange-gold, the tube 3.5–4 × 4–6 mm, the limb with 5 distinct linear lobes 1.5–2.3 cm long; stamens exserted > 5 mm. Fruits seen only in immature stage, conic, 2-locular, 4-valvate; seeds dark brown, pubescent with long, brown trichomes.

Distribution. Mesophyllous forests, pine-oak forests, low deciduous forests, oak forests; 700–2100 m. Endemic to Mexico. Flowering July–September, January.

Illustrations. House (1908b: pl. 2, fig. c).

Common name. *Frijol de la virgen* (Oaxaca); flowers are said to be edible.

Etymology. The epithet *electrina* refers to the "amber" color (yellow-orange) of the corollas. The base *electrinus, -a, -um* derived by combining the noun *electrum* (Greek *elektron*, usually meaning amber), with the Greek adjectival suffix *-inus, -a, -um* indicating the color of amber. Information on orthography was extracted partly from Nicolson and Brooks (1974).

Ipomoea electrina bears only a superficial resemblance to *I. urbinei.* House described and illustrated the species as having linear limb segments, much as in agreement with the type specimen. This feature contrasts dramatically with the much reduced, scarcely triangulate limb segments of *I. urbinei* (see McDonald, 1987: 80, fig. 9b). Moreover, the corollas of *I. urbinei* are red, with stamens exserted but a few millimeters beyond the plane of the limb. In contrast, corollas of *I. electrina* are bright yellow-orange, the stamens and style exceeding the corolla by more than 5 mm. In all likelihood *I. electrina* is a relative of *I. conzattii* Greenman and allies, belonging to *Ipomoea* sect. *Eriospermum.* With them, it shares the long woolly trichomes on the margins of the seeds.

Specimens examined. MEXICO. **Oaxaca:** Distr. Tehuantepec, Cerro Marimba, *Martínez 1035* (MEXU); S del Cerro Guiengola, *Torres & Cabrera 6310* (MEXU), *Torres & Torres 194* (MEXU), *Torres & Torres 202* (MEXU); Santa Lucia, *Martínez 133* (MEXU); SO de Buenos Aires, *Torres & Martínez 7349* (MEXU); San Carlos Yautepec, SE de el Camerón, *Torres & Martínez 12582* (MEXU); Santiago Lachiguiri, Cerro de Las Flores, *Campos 3803* (MEXU). **Chiapas:** *Purpus 9189* (US).

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Una Nueva Especie Sudamericana del Género *Rytidosperma* (Poaceae: Arundinoideae: Danthonieae)

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RESUMEN. Se describe e ilustra una nueva especie de *Rytidosperma* (*R. quirihuense*; Poaceae: Arundinoideae: Danthonieae) para sudamérica. Esta especie crece en el centro-sur de Chile (36°13′S, 72°45′W). Morfológicamente es muy diferente al resto del grupo sudamericano. Sólo presenta afinidades fenéticas con *Rytidosperma paschale*, de la cual se diferencia por la panícula dística, por el tamaño de la espiguilla terminal, por la densidad y longitud de pelos de los fascículos de la lemma, entre los caracteres más importantes.

ABSTRACT. A new species of *Rytidosperma* (*R. quirihuense*; Poaceae: Arundinoideae: Danthonieae) from south-central Chile (36°13′S, 72°45′W) is described and illustrated. It differs morphologically from other South American representatives of the genus. Its closest phenetic affinities are with *Rytidosperma paschale*, from which it differs in possession of a distichous panicule, as well as differences in size of the terminal spikelet, and in the density and length of hairs on the fascicules of the lemma.

Key words: Arundinoideae, Chile, Danthonieae, Poaceae, *Rytidosperma*.

El género *Rytidosperma* Steudel comprende unas 45 especies, la mayoría de ellas distribuidas en Australia, Nueva Zelandia y Tasmania (Nicora & Rúgolo, 1987). En el continente americano crecen 8 taxa, los cuales se encuentran en Chile y Argentina. En Chile la distribución abarca desde la provincia de Limarí en la IV Región hasta la provincia de Última Esperanza en la XII Región, incluyendo a *Rytidosperma paschale* (Pilger) C. Baeza [publicado como *Rytidosperma paschalis* (Pilger) Baeza], especie endémica de Isla de Pascua (Baeza, 1990). Numerosos son los autores que han contribuido al conocimiento de este género, ya sea a nivel morfológico, anatómico, citológico, biogeográfico, fenético y filogenético (Nicora, 1973; Connor & Edgar, 1979; Baeza, 1996a, 1996b, 1997, 1998; Linder & Verboom, 1996; Hsiao et al., 1998; Barker et al., 2000; Linder & Barker, 2000). Durante el desarrollo del proyecto "Análisis de la flora vascular de la zona de transición climática mediterráneo-templada de Chile (36°31′S, 38°30′S): distribución de la riqueza taxonómica y determinación de áreas prioritarias" se recolectó material de esta nueva especie.

Para la descripción de la nueva especie todas las medidas referidas al antecio se hicieron considerando el último de la espiguilla terminal, debido a que hay una gran variación dentro de la espiguilla, en cuanto al tamaño de éste. Para la descripción anatómica de la lámina se consideró la zona media de la penúltima innovación estéril siguiendo los criterios propuestos por Baeza (1997).

Rytidosperma quirihuense C. Baeza, sp. nov. TIPO: Chile. Ñuble: Camino Las Achiras hacia Quirihue (36°13′S, 72°45′W), 355 m, 20 Nov. 2000, *C. Baeza, P. López & M. Parra 2112* (holótipo, CONC; isótipo, SGO). Figura 1.

Planta perennis, culmi 2–4 nodi, 25–45 cm alti. Innovationes intravaginales. Ligulae dense ciliatae, ciliis 0.2–0.4 mm longis. Paniculae distichae, 4.5–8 cm longae; spiculae 5–9-flores; glumae lanceolatae, subaequales vel inferior superiorem paullo excedens, plerumque 10.5–14 mm longae, 5–6-nervatae; lemma in dorso pilorum seriebus duobus distinctis, serie inferiore prope supra callum, 1.5–2 mm longa, serie superiore 0.7–2 mm longa; lemmatis corpus 11–13 mm longum 1–1.2 mm callum includens; lobi laterales 6.5–8 mm longi, setae 3–4 mm longae; arista firma, 12–16 mm longa; palea firma, lanceolata, 5–6.5 × 1.4–1.8 mm longa, bidenticulata, in carinis supra minute ciliolata; antherae 0.8–1.8 mm longae, luteae. Caryopsis 2 × 0.8–1 mm, fulva; hilum punctiforme, ovatum, 0.6 mm longum.

Planta perenne, cañas floríferas 2 a 4 nodes, de 25–45 cm de altura. Innovaciones intravaginales. Hojas basales de hasta 10 cm de largo, pilosas. Vainas pilosas, con mechones de pelos de hasta 3 mm a ambos costados de la lígula. Lígula pestañosa, con pelos de 0.2–0.4 mm. Láminas pilosas ralas, de hasta 9 cm de largo por 1.5–2 mm de ancho. Panícula dística, de 4.5–8 cm de largo, estrecha, con 4 a 10 espiguillas. Pedicelos pubescentes, de 1–10 mm de longitud. Espiguillas 5- a 9-floras, sin considerar el último antecio estéril, la espiguilla terminal de 2–2.4 cm de largo. Glumas verdosas, lanceoladas, 5- ó 6-nervadas, la inferior de 10.5–

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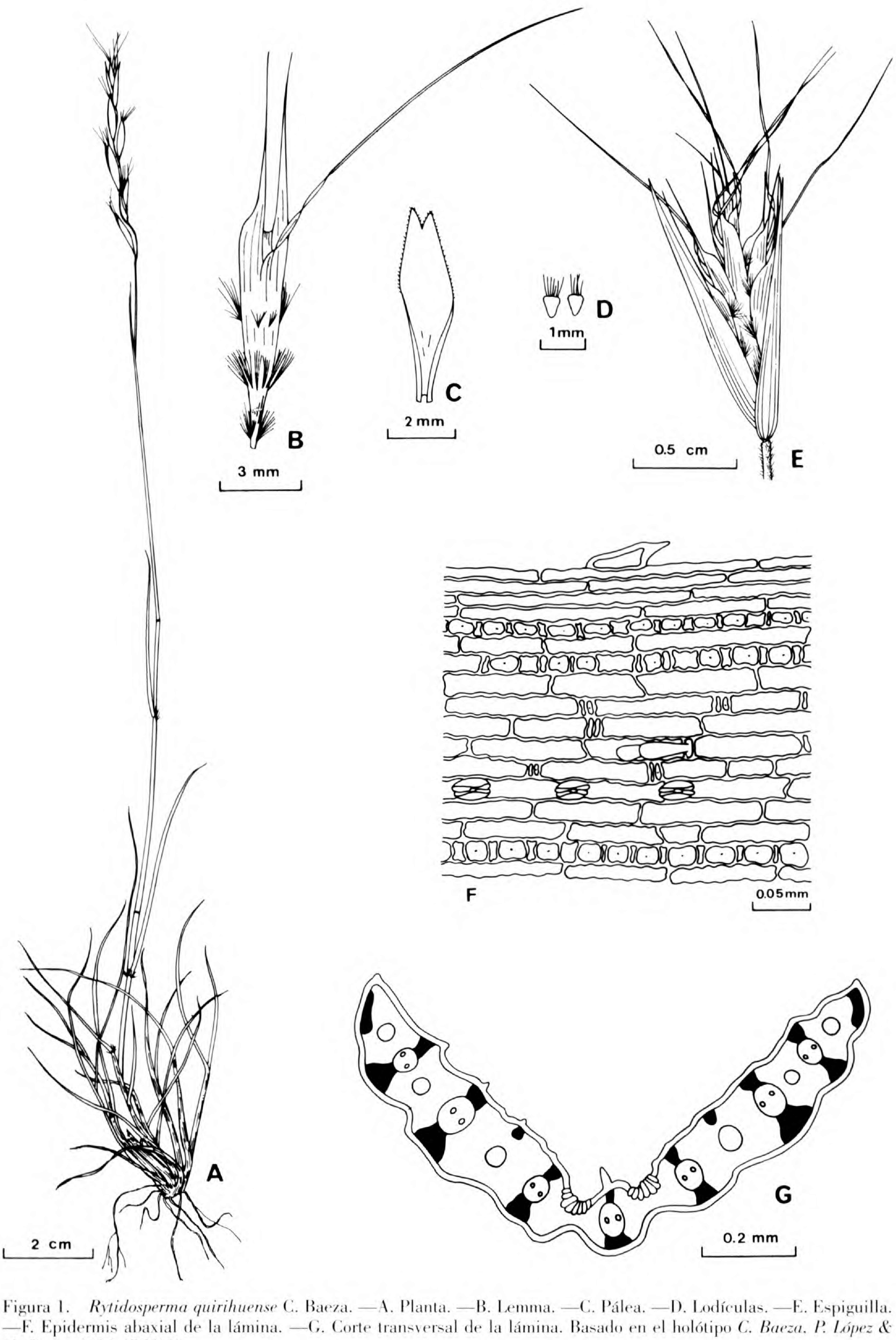

Figura 1. *Rytidosperma quirihuense* C. Baeza. —A. Planta. —B. Lemma. —C. Pálea. —D. Lodículas. —E. Espiguilla. —F. Epidermis abaxial de la lámina. —G. Corte transversal de la lámina. Basado en el holótipo *C. Baeza, P. López & M. Parra 2112* (CONC).

14 mm de longitud, la superior de 11–14 mm, mayores que el conjunto de los antecios. Antecio inferior desde el callo hasta las aristas de los lóbulos de 11–13 mm y desde el callo hasta el ápice de la arista dorsal de 17–21 mm, callo piloso, de 1–1.2 mm, pelos de 0.3–1.2 mm, arista dorsal con la base geniculada, de 12–16 mm de longitud. Lemma pilosa en el dorso, con pelos fasciculados dispuestos en dos hileras paralelas bien definidas, la superior con 6 fascículos, cuatro laterales y dos dorsales, los pelos de 0.7–2 mm de largo, los fascículos dorsales con una baja densidad de pelos, a veces caedizos, los laterales siempre bien visibles y persistentes. Hilera inferior compuesta de 10 fascículos de pelos persistentes, muy densos, de 1.5–2 mm de largo, sin pelos ralos entre ambas hileras de fascículos transversales. Lema desde su base (sin incluir el callo) hasta la inserción de la arista dorsal de 3–4 mm. Lóbulos laterales de 6.5–8 mm, las aristas de 3–4 mm de largo. Pálea lanceolada, de 5–6.5 × 1.4–1.8 mm, carinas finamente ciliadas, base del dorso con pelos ralos, cortos, a veces caedizos en la madurez, ápice bidenticulado. Lodículas 2, pilosas, cuneadas, de 0.4–0.6 mm, con pelos de 0.2–0.6 mm. Estambres 3, anteras de 0.8–1.8 mm. Ovario de 1–1.5 mm. Estigmas de 1.5–2 mm. Cariopsis elíptica, castaña, de 2 × 0.8–1 mm. Embrión de 0.8–1 mm. Hilo punctiforme, ovalado, de 0.6 mm.

Epidermis abaxial de la lámina. Células largas intercostales con paredes onduladas, de 40–146 × 10–18 µm; estomas redondeados a algo romboidales, numerosos; células cortas intercostales presentes; pelos bicelulares presentes, frecuentes, con la célula apical de menor tamaño que la célula basal; macropelos presentes, frecuentes; células interestomáticas de 40–75 × 12–18 µm. Células costales con paredes onduladas iguales a las intercostales, de 30–210 × 6–14 µm, con células sílico-suberosas alternadas, las silíceas redondeadas a algo halteriformes, de 4–23 × 6–15 µm, las suberosas rectangulares, de 2–12 × 8–17 µm. Aguijones presentes, numerosos, ubicados en los márgenes de la lámina. Figura 1F.

Corte transversal de la lámina. Contorno de la lámina en forma de U abierta. Haces vasculares de primer orden 7, trabados, con bandas de tejido esclerenquimático conectado a ambas epidermis, los de segundo orden 2, con un casquete de tejido esclerenquimático en la epidermis adaxial, no conectado a la vaina parenquimática, los de tercer orden 4, libres, sin esclerénquima. Tejido esclerenquimático discontinuo en ambas epidermis. Células buliformes en forma de abanico, 2 ó 3 veces mayores que las células epidérmicas, disminuyendo en tamaño hacia los lados. Figura 1G.

Distribución y hábitat. Esta especie habita en la Cordillera de la Costa de Chile centro-sur, en la localidad de Las Achiras, camino hacia Quirihue, Provincia de Ñuble, VIII Región. El suelo es de naturaleza arcilloso. Esta nueva especie crece en sectores donde aún permanecen fragmentos de bosque nativo y flora herbácea y arbustiva asociada. La población observada no sobrepasaba los 20 individuos. En la actualidad, esta localidad está altamente intervenida por plantaciones artificiales de *Pinus radiata* D. Don y *Eucalyptus globulus* Labillardière. Sólo ha sido colectada en la localidad tipo. Sin embargo, es muy probable que otras poblaciones de la misma especie estén creciendo en sectores cercanos donde aún hay fragmentos de vegetación nativa. Esta zona de la Cordillera de la costa ha sido históricamente poco colectada, lo que se demuestra por el bajo número de colectas depositadas en los herbarios de CONC y SGO.

Morfológicamente, esta especie es muy diferente al resto de los taxa que crecen en Sudamérica continental. La panícula dística, la morfología de la lemma, la distribución de los fascículos de pelos, su número y densidad son caracteres propios de esta especie, que la separan completamente del resto. Sólo *Rytidosperma paschale*, especie insular, presenta algunas similitudes, sobre todo respecto a la densidad de pelos en el dorso de la hilera superior de la lemma y en la poca pilosidad de la pálea, sin embargo es fácilmente diferenciable de *R. quirihuense* porque las espiguillas terminales no sobrepasan los 1.5 cm de longitud, no posee una panícula dística, por la baja densidad de pelos en la hilera inferior de la lemma, por la presencia de pelos bicelulares con la célula apical de mayor tamaño que la basal, por el contorno de la lámina en forma de V, convoluto, por presentar sólo 3 haces vasculares de primer orden, por la ausencia de haces vasculares de segundo orden, etc. En *R. quirihuense*, la sección transversal de la lámina presenta una gran cantidad de haces vasculares de primer orden trabados como también presencia de haces vasculares de tercer orden, lo que se repite en el resto de las especies americanas. Las células buliformes mayores en tamaño que las células epidérmicas es un carácter que también está presente en *Rytidosperma paschale*, *R. sorianoi* Nicora y *R. virescens* (E. Desvaux) Nicora var. *parvispiculum* Nicora. La epidermis abaxial presenta las mismas características de las otras especies sudamericanas, esto es células largas intercostales de paredes onduladas, macropelos y pelos bicelulares presentes, células suberosas rectangulares, etc. La forma redondeada de las células silíceas es un carácter que se repite en todas las especies del género, aunque en *Rytidosperma quirihuense* tienden a ser algo halteriformes, situación también observada en *R. paschale*.

Clave para *Rytidosperma quirihuense* y las Especies Sudamericanas (Modificada de Baeza, 1996a)

1a. Hilera superior de fascículos pilosos de la lemma con 2–6 haces de pelos.
  2a. Panícula dística; espiguilla terminal de 2–2.4 cm de longitud; planta del continente . . . . *R. quirihuense*
  2b. Panícula no dística; espiguilla terminal de 1.1–1.5 cm de longitud; planta de Isla de Pascua . . . . *R. paschale*
1b. Hilera superior de fascículos pilosos de la lemma con 8–10 haces de pelos.
  3a. Glumas linear-lanceoladas, muy agudas y violáceas . . . *R. violaceum* (E. Desvaux) Nicora
  3b. Glumas lanceoladas.
    4a. Hilera inferior de fascículos pilosos de la lemma poco definidos, con baja densidad de pelos, a veces sólo hay pelos ralos.
      5a. Apice de la pálea bimucronado, plantas muy pilosas . . . . *R. pictum* (Nees & Meyen) Nicora var. *bimucronatum* Nicora
      5b. Apice de la pálea obtuso, 2–4-denticulado, truncado o algo agudo, las carinas nunca prolongadas en mucrones, plantas glabras a pilosas ralas . . . . *R. pictum* var. *pictum*
    4b. Hilera inferior de fascículos pilosos de la lemma bien definidos, con alta densidad de pelos.
      6a. Pálea de 2.3–4 mm de largo, aristas de los lóbulos de la lemma de 0.2–2 mm, largo de la lemma desde el callo hasta las aristas de los lóbulos de 3.6–7(–8) mm.
        7a. Apice de la pálea agudo, vainas muy pilosas . . . . . *R. sorianoi*
        7b. Apice de la pálea obtuso o levemente bidenticulado, vainas glabras, muy raro con pelos en los márgenes *R. lechleri* Steudel
      6b. Pálea de (4–)4.7–6.5 mm de largo, aristas de los lóbulos de la lemma de 1.8–5(–5.8) mm, largo de la lemma desde el callo hasta las aristas de los lóbulos de 7.5–14(–15) mm.
        8a. Apice de la pálea obtuso a subtridenticulado, vainas pilosas a pilosas ralas . . . . *R. virescens* var. *parvispiculum*
        8b. Apice de la pálea 2–3-denticulado, vainas glabras . . . . *R. virescens* var. *virescens*

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Senecio albaniae (Asteraceae: Senecioneae), a New Species from Central Peru

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ABSTRACT. A new species, *Senecio albaniae* (Asteraceae: Senecioneae), is described from central Peru. The species is characterized by its shrubby habit, decurrent leaf bases forming winged stems, and solitary capitula on elongated peduncles. The species is described and illustrated, and its possible relationships are discussed.

RESUMEN. Una especie nueva, *Senecio albaniae* (Asteraceae: Senecioneae), se describe del Peru central. La especie es caracterizada por su habito arbustivo, hojas decurrentes y tallos alados, capitulo solitario con pedúnculos 5–15 cm de longitud. Se describe e ilustra la especie, y discuto las relaciones potenciales de esta especie.

Key words: Andes, Asteraceae, Peru, *Senecio*, Senecioneae.

Senecio L. is an important genus of the South American Andes, which is a center of diversity for the genus. *Senecio* is found from coastal deserts to alpine habitats in the Andes. The genus is represented by ca. 180 species in Peru (Dillon & Hensold, 1993), several of which are endemic and of limited geographic distribution (Vision & Dillon, 1996). Recently two new species have been added (Beltran & Galan De Mera, 1997, 1998). A species of *Senecio* with decurrent leaf margins and winged stems was discovered among unidentified Senecioneae housed at the Herbarium of the Universidad de San Marcos in Lima (USM). Subsequent field studies in the approximate region of the first collection confirmed the species as new.

Senecio albaniae H. Beltran, sp. nov. TYPE: Peru. Lima: Huarochiri, San Pedro de Casta, Mashca, Camino del pueblo San Pedro de Casta hacia Marcahuasi, 11°46′S, 76°35′W, 3680 m, 21 mayo 2000, *H. Beltran 3474* (holotype, USM; isotypes, F, HAO, HUT, MO, NY, S, TEX, US). Figure 1.

Haec species *S. calcencis* Cabrera & Zardini etiam *S. mollendoensis* Cabrera primo viso similis, sed a hoc lamina foliari basi exauriculata marginibus integra, ab illo capitulis majoribus pedicellis longioribus insidentibus, ab ambobus foliis decurrentibus distinguitur.

Shrubs to 0.6 m high; stems much branched, sparsely tomentose and winged from the decurrent leaf bases, the wings 2–3 mm wide. Leaves alternate, simple, sessile, lamina membranaceous, lanceolate to oblanceolate, 6–9 × 0.5–1 cm, apex acuminate, basally decurrent to 1–1.5 cm; adaxially dark green and arachnoid tomentose, abaxially pale green and densely tomentose, pinnately veined, margins denticulate. Capitulescence lax, with 1 or 2 branches terminating in capitula from the uppermost nodes; peduncles 5–15 cm long, finely striate, arachnoid tomentose, with bracteoles ca. 7 per peduncle, lanceolate, 15–35 × 0.5–1.5 mm, apex long attenuate distally. Capitula radiate; calycular bracts ca. 9, linear, 9–11 × 0.5–0.8 mm, apex attenuate; involucre campanulate to hemispherical, 9–10 × 10–13 mm diam.; phyllaries 12 to 14, uniseriate, subequal, chartaceous, lanceolate, 10–12 × 1–3 mm, free, dorsally arachnoid tomentose, inside glabrous, apex acute, briefly short-pubescent, margins scarious; ray florets 9 to 12, pistillate, well exserted from the involucre; corolla yellow, the tube linear, 5–6 mm long, glabrous, the limb oblong, 15–20 × 2–3 mm, flat, glabrous, 4- or 5-nerved, apex bi- or tridenticulate; disk florets 55 to 70, bisexual, corolla yellow, tubular, 12–14 mm long overall, tube 5–6 mm long, the limb 3–4 mm long, narrowly campanulate, apically 5-dentate, teeth triangular, 1–1.2 × 0.4 mm, apex acute and slightly thickened; anthers ca. 4 mm long, base obtuse, with apical appendage 0.4–0.5 mm long; style branches recurved, 2.5 mm long, with papillate stigmatic lines marginally on inner surfaces, apex truncate with a small crown of penicillate trichomes. Achene (immature) cylindrical, 3–4 × 0.7–0.9 mm, densely sericeo-papillose; pappus biseriate, persistent, white, 6–7 mm long with bristles equivalent in length, strigillose.

Distribution and ecology. Senecio albaniae is known only from the type locality, San Pedro de Casta in the province of Huarochiri, Lima, Peru, on

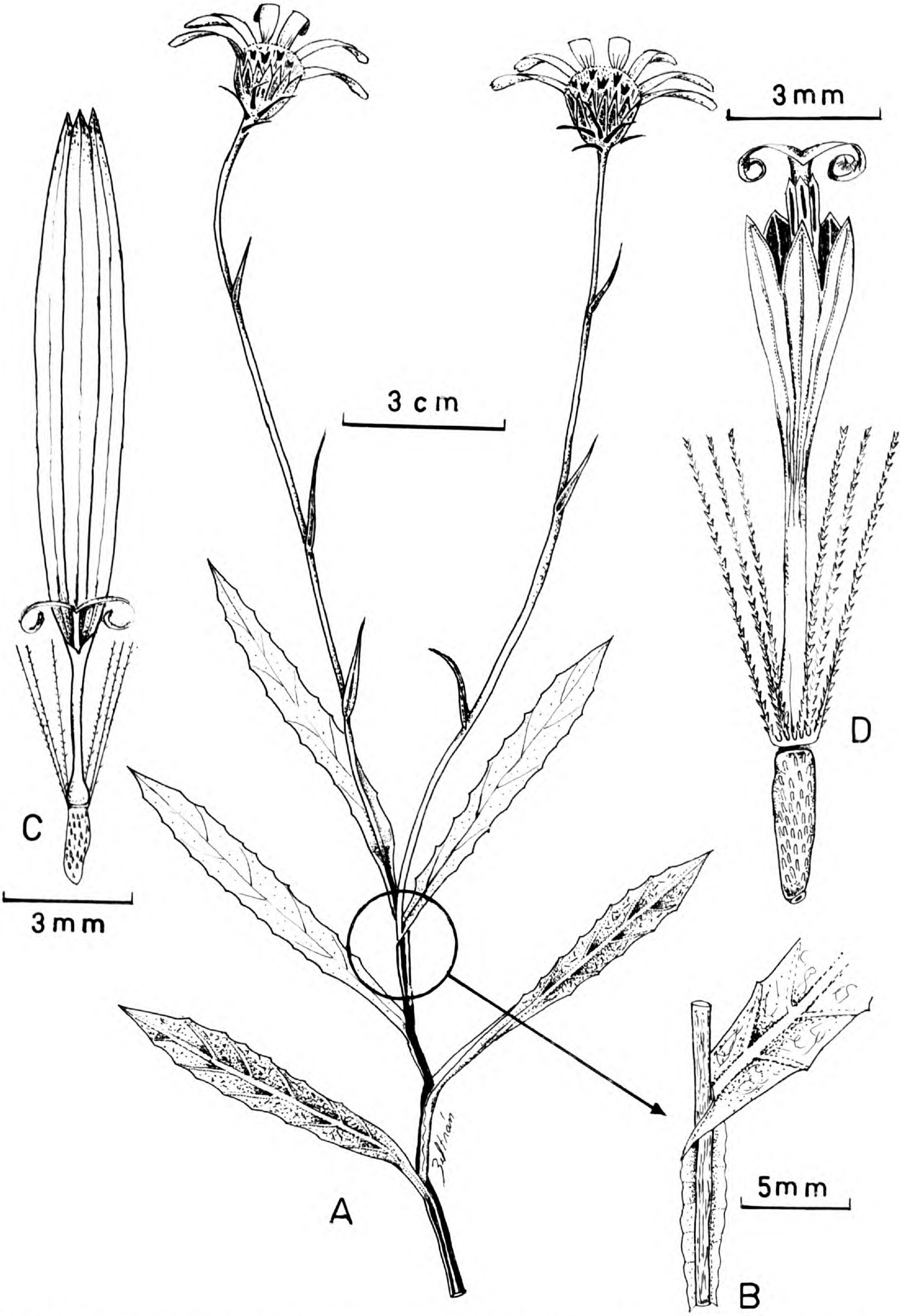

Figure 1. *Senecio albaniae* H. Beltran. —A. Flowering branch. —B. Enlarged leaf with decurrent base. —C. Ray floret. —D. Disc floret. (Drawn from *J. Alban & N. Malca 11339*, USM.)

the western escarpment of the Andean Cordillera and shrubby communities that include *Mutisia acuminata* Ruiz & Pavón, *Ophryosporus peruvianus* (Gmelin) King & Robinson, *Senecio cerratei* Cuatrecasas, *Senecio richii* A. Gray, *Senecio subcandidus* A. Gray (all Asteraceae), and *Opuntia subulata* (Muehlenpfordt) Engelmann (Cactaceae).

Etymology. This new species is named for its first collector, Joaquina Alban, a Peruvian ethnobotanist at the Universidad de San Marcos.

Discussion. This is the only known South American species of *Senecio* with winged stems. This character, however, is also known from the Peruvian *Caxamarca sanchezii* M. O. Dillon & Sagastegui in a newly described monotypic genus in the Senecioneae (Dillon & Sagastegui, 1999).

Since there is no modern account of the entire genus, relationships among species of *Senecio* remain speculative; therefore, I am not able to fit the new species within any of the infrageneric categories established by Cabrera (1985) and Jeffrey (1992) for Andean taxa of *Senecio*. However, it could be placed tentatively into the series *Otopteri* (Cabrera, 1985) through the link with *Senecio bangii* Rusby, a superficially similar Bolivian plant. Curiously and according to my observations, *S. bangii* Rusby is an anomalous member of the series.

Clearly, *S. albaniae* would appear closest to a Peruvian natural complex made up of *S. icaensis* H. Beltran & Galan de Mera, *S. abadianus* DC., *S. arnaldii* Cabrera, *S. okopanus* Cabrera, *S. lomincola* Cabrera, *S. yauyensis* Cabrera, *S. subcandidus* A. Gray, *S. tovarii* Cabrera, *S. truxillensis* Cabrera, *S. calcensis* Cabrera & Zardini, and *S. mollendoensis* Cabrera. Probably, *S. bangii* Rusby could find a better position within this latter complex.

In Peru, *Senecio albaniae* superficially resembles *S. calcensis* Cabrera & Zardini (1975), a species with shorter peduncles and smaller capitula, and *S. mollendoensis* Cabrera (1962), a species with upper leaves with dilated and auriculate bases and coarsely dentate margins.

Paratype. PERU. **Lima:** Huarochiri, San Pedro de Casta, Path Chaniulpo-Quinual 11°45.734′S, 76°35.581′W, 3200–3500 m, 21 May 1999, *J. Alban & N. Malca 11339* (F, MO, USM, NY).

KEY TO *SENECIO ALBANIAE* AND RELATED PERUVIAN SPECIES

1a. Leaves decurrent on stems . . . . *S. albaniae*
1b. Leaves not decurrent on stems.
    2a. Basal leaves sessile, auriculate, the margins coarsely dentate . . . . *S. mollendoensis*
    2b. Basal leaves with short petioles, not auriculate, the margins finely dentate . . *S. calcensis*

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Bernardia fonsecae (Euphorbiaceae), a New Species from Guerrero, Mexico

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ABSTRACT. *Bernardia fonsecae*, endemic to Guerrero, Mexico, is described and illustrated, and habitat data are provided. *Bernardia fonsecae* is morphologically similar to *B. mollis* Lundell. They have in common long petioles, similar shape and size of the staminate bract, and a lobulate intrastaminal disc. *Bernardia fonsecae* differs from *B. mollis* in its leaf base and leaf shape, vestiture of the adaxial surface of the leaf, vestiture of the abaxial veins, diameter of the cicatricoso-crateriform glands, position of the staminate inflorescence, and number of stamens, among other characteristics.

Key words: *Bernardia*, Euphorbiaceae, Mexico.

Pax and Hoffmann (1914) wrote the most recent revision for *Bernardia*, a wholly Neotropical genus of Euphorbiaceae, recognizing only four species in Mexico. As the number of collections for the genus in Mexico has increased, new species have been described, and the contributions of McVaugh (1961, 1995) and Lundell (1940, 1945, 1976, 1985) are of special interest. With ca. 25 species of 50 recorded for the genus (Webster, 1994), Mexico has been considered, together with Brazil, as a center of diversity for the genus.

Bernardia is divided into seven sections according to Pax and Hoffmann (1914), three of which occur in Mexico: sect. *Tyria* (Klotzsch) Müller Argoviensis, sect. *Alevia* (Baillon) Müller Argoviensis, and sect. *Traganthus* (Klotzsch) Müller Argoviensis. Sections *Tyria* and *Alevia* consist of trees and shrubs with fasciculate or divided hairs, while the monotypic section *Traganthus* has simple hairs and includes the only herbaceous species of the genus. Section *Tyria* has lacinulate-lacerate style branches, and section *Alevia* has non-laciniate style branches. *Tyria*, with ca. 21 species, is mainly Mexican with two representatives in the West Indies. Here we describe a new species of section *Tyria* from Mexico.

Bernardia fonsecae A. Cervantes & J. Jiménez Ramírez, sp. nov. TYPE: Mexico. Guerrero: Mpio. Leonardo Bravo, Puerto Soleares, 7 km después de Carrizal hacia Atoyac, 17°35′15″N, 99°50′W, 2500 m, montane rain forest, 5 Nov. 1998, *R. M. Fonseca 2538* (holotype, MEXU; isotypes, FCME, MO). Figure 1.

Arbor 6.0–18.0 m alta, dioica. Folia chartacea leviter scabra, longe petiolata; costa abaxialiter trichomatibus stellatis radiis longissimis praeditis vestita. Inflorescentia mascula ex racemo axillari terminelive constans, bracteis 4- ad 7-floris. Inflorescentia feminea ex spica terminali constans, bracteis unifloris. Flos masculus staminibus (22 ad) 26 ad 44. Flos femineus stylo lacerato piloso rufo vel rubiginoso. Capsula ca. 24 mm diametro, pericarpo minute aculeato, confertim stellato-hirto; seminibus globosis leviter carinatis.

Trees 6.0–18.0 m tall; dioecious. Branchlets with conspicuous elongate lenticels (1)2–4 mm long. Leaf blade 6.0–16.0(–22.0) cm long, 3.3–9.5(–12.0) cm wide, broadly elliptic to elliptic, elliptic-obovate or rarely lanceolate; margin serrate with 3 or 4 teeth per cm, teeth glandular; base attenuate, rounded or sometimes cordate or subtruncate; apex abruptly acuminate or acute; 3-nerved at the base, adaxial midrib especially near the base with fasciculate and stellate trichomes with 2 to 8 radii, 0.2–0.5 mm long, abaxial midrib especially near the base with conspicuous and soft stellate trichomes with 8 to 15 radii, 0.75 mm long; upper foliar surface punctate under magnification; drying chartaceous, darker above, slightly rough; adaxial

→

Figure 1. *Bernardia fonsecae* A. Cervantes & J. Jiménez Ramírez. —A. Branch with staminate inflorescence (*Fonseca 2538*, type). —B. Branch with pistillate inflorescence (*Fonseca 2539*). —C. Ovary; note the style and annular disc

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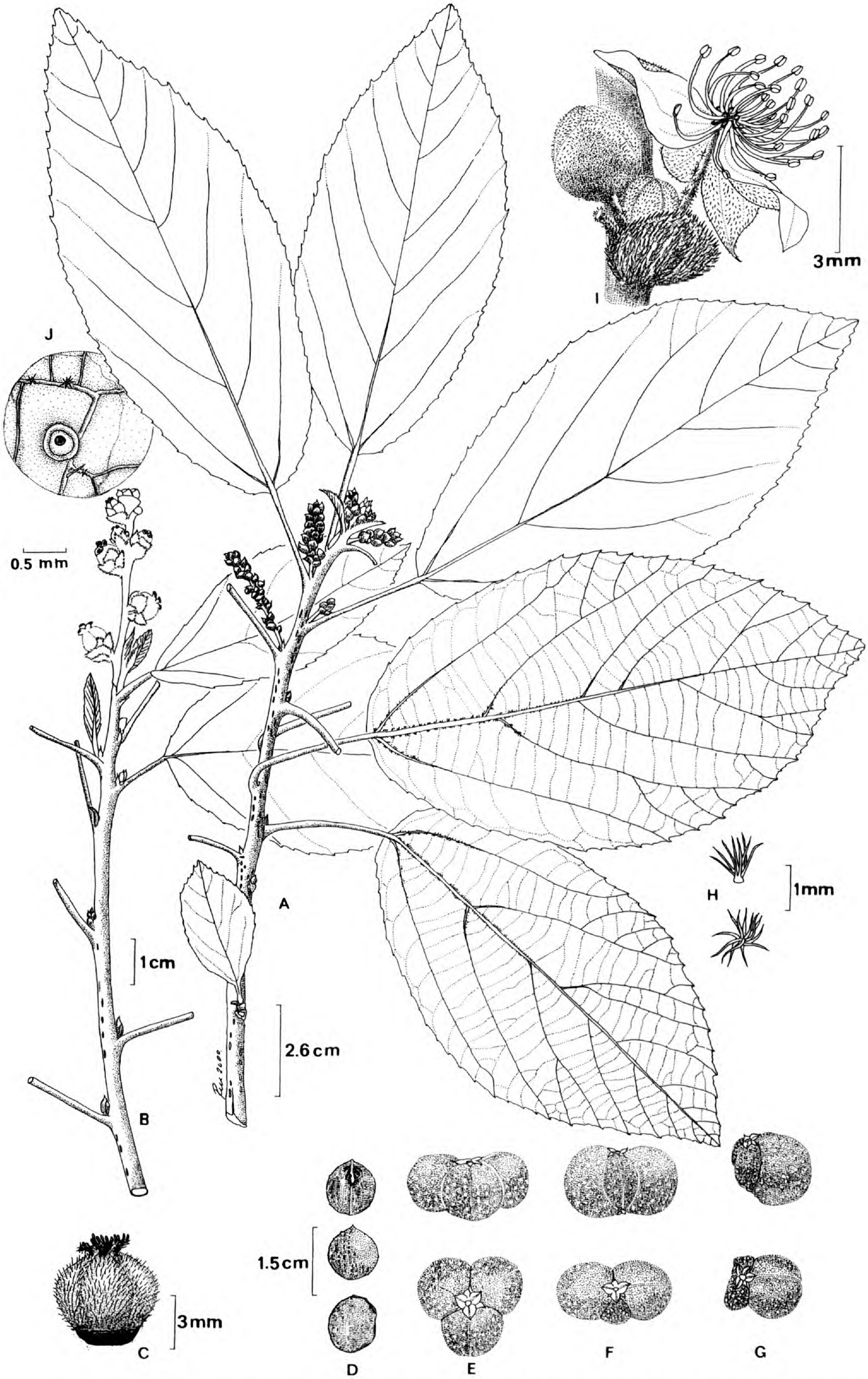

(*Fonseca 2539*). —D. Seed: ventral, dorsal, and lateral views (*Fonseca 2540*). —E–G. Fruit, equatorial and polar views (bottom) (*Fonseca 2540*). —H. Stellate trichomes from the abaxial midrib (*Fonseca 2538*, type). —I. Staminate flowers and a subtending bract (*Lozano 710*). —J. Cicatricoso-crateriform gland on abaxial surface of the leaf (*Fonseca 2539*).

Table 1. Morphological characteristics distinguishing *Bernardia fonsecae* and *B. mollis.*

Characteristics	*B. fonsecae*	*B. mollis*
Leaf shape	broadly elliptic to elliptic, elliptic-obovate or rarely lanceolate	ovate, elliptic-ovate
Leaf base	attenuate or rounded	broadly rounded
Foliar surface	smooth, punctate under magnification	rugose
Abaxial vein vestiture	stellate trichomes with 8 to 15 radii, 0.75 mm long, only near the leaf base	fasciculate and stellate trichomes with 2 to 6 radii, 0.5 mm long, along the entire leaf
Adaxial vestiture	stellate-puberulent	appressed fasciculate
Cicatricoso-crateriform gland diameter	0.5–0.8 mm	0.8–1.0 mm
Staminate inflorescence position	axillary and terminal	axillary
Staminate tepal size	3.5–4.5 × 1.5–4.0 mm	2.0–3.5 × 1.2 mm
Staminate tepal vestiture	glabrescent on inner surface	pilose on inner surface
Staminate flowers per bract	4–7 flowers	3–5 flowers
Stamen number	(22)26–44	22–24
Filament length	2.5 mm	2.0 mm
Anther length	0.3 mm	0.5 mm

surface glabrescent or sparsely puberulent with simple, stellate or multiradiate trichomes, radii 6 to 10, ca. 0.1 mm long, abaxial surface glabrescent or sparsely puberulent with stellate and multiradiate trichomes, radii 8 to 16, ca. 0.1 mm long; 1 to 3 cicatricoso-crateriform glands at margin and on each side of the midrib in abaxial surface, 0.5–0.8 mm diam.; petioles 1.0–4.2(–8.0) cm long, stellate-puberulent and tomentose; stipules deciduous, 2.0–2.5 mm long, narrowly triangular, entire, rigid, appressed, strigulose, pale yellow. Staminate inflorescence racemose, terminal and axillary, at anthesis 1.5–7.5 cm long, the (5)10 to 15 bracts separated or congested on the axis; bract 4- to 7-flowered, broadly deltoid-ovate, cupuliform, 2.5–3.0 × 3.5–4.5 mm, apiculate, coriaceous, pilose on outer surface, glabrescent on inner surface; bracteoles inconspicuous. Staminate flowers pedicellate, pedicel 2.0–3.5 mm long at anthesis; tepals 3 or 4, valvate, elliptic or oblong, 3.5–4.5 × 1.5–4.0 mm, equal, densely pilose on outer surface, glabrescent on inner surface; stamens (22)26 to 44; filaments stout, 2.5 mm long, pinkish; anthers globose, 0.3 mm long, connective inconspicuous; intrastaminal disc lobulate. Pistillate inflorescence spicate, terminal, peduncles 10 mm long, 4 to 8 bracts; bract 1-flowered, ovate, cupuliform, 3.0–3.5 × 3.0–4.0 mm, acute, coriaceous; bracteoles conspicuous. Pistillate flower sessile; tepals 6, imbricate, broadly ovate, unequal in size, densely pilose on outer surface, glabrescent on inner surface; disc annular, flat, margin erose, glabrous; ovary densely stellate-hirsutulous, globose, deeply 3-lobed, 3–4 × 3–5 mm, styles 3, lacerate, stigma reddish or rufous, pilose. Fruits capsular (1)2- or 3-lobed, 24.0 mm diam., densely stellate-hirsutulous, slightly keeled on midrib, pericarp minutely aculeate, dehiscent. Seeds spheroid, 14.0 mm long, 12.0 mm wide, slightly carinate on superior and dorsal face, caruncle absent, testa crustaceous, chestnut-colored, minutely lineolate-verrucose and brown-marbled.

This species is known only from montane rainforests at 2200–2500 m in Guerrero, Mexico, where it is associated with *Fuchsia* sp., *Clethra* sp., *Solanum* sp., *Abies religiosa* Lindley, *Chiranthodendron pentadactylon* Larreat, and *Cornus disciflora* Sessé & Moçiño ex DC.

Bernardia fonsecae is unique within the section in its large leaf size, the vestiture of the abaxial midrib (soft stellate trichomes with 8 or 15 radii, 0.75 mm long), and in having the largest fruit known of *Bernardia.* It belongs to section *Tyria* and is morphologically similar to *B. mollis* Lundell, which occurs in montane rainforests of Chiapas. These species have in common long petioles, similar shape and size of the staminate bract, and a lobulate intrastaminal disc. *Bernardia fonsecae* differs from *B. mollis* in its leaf base and leaf shape, vestiture of the adaxial surface of the leaf, vestiture of the abaxial veins, diameter of the cicatricoso-crateriform glands, position of the staminate inflorescence, and number of stamens, among other characteristics (Table 1).

The name honors Rosa María Fonseca, teacher and botanist from the Facultad de Ciencias, UNAM, who has made important contributions to the knowledge of the flora of Guerrero state.

Paratypes. MEXICO. **Guerrero:** Mpio. Gral. Heliodoro Castillo, aprox. 3 km de Puerto del Gallo en dirección NE, ladera O del cerro Teotepec, 18 Oct. 1999, *E. Domínguez 1250* (FCME, MEXU); Mpio. Leonardo Bravo, Puerto Soleares, 7 km después de Carrizal hacia Atoyac, 5 Nov. 1998, *Fonseca 2539* (FCME, MEXU, MO), *2540* (FCME, MEXU, MO); Mpio. Leonardo Bravo, 7 km delante de Carrizal rumbo a Atoyac y 2 km al E rumbo a Cacho de Oro, 11 Sep. 1999, *Fonseca 2937* (FCME, MEXU); Mpio. Leonardo Bravo, aprox. 500 m del Puente Las Pastillas, camino Filo de Caballos–Chichihualco, 6 Dec. 1999, *Fonseca 2951* (FCME, MEXU); Mpio. Chilpancingo, al O de Omitelmi, cañada de la Laguna de Agua Fría, 19 July 1985, *Lozano 710* (FCME, MEXU, MO).

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Novelties in *Croton* (Euphorbiaceae) from Southeast Asia

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ABSTRACT. A new species, *Croton kongkandanus* Esser, is described from Thailand, based mainly on its large fruits. The name of *Croton lissophyllus* from India and Bangladesh is validated, and *C. laniflorus* Geiseler is recognized as the valid name for the poorly known and illegitimate *Croton lanatus* Loureiro from Vietnam and described here. Seven taxa of Southeast Asian *Croton* are lectotypified, two new synonyms are proposed, and two potential ones are discussed, some of them in preparation for inclusion in the *Flora of Thailand*.

Key words: Asia, Bangladesh, *Croton*, Euphorbiaceae, India, Thailand, Vietnam.

The revision of Euphorbiaceae for the *Flora of Thailand*, recently conducted by staff of the Forest Herbarium, Bangkok, and collaborators, had a reliable basis in the study of Thai Euphorbiaceae by Airy Shaw (1972). Nevertheless, several novelties and problems came to light, among them some in the genus *Croton* L. In connection with this project, taxonomic problems in *Croton* from Indochina and India were studied. The complete revision of *Croton* for the *Flora of Thailand* will be published separately, but some notes on *Croton* in Thailand and adjacent regions are recorded here. Thai localities are cited in accordance with the guidelines for the *Flora of Thailand*.

Croton chevalieri Gagnepain, Bull. Soc. Bot. France 68: 550. 1921 [1922]. TYPE: Vietnam. Bienhoa, reserve of Trang Tôm, 30 Mar. 1914 (fl), *A. J. B. Chevalier 32048* (holotype, P; isotype, A).

In contrast to the other species of *Croton* he had described in 1922, Gagnepain did not accept *C. chevalieri* later in 1925 (Gagnepain, 1925), but listed it under his dubious species at the end, not including it in his key. *Croton chevalieri* is based on a single, rather poor collection. It is most probably not a separate species. It resembles *C. poilanei*, except that the hairs are stellate to stellate-lepidote, whereas lepidote hairs are diagnostically important for *C. poilanei*. It might prove to be an aberrant collection of the latter on further study.

Croton delpyi Gagnepain, Bull. Soc. Bot. France 68: 552. 1921 [1922]. TYPE: Vietnam. "Ad Deon-ba montem prope Cay minh," Apr. 1866 (fl, fr), *L. Pierre 6231* (lectotype, designated here, P; isolectotypes, BM, K, P).

Among the four syntype collections, *Pierre 6231* is the one with the largest number of duplicates found and the only one with both flowers and fruits. The sheet with analytical drawings attached to it, made by E. Delpy, is chosen as the lectotype.

Croton griffithii Hooker f., Fl. Brit. Ind. 5: 392. 1887. TYPE: Malaysia. "Malacca," s.d. (fl, fr), *W. Griffith 4781* (lectotype, designated here, K; isolectotype, K).

Hooker noted in his protologue that his new species might be heterogeneous. Among the nine syntype collections at Kew, six (*Griffith 4778, 4781, King's Collector 1115, 4484, 6157, Scortechini s.n.*) agree with the current concept of *C. griffithii* (leaves drying yellowish brown, cordate-rounded at base, with abaxial glands), whereas two (*Wallich 7754, 7967*) belong to *C. laevifolius* Blume (leaves drying darker, acute-obtuse at base, with lateral-adaxial basal glands). *Maingay 1406* was not studied. Airy Shaw (1972) was certainly correct to distinguish these two species that had been united by several authors in the past, such as Corner (1939). The above lectotypification fixes the current use of the name, with *Griffith 4781* being the only syntype bearing both flowers and fruits.

Among the two sheets of *Griffith 4781* at Kew, the one with analytical sketches of flowers and attached dissected flowers is chosen here as the lectotype.

Croton kongensis Gagnepain, Bull. Soc. Bot. France 68: 555. 1921 [1922]. TYPE: Laos. Pak-lay, leg. 1866–1868 (fl, fr), *C. Thorel s.n.* (lectotype, designated here, P; isolectotype, P).

The sheet with fruits and analytical drawings, which had already been separated in a type folder, is selected here.

Croton kongkandanus Esser, sp. nov. TYPE: Thailand. South-Eastern: Chon Buri, Khao Kieo Wildlife Sanctuary, 300 m, 25 July 1976 (fr), *J. F. Maxwell 76–443* (holotype, BK 56565; isotype, AAU).

Species *Crotonis* foliis ovato-ellipticis non triplinerviis pilis stellato-lepidotis argenteo-brunneis dense obtectis ad *C. argyratum* maxime accedit, sed ab eo fructibus multo majoribus 22–27 mm (non 12–16 mm) longis brevipedicellatis (3–4 mm, non 10–13 mm) differt.

Tree to 15 m tall, DBH to 25 cm; bark gray, smooth to very finely roughened and with prominent, scattered lenticels; young branchlets densely pubescent, glabrescent. Indumentum consisting of stellate to stellate-lepidote hairs (radii more fused on leaves) with a small brownish center and hyaline radii (appearing silvery) on the leaves, brownish on leaf veins and floral parts, flat, sometimes with a porrect central radius, ca. 0.2–0.3 mm diam., with ca. 20–30 radii. Stipules linear-elliptic, 7–20 mm long, densely pubescent. Leaves often apically crowded but basically alternate; petioles 25–55 mm long, densely pubescent; blades chartaceous, elliptic to slightly ovate, 11–19 × 5–8.5 cm, index 1.8–2.3, base obtuse with the very base cordate, margin entire, apex shortly acuminate, soon glabrous above, beneath densely silvery-pubescent and not glabrescent, hairs quite uniform, brown-tinged on venation; basal glands lateral on the abaxial midrib base, flat, sessile, 0.5–1 mm diam., marginal glands absent; side veins distinct on both surfaces, in 8 to 10 pairs, not triplinerved, tertiary veins visible on both surfaces. Inflorescences terminal, solitary, densely and persistently silvery-brown pubescent throughout, 8–10 cm long, consisting of a basal part of 1–2 cm with 2 to 6 pistillate flowers, without lateral staminate flowers in the same bract, and a larger upper staminate part, with 1 to 3 flowers per bract; floral bracts ca. 1 mm long, eglandular, quite persistent. Staminate flowers densely pubescent; pedicel 1–1.5 mm long; sepals ca. 2 × 1.5 mm; petals ca. 2–2.5 × 1 mm; stamens ca. 11, pubescent at base. Pistillate flowers densely pubescent; pedicel ca. 1 mm long; sepals ca. 4–5 × 2–2.5 mm, longer than the ovary; petals 2 × 0.5 mm; ovary 2.5 mm long; stylar column short (ca. 0.5 mm), stigmas 4–5 mm long, bifid on the apical ca. 3 mm. Fruits: pedicel 3–4 mm long; schizocarp 22–27 × 20–21 mm, elliptic to slightly obovate, not sulcate, densely pubescent outside. Seeds flattened-elliptic, 15–16 × 8–11 × 6 mm, smooth, brown, sometimes slightly variegated, caruncle not seen.

The species in named after Kongkanda Chayamarit of the Forest Herbarium, Royal Forest Department, Bangkok, who spent so much of her time and energy in arranging and organizing the Euphorbiaceae project for the *Flora of Thailand*.

This species probably belongs in *Croton* sect. *Argyrocroton* (Müller Argoviensis) G. L. Webster according to Webster (1993). *Croton kongkandanus* differs from all silvery-leaved species of *Croton* in Southeast Asia and Malesia by the much larger fruits, a diagnostically important difference. The other Malesian species with silvery leaves have fruits 4–16 mm long. In other characters, the new species is very similar to *C. argyratus* Blume. The latter has mature fruits 12–16 mm long on distinctly longer pedicels exceeding 10 mm, and is restricted to West Malesia, while in Thailand it is only known from the southernmost Peninsular provinces. The Indo-Chinese species *C. budopensis* Gagnepain and *C. maieuticus* Gagnepain, considered as synonyms of *C. argyratus* by Airy Shaw (1972), are all separate endemic species: *C. budopensis* has much smaller, subsessile fruits only 4–5 mm long, and *C. maieuticus* has a fruit size similar to *C. argyratus* but stipitate glands on the leaf bases.

Type and paratype collections of *C. kongkandanus* were distributed under the name of *Croton argyratus*.

The only Asian species comparable with *C. kongkandanus* in fruit size is *C. malabaricus* Beddome. This species is only known from southwestern India (Western Ghats) and was thoroughly described and illustrated by Chakrabarty and Balakrishnan in 1997. *Croton malabaricus* seems to differ in having shortly stipitate fruits and longer pedicels in staminate and pistillate flowers and fruits.

Croton kongkandanus is so far only known from Thailand. It grows in mixed deciduous and evergreen, seasonal hardwood forest, disturbed evergreen forest, found over shale bedrock.

Paratypes. THAILAND. **Northern:** Chiang Mai, Chiang Dao Distr., Doi Chiang Dao Animal Sanctuary, Huay Nah Lao Station, 600 m, 14 Aug. 1995 (fr), *Maxwell 95–496* (BKF, CMU); Tak, Pha Wo, 650 m, 13 July 1972 (fr), *Smitinand & Seidenfaden 11630* (BKF); Sukhotai, Sri Satchanalai National Park, 200 m, 7 Feb. 1988 (ster), *Smitinand s.n.* (BKF 87372). **South-Eastern:** Chon Buri, Khao Khieo Wildlife Sanctuary, 400 m, 27 Mar. 1976 (fl), *Maxwell 76–162* (AAU, BK, L); Chanthaburi, Khao Sabap National Park, 6 July 1927 (fr), *Put 912* (BK, BM, K, L, P).

Croton krabas Gagnepain, Bull. Soc. Bot. France 68: 555. 1921 [1922]. TYPE: Cambodia. Mekong river, Kratee, 9 Mar. 1914 (fl), *A. J. B.*

Chevalier 31882 (lectotype, designated here, P).

Although several of the remaining seven syntype collections (now paralectotypes) are distributed with duplicates, the chosen lectotype is the only sheet with attached analytical drawings, and with the vernacular name 'krabas prey' on the label, the source of the epithet. It is also one of the richest collections among the syntypes.

Croton lachnocarpus Bentham, Hooker's J. Bot. Kew Gard. Misc. 6: 5. 1854. TYPE: Hong Kong, *J. G. Champion* (holotype, K not seen).

Croton calococcus Kurz, J. Asiat. Soc. Bengal 42: 242. 1873. Syn. nov. TYPE: Burma. Rangoon, s.d., *S. Kurz 1607A* (lectotype, designated by Chakrabarty & Balakrishnan ("1992," published in 1997), CAL not seen; isolectotype, K not seen).

Croton bonianus Gagnepain, Bull. Soc. Bot. France 68: 549. 1921 [1922]. SYNTYPES: Vietnam. Lan Mak, 10 Nov. 1883, *R. P. Bon 2260* (A, P), *R. P. Bon 215* (P not seen), near Hanoi, But-son, 7 Dec. 1883, *R. P. Bon 2343* (A, P); Thinh-chau, *R. P. Bon 2568 bis* (P not seen).

Croton murex Croizat, J. Arnold Arbor. 23: 41. 1942. TYPE: Vietnam. 12 km N of Dankia-Langbiang, 27 Oct. 1930 (fl), *E. Poilane 18657* (holotype, A; isotypes, K, P).

Croton trachycaulis Airy Shaw, Kew Bull. 23: 74. 1969. TYPE: Thailand. South-Western: Prachuap Khiri Khan, Hui Yang, 3 Oct. 1930 (fl, fr), *Put [= Put Phraisurind] 3186* (holotype, K; isotypes, A, BK, BM, L).

This synonymy was largely (except for *C. calococcus*) included by Govaerts et al. (2000) after discussion with the author. The whole complex is best treated as a single polymorphic species, and was formerly divided into species mostly on the basis of two characters, indumentum and fruit surface. Fruit surfaces vary from smooth to muriculate seemingly as natural variation, not correlated with other characters or geography. The indumentum does show a geographical pattern: Plants from China are usually glabrescent on the upper leaf surface, with leaf hairs that are slightly smaller (ca. 0.8 mm diam.) with a central porrect radius not longer than the lateral radii. Plants from Thailand always have leaves pubescent above, and the hairs are often larger [(0.2–)0.8–1.5 mm diam.] and with an exceptionally long porrect radius, with the lateral radii short to nearly rudimentary on the upper leaf surface (not on other parts). This alone is probably not sufficient for separation at the species level. Further studies with a better representation from Indochina are necessary to evaluate if clear-cut differences exist somewhere along the cline. If the indumentum turns out to be significant, the correct name for the Thai plants is probably *C. calococcus*, and among the Vietnamese names at least *C. bonianus* certainly remains a synonym of *C. lachnocarpus*.

The two syntypes of *C. bonianus*, *Bon 2260* and *Bon 2343*, are mounted together on one sheet in both A and P, with one fruiting twig and one flowering but one joint label; they cannot be separated.

Croton laniflorus Geiseler, Croton. Monogr.: 44. [Mar.] 1807. *Croton lanatus* Loureiro, Fl. Cochinch. ed. 1, 2: 581. 1790, nomen illeg., non Lamarck, Encycl. 2: 211. 1788. *Croton lasianthus* Persoon, Syn. Pl. 2: 586. [Sep.] 1807, redundant name. *Croton erioanthemus* Smith, in Rees, Cycl. 10: Croton no. 21. 1808, redundant name. *Triplandra lanata* (Loureiro) Rafinesque, Sylva Tellur.: 63. 1838. TYPE: Vietnam. "In sylvis montanis Cochinchinae," s.d. (fl, fr), *J. Loureiro s.n.* (holotype, BM).

Croton limitincola Croizat, J. Arnold Arbor. 23: 45. 1942. Syn. nov. TYPE: Vietnam. Taai Wong Mo Shan, Sep. 1939 (fl, fr), *W. T. Tsang 29584* (holotype, A).

Geiseler's name is the earliest of three names replacing the illegitimate name of Loureiro. *Croton laniflorus* was misspelled as "*laxiflorus*" by the Index Kewensis, a mistake not picked up by Govaerts et al. (2000); neither works indicate that it was a replacement for Loureiro's name. *Croton lasianthus* was published a few months later than *C. laniflorus*, but has been the accepted name in the literature, following the authority of Müller (1866) and Merrill (1935).

Because the identity and many important characters of *C. laniflorus* have never been clarified (even Merrill, 1935, was in doubt), it is useful to contribute a short description of the type:

Woody plant. Indumentum consisting of stellate hairs with a brown center and pale-hyaline radii (appearing as brownish dots), flat, with ca. 15 radii. Stipules linear-elliptic, ca. 6 mm long. Leaves alternate, only immature ones on the type sheet; petioles with few hairs; immature blades membranous, elliptic, ca. 8 × 3.5 cm, index ca. 2.3, base obtuse, margin shallowly serrate, apex acute to subacuminate, glabrous above, beneath with scattered but distinct hairs; basal glands abaxial-lateral on the junction of petiole and midrib, stipitate and quite distinct, marginal glands not seen; side veins distinct on both surfaces, in 10–11 pairs, not triplinerved, arching in quite distinct loops (brochidodromous). Inflorescences only seen in fragments. Pistillate flowers: pedicel 4 mm long, with few hairs only; sepals 4–5 × 1.5–2.5 mm, much longer than the ovary, nearly glabrous; petals not seen; ovary ca. 2 mm long, distinctly brown hispid-pubescent with long porrect radii; stylar column short (ca. 0.5 mm) but present, stigmas ca. 3 mm long, bifid on the apical ca. 2 mm, slightly flat and broadened. Fruits only seen in fragments; schizocarp 9 mm long, distinctly pubescent, smooth. Seeds not seen.

Although the holotype of *C. laniflorus* is a somewhat fragmentary collection, sufficient diagnostic characters are present. The type of *C. limitincola* is identical in all important characters studied here, and differs in more distinctly pubescent pistillate flowers and in much larger leaves up to 22 × 9 cm, but the leaves are mature and the smallest leaf on the holotype is nearly identical in size with the type of *C. laniflorus.*

Croton vietnamensis Radcliffe-Smith & Govaerts (the name replacing the illegitimate *Croton longipes* Gagnepain non M. E. Jones), described from Nhatrang, Vietnam, is probably also synonymous, although this needs further study.

Croton lissophyllus Radcliffe-Smith & Govaerts, Kew Bull. 52: 187. 1997 (nomen) ex Esser, sp. nov. *Croton laevifolius* auct. non Blume, in Hooker f., Fl. Brit. India 5: 391. 1887. *Croton khasianus* Hooker f., Fl. Brit. India 5: 392. 1887, nomen inval. *Croton hookeri* Croizat, J. Arnold Arbor. 21: 498. 1940, nomen inval. et illeg., non *Croton hookeri* André, Ill. Hort. 19: 56. 1872. TYPE: India. Meghalaya: Khasi Mountains, 2000–4000 ft. (fl, fr), *J. D. Hooker & T. Thomson s.n., s.d. ("Croton 17")* (holotype, GH).

Species *Crotonis* ad *C. laevifolium* accedit sed pilis stellatis, foliis serratis glabris vel parce pubescentibus, glandulis basilaminaribus stipitatis, fructibus bilocularibus distinguenda est.

Chakrabarty and Balakrishnan ("1992," published in 1997) contributed an excellent description and illustration of this species (as "*C. hookeri*"), and they seem to be completely correct in their circumscription. The bilocular ovaries and fruits seem indeed to separate the species from several similar Asian Crotons. The record for Thailand by Airy Shaw (1972) could not be confirmed.

This species has a remarkable nomenclatural history. Hooker (1887) had proposed the name *C. khasianus* only provisionally, allowing for the possibility that the plants he had described under *C. laevifolius* Blume on the previous page of his work turned out to be different from Blume's species. This did not constitute a valid publication (ICBN Art. 34.1; Greuter et al., 2000). Croizat (1940) was aware of that; he accepted the species and replaced the name with *C. hookeri.* He did not realize that he had created a later homonym of *C. hookeri* André. Radcliffe-Smith and Govaerts (1997) therefore replaced the name *C. hookeri* Croizat with *C. lissophyllus.* Their literature reference for *C. hookeri* André was unfortunately erroneous here and in Govaerts et al. (2000: 404), who also attributed the name to Veitch. Croizat's name, however, was not only illegitimate but also invalid, because he did not contribute a Latin description or diagnosis, and did not refer to a previously published Latin diagnosis, which is mandatory after 1 January 1935 (ICBN Art. 36.1), for which reason *C. lissophyllus* also remained invalid.

Govaerts et al. (2000) cited a synonym under *C. lissophyllus, C. cnidopyllus* Radcliffe-Smith & Govaerts, the name replacing the illegitimate *C. urticifolius* Y. T. Chang & Q. H. Chen non Lamarck. It was described from China (Guizhou). Although I was unable to examine original material of that species, it is improbable that it is conspecific with *C. lissophyllus.* The latter seems to be a local endemic, and its leaves are not triplinerved. *Croton cnidophyllus* might be closely related to (or even be synonymous with) *C. lachnocarpus.*

The type specimens of *C. lissophyllus* were distributed under the name of *Croton laevifolius.*

Paratypes. BANGLADESH. Silhet, Pandowah Hill, May 1822 (fem. fl), *N. Wallich 7719* (CAL not seen, K, K-WALL). INDIA. **Meghalaya:** Khasi Mountains, 13 June 1850 (fl), *J. D. Hooker & Thomson s.n.* (A, K); 20 June 1850 (fl), *J. D. Hooker & T. Thomson s.n.* (K); s.d., *J. D. Hooker & T. Thomson s.n.* ("Croton 17") (A, G-DC, NY, TCD, U); s.d. (male fl), *W. Griffith 4784* (GH, K).

Croton mekongensis Gagnepain, Bull. Soc. Bot. France 68: 558. 1921 [1922]. TYPE: Cambodia. Campong-luang, leg. 1866–1868 (fl, fr), *C. Thorel s.n.* (lectotype, designated here, P; isolectotype, P).

The Thorel collection from Campong-luang is the only one among the four syntype collections (two made by Harmand and Thorel each) with fruits. Among the two sheets at P, the one with attached drawings is chosen here.

Croton poilanei Gagnepain, Bull. Soc. Bot. France 68: 559. 1921 [1922]. TYPE: Vietnam. Baria: Nui-dinh, 25 Oct. 1919 (fl), *E. Poilane (leg. A. J. B. Chevalier) 636* (lectotype, designated here, P; isolectotypes, A, K).

Several excellent syntypes with duplicates are available, all with analytical drawings by Delpy and used by Gagnepain attached to the Paris sheet. The chosen lectotype had already been separated in a type folder in Paris, and it is the only one among the syntypes with a label by Poilane, to whom the species was dedicated.

Croton thorelii Gagnepain, Bull. Soc. Bot. France 68: 560. 1921 [1922]. TYPE: Vietnam. "Ad montem Dinh prope Baria," Apr. 1867 (fl, imm. fr), *L. Pierre 6226* (lectotype, designated here, P; isolectotypes, BM, GH, NY).

Croton thorelii was based on nine syntype collections. All of them belong to this species and not to the similar *C. decalvatus* Esser, with which *C. thorelii* was formerly confused by some authors, such as Airy Shaw (1972) (Esser & Chayamarit, 2001). Among the syntypes in P with drawings attached, the one with the largest number of duplicates is selected here.

Gagnepain (1925: 264, fig. 28.8–10) stressed the diagnostic importance of pubescent stamens. Stamens pubescent to a various and often variable degree were found in several Asian species of *Croton*, and do not appear to be significant. The quadrifid stigmas however, also discussed by Gagnepain, seem to be diagnostic for *C. thorelii*.

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Astragalus tuyehensis (Fabaceae), a New Species from Iran

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ABSTRACT. A new species from Iran, *Astragalus tuyehensis*, belonging to the bifurcate-haired subgenus *Cercidothrix*, is described and illustrated. Its relationships to *A. durandianus* and its distinguishing characters, such as inflated calyx and non-swollen fruit, are discussed.

Key words: *Astragalus*, Fabaceae, Iran.

Astragalus L. (Fabaceae) is probably the largest genus of flowering plants, containing up to 3000 species (Lock & Simpson, 1991). Iran is one of the biggest centers of diversity for the genus (Ghahremani-nejad, 2000), with approximately 700 species with 56% endemism (Maassoumi, 1998). The new species belongs to *A.* subg. *Cercidothrix* Bunge, which is characterized by perennial growth and the presence of bifurcate hairs (Bunge, 1868). This subgenus has nearly 800 species in the Old World, 157 (20%) of which occur in Iran. In Iran, subgenus *Cercidothrix* has 83 (53%) endemic species (Ghahremani-nejad, 2000). Major areas of species endemism for this subgenus occur in Turkey, Iran, Kazakhstan, Afghanistan, and China, with 88, 83, 47, 38, and 32 endemic species reported, respectively (Ghahremani-nejad, 2000).

Astragalus tuyehensis Ghahreman, Maassoumi & Ghahremani-nejad, sp. nov. TYPE: Iran. Semnan: 35 km N of Damghan, above Tuyeh (SW slope), 2000 m, 16 May 1978, *P. Wendelbow & M. Assadi 2948a* (holotype, TARI). Figure 1.

Haec species ad *Astragalum* subg. *Cercidotrichem* pertinens *A. durandiano* Aitchison & Baker maxime affinis, sed ab eo calyce inflato oblongo-ovoideo (vs. cylindrico) atque fructu non tumido facile distinguitur.

Perennial, ca. 8–13 cm tall, vested with bifurcate hairs; caudex branched, short, woody. Stems 1–2 cm long, whitened by a dense coat of short appressed white hairs. Stipules partly adnate at base to petiole, free (non-connate), lanceolate-ovate, 2–3 mm long, densely canescent with appressed white or mixed white and black hairs. Leaves imparipinnate, 1.5–3.5 cm long, both petiole and rachis densely canescent; petiole 1.5–2 cm long, 2.5–3.5 times the length of the rachis, partially persistent but not spinescent; leaflets in 2 or 3 pairs, elliptic, elliptic-oblong to rarely elliptic-obovate, acute, 5–9 × 1.5–2.5 mm, canescent on both sides. Peduncles 3–5.5 cm long, somewhat shorter than to 2 times leaf length, canescent; inflorescence ovate-spherical, 3- to 10-flowered; bracts lanceolate-ovate to lanceolate, (1)2–3 × 1–2 mm, canescent with ascending black and mixed, or exclusively white hairs; bracteoles wanting; pedicel 2 mm long. Flowers: calyx at first cylindric, becoming oblong-ovoid inflated (to 6 mm diam.) in fruit, 12–14 mm long, finally ruptured or not ruptured by fruit, canescent with ascending white and black hairs, the calyx tube 4–5 times the length of the lanceolate teeth; corolla yellow to yellow-brown (known only from dry state). Standard 20 mm long, 10 mm broad, retuse, the limb elliptic-ovate, not auriculate, 4 to 5 times as long as the claw; wing 20 mm long, the limb oblong-elliptic, 7–8 × 3–3.5 mm, obtuse; keel 19 mm long, the limb 6 × 3.5 mm; ovary 9–10 mm long, subsessile, densely white-sericeous, imperfectly bilocular, 18-ovulate; ovules reniform, 0.25 × 0.2 mm; style 9–10 mm long, glabrous, basally pilose. Pod 9–10 mm long, terminating in a beak 1–1.5 mm long, somewhat bilocular, densely white-sericeous.

Taxonomic and distributional remarks. *Astragalus tuyehensis* has not been seen in the field by the authors, but is known to us only from four specimens, one at TARI, and three at FUMH. The species occurs in the provinces of Semnan and Khorassan (Fig. 2). The closest relative of the new species is *A. durandianus* Aitchison & Baker (*J. E. T. Aitchison 688*, type, LE!), also from subgenus *Cercidothrix*, and shares the characters of short overall height, bifurcate hairs, short stem, bracteole wanting, with stip-

Figure 1. *Astragalus tuyehensis* Ghahreman, Maassoumi & Ghahremani-nejad. Habit with details of flowers. —1. Habit. —2. Magnified view of rachis and leaflets. —3. Calyx. —4. Floral standard. —5. Wing. —6. Keel. —7. Stamens. —8. Pistil. —9. Fruit. (From the holotype: *Wendelbow & Assadi 2948a*.) (1, scale bar = 2 cm; 2, 9, scale bar = 6 mm; 3–8, scale bar = 1 cm.)

ules adnate at the base on one side of the petiole and free (non-connate) on the other side. *Astragalus durandianus*, which has a small distributional range in western Afghanistan and eastern Iran (Lock & Simpson, 1991; Rechinger, 1957: 133), is a perennial plant with bladdery-swollen fruit. The new species is readily separated from *A. durandianus* by its oblong-ovoid inflated calyx (not cylindric) and non-swollen fruit. Both of these species are excellent candidates for section *Erioceras*, if only one character for each species is ignored (the swollen fruit of *A. durandianus* and the swollen calyx of *A. tuyehensis*). Future molecular systematic work will be necessary to help us better understand the sectional placement of selected Old World *Astragalus*.

Paratypes. IRAN. **Khorassan:** between Mashhad and Neyshabur, Piveh-jan, 29 Apr. 1985, *H. Safavi & M. Johartchi 12341* (FUMH); Golmakan, S of Esjil, 4 May 1985, *M. Johartchi 12538* (FUMH); S of Ghuchan, Yadak, 1700 m, 15 May 1985, *M. Joharchi & Zanguee 12905* (FUMH).

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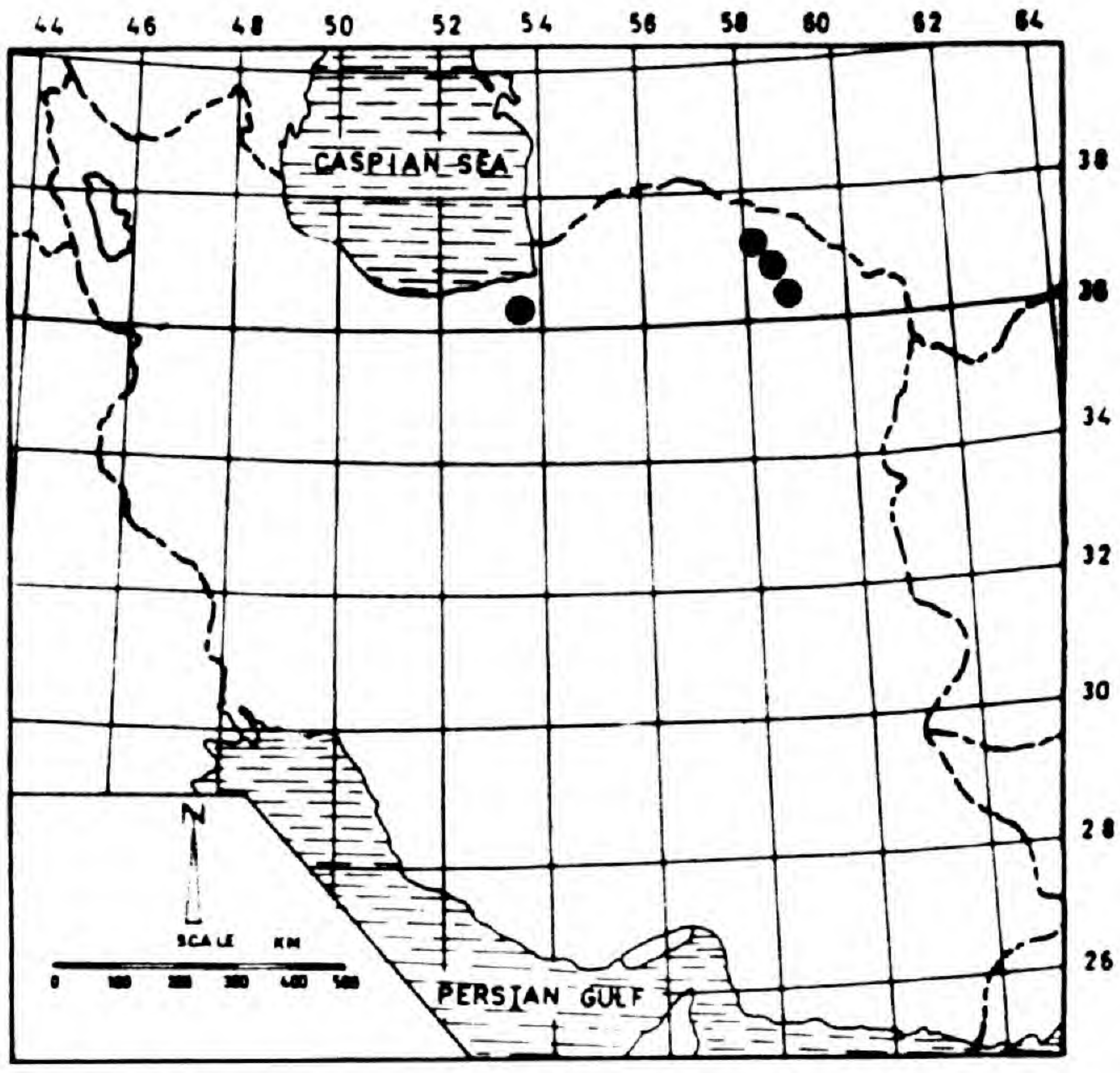

Figure 2. Distribution of *Astragalus tuyehensis.*

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Phlomis tathamiorum (Lamiaceae), a New Species from Lebanon

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ABSTRACT. A new species of the genus *Phlomis* L. is described. *Phlomis tathamiorum* R. M. Haber & Semaan is distinguished by the following characters: whole plant eglandular; basal leaves cordate, oblong-lanceolate; indumentum almost solely pannose, of layered unstalked, short-stalked, and long-stalked stellate trichomes; inflorescence paniculate with few 1–6(–7) mm long subulate to lanceolate bracteoles; verticillasters and flowers numerous; calyx tubular, enlarged at middle; lower lip of corolla longer; nutlet tip stellate with stipitate glands.

Key words: Lamiaceae, Lebanon, *Phlomis*.

For two decades the authors have joined their efforts in reviewing the described flowering plants of Lebanon to update their geographical distributions and amass botanical photographic records to be used in awareness campaigns and education kits concerning the importance of biodiversity and ecological stability. This extensive research resulted in the discovery of a new species of the genus *Phlomis* L. (Lamiaceae).

The genus *Phlomis* has until now been represented in Lebanon by eight species (Huber-Morath, 1982; Mouterde, 1983). While six species (*P. amanica* Vierhapper, *P. kurdica* Rechinger f., *P. longifolia* Boissier & Blanche, *P. rigida* Labillardière, *P. syriaca* Rechinger f., and *P. viscosa* Poiret) are also distributed in Turkey and the Levant, *P. brevilabris* Ehrenberg and *P. brachyodon* subsp. *damascena* (Bornmüller) Samuelsson are endemic to Lebanon and Syria.

Phlomis tathamiorum R. M. Haber & Semaan, sp. nov. TYPE. Lebanon: North Lebanon Province: Ehden town, 1400 m, 34°17′32.3″N, 35°56′51.9″E, 15 Aug. 2000, *R. Haber & M. Semaan s.n.* (holotype, MO; isotypes, PH, RBGK). Figure 1.

Herba perennis eglandulata; radice lignosa; indumento panniformi fere omnino stellato ex trichomatibus sessilibus stipitatisque constantei; caule erecto usque ad 110 cm alto, quadrangulato, rigido autem fragili, infra brunneolo supra purpurascente, trichomatibus stellatis albis apprime circa nodos densis floccosisque pannoso. Folia basalia 7–13 × 2.5–6.0 cm, cordata, oblongo-lanceolata, acutata, minute crenata. Inflorescentia ex verticillastris multifloris in paniculum dispositis constans; bracteolis paucis, 1–6(–7) mm longis, lineari-lanceolatis, subulatis. Flos calyce tubulari, 14–16 mm longo, ad medium dilatato, intus villoso, dentibus 4–6 mm longis, inaequalibus, acuminatis; corollae labio inferiore quam superiore longioris. Nuculae ad apices trichomatibus stellatis persistentibus ornatae.

Perennial eglandular herb with ligneous base; indumentum pannose, of dense white and yellow layered unstalked, short-stalked, and long-stalked erect stellate trichomes, with mixed adpressed stellate and dendroid trichomes only at base of calyces and on upper side of petioles; stem erect, to 110 cm high, quadrangular, rigid but brittle, brownish below, purplish above, pannose with white stellate trichomes, these especially dense and floccose around nodes. Basal leaves with petiole 3–6 mm wide, up to 15 cm long; blade 7–13 × 2.5–6.0 cm, oblong-lanceolate, broadly acute, usually deeply cordate, rarely cuneate, minutely crenate, slightly undulate, conduplicate or rarely flat, rugose especially below, coriaceous, pannose with trichomes white or yellow especially beneath along midvein and main veins; cauline leaves with petioles 3–5 cm below, becoming shorter and more slender upward; blade 6–10 × 2.5–4.0 cm, acute, slightly conduplicate, pannose, the lower cordate-lanceolate and similar to basal leaves, becoming oblong-lanceolate upward, base cuneate to attenuate, often unequal; floral leaves shortly petiolate, rarely sessile; blade pannose, 1.5–5.0 × 0.4–1.5 cm, oblong-lanceolate, conduplicate, acute, attenuate, longer than lower verticillasters, shorter upward. Inflorescence a panicle of verticillasters; terminal axis with 5 to 10 lax verticillasters, each 8- to 14(usually 10)-flowered; lateral branches up to 8, sometimes lon-

Figure 1. *Phlomis tathamiorum* R. M. Haber & Semaan. —A. Whole plant. —B. Verticillasters.

ger than terminal, major branches with 1 to 5 (or 6) verticillasters each 5- to 10-flowered; petioles 0–2 mm long; bracteoles 1–6(–7) mm, few (ca. 20), herbaceous, linear to lanceolate, subulate, rarely clavate, sometimes irregular or dimidiate; pannose outside with evident dendroid-stellate trichomes, often yellow at tip, glabrescent inside. Calyx 14–16 mm long, tubular, broadest (4–7 mm) in middle, pannose outside, especially around base, villous inside, 10-veined, the teeth unequal, 4–6 mm long, triangular-lanceolate, acuminate; corolla 25–30 mm long, yellow, lower lip orange-tipped, exceeding upper lip; upper lip helmet-shaped, pannose outside, villous inside at tip and lateral margins, glabrous at center; lower lip pannose outside with sessile stellate trichomes especially toward margin, sparsely villous inside, densely and minutely verruculate in middle; corolla tube annulate within; stamens included in corolla, inserted just below annulus; periphery of nectar disk raised into two large and two small fringed, glandular-pubescent, succulent, reniform-lenticular, basally joined septa, the larger shallowly sulcate from middle to base, the smaller brachiate between two pairs of nutlets. Nutlets tipped with persistent stellate trichomes and many stipitate glandules, only one maturing per ovary; mature seed 5–9 × 2.5–3.5 mm, brown, obovate-oblanceolate, rugose, slightly dorsoventrally flattened, with prominent funiculus.

Distribution and habitat. The species is rare, localized in the rocky mountain pastures around the town of Ehden, North Lebanon, which lies on the western slopes of the Mount Lebanon Range at mid altitudes (1400–1700 m). Disturbance and loss of habitat are inferred to influence the abundance of the species. *Phlomis tathamiorum* occurs today in wild land lots patched among considerable areas that have been claimed for development, agriculture, and diverse human activities. The remnant habitat areas are subject to various disturbance factors. Threats by real estate development and recreational activities seem imminent. In 1997, the authors transplanted stem bases from different populations to privately owned land within the habitat range of *P. tathamiorum.* The transplants have matured to seeding individuals. The flowering period of *P. tathamiorum* extends from July to August.

The differentiation of *P. tathamiorum* from the other *Phlomis* species in Lebanon is emphasized in the following key.

- 1a. Corolla pink . . . . *P. rigida*
- 1b. Corolla yellow, sometimes with brownish upper lip.
  - 2a. Shrubs; bracteoles 10–20 mm long, about as long as calyx tube, numerous, dense.
    - 3a. Calyx teeth up to 1 mm long . . *P. amanica*
    - 3b. Calyx teeth 1–12 mm long.
      - 4a. Calyx and bracteoles viscid . . . . *P. viscosa*
      - 4b. Calyx and bracteoles not viscid . . . . *P. longifolia*
  - 2b. Herbs; bracteoles 1.5–9(–12) mm long, usually few or absent, weak.
    - 5a. Calyx tubular or narrowly campanulate; tube enlarged, broadest above.
      - 6a. Indumentum floccose, not persistent; stem and leaves become glabrescent; corolla lips equal . . . . *P. brachyodon* subsp. *damascena*
      - 6b. Indumentum persistent; corolla lips unequal.
        - 7a. Indumentum yellowish gray; calyx sub-adpressedly tomentose; bracteoles 2–6 mm long . . . . *P. syriaca*
        - 7b. Indumentum gray; calyx erectly tomentose; bracteoles longer . . . . *P. brevilabris*
    - 5b. Calyx tubular; tube broadest at middle.
      - 8a. Nutlets eglandular, glabrous; bracteoles 1.5–2 mm long . . . *P. kurdica*
      - 8b. Nutlets with stipitate glands and stellate trichomes at apex; bracteoles 1–6 mm long . . . *P. tathamiorum*

In addition, *Phlomis tathamiorum* differs from *P. kurdica* by its taller stems, its more branched inflorescence with more verticillasters, and attenuate-based floral leaves. It differs from *P. syriaca* by longer-petiolate basal and cauline leaves, more branched inflorescence, more flowers per verticillaster, oblong-lanceolate floral leaves, and pubescent nutlets. It is differentiated from *P. brevilabris* and *P. brachyodon* subsp. *damascena* by its taller stems, its more branched inflorescence, more flowers per verticillaster, and shorter bracteoles. It also differs from *P. brevilabris* by pubescent nutlets, and from *P. brachyodon* subsp. *damascena* by the unequal lips of the corolla, the inferior being longer.

The geographical distribution of *P. tathamiorum* is sympatric with that of *P. syriaca* and *P. brevilabris* (Mouterde, 1983). They co-exist in the mid altitudes of the western slopes of the Mount Lebanon Range in a Mediterranean climate associated with a snowy season (Service Météroligique, 1966, 1967). However, the expansion range of *P. tathamiorum* is distinctly allopatric from that of *P. kurdica* and *P. brachyodon* subsp. *damascena* (Mouterde, 1983). The occurrence of the latter taxa is restricted to the inland, where climatic conditions are semi-arid (Service Météroligique, 1966, 1967).

The species is named in gratitude and respect after H.E. Mr. David Tatham, former United Kingdom Ambassador to Lebanon, and to Mrs. Valerie Tatham, for their invaluable support of conservation efforts for Lebanon's wildlife and natural resources, and most especially for their love of Lebanon's wilderness.

Paratype. LEBANON. **North Lebanon Province:** Ehden town, 1400 m, 34°17′38″N, 35°56′45″E, 12 Sep. 2000, *R. Haber & M. Semaan s.n.* (MO, PH, RBGK).

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A New Species in *Potentilla* Section *Leptostylae* (Rosaceae) from Yunnan, China

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ABSTRACT. A new species, *Potentilla polyphylloides* H. Ikeda & H. Ohba, is described and illustrated. It is assigned to section *Leptostylae* by having an herbaceous habit, slender or fusiform styles, auricles of stipules of basal leaves situated at adaxial side of petioles, and flowering stems from axils of basal leaves. It resembles *P. polyphylla* Wallich ex Lehmann, but differs by its glandular hairs on the lower surface of leaflets, pedicels, and the outside of episepals, as well as the occasional rooting at the axils of cauline leaves on the lower portion of flowering stems. *Potentilla polyphylloides* resembles *P. fallens* Cardot sharing the glandular hairs, but *P. fallens* differs in having nearly entire episepals that are shorter than the sepals, and longer styles nearly twice as long as the ovaries. *Potentilla polyphylloides* has a chromosome number of $2n = 42$, while that of *P. polyphylla* and *P. fallens* is $2n = 28$.

Key words: China, chromosome number, *Potentilla*, Rosaceae, section *Leptostylae*.

Ikeda and Ohba (1993, 1999) revised the taxonomy of *Potentilla* sect. *Leptostylae* in the Himalayas and adjacent regions. Species of section *Leptostylae* are characterized by sharing an herbaceous habit, slender or fusiform styles, auricles of stipules of basal leaves situated at the adaxial side of petioles, and flowering stems from the axils of basal leaves (Ikeda & Ohba, 1999). In 1994 and 1996, Wu et al. collected specimens of one *Potentilla* resembling *P. polyphylla* Wallich ex Lehmann in a meadow on Mt. Cangshan, Yunnan Province, southwest China. It was assigned to section *Leptostylae*, but Ikeda and Ohba (1999) excluded this from their revision due to insufficient material. After completing the manuscript of this revision, Wu and Ikeda found the same *Potentilla* again in a meadow on Mt. Cangshan in 1997. After the study of its morphological variation, chromosome number, and reproductive biology, it is concluded that the material represents a new species.

Somatic chromosomes were counted from root tips. In the field root tips were pretreated in 2 mM 8-hydroxyquinoline solution for 2–3 hours and fixed in Newcomer's fluid. They were subsequently macerated in 1N HCl at 60°C for 10.5 min., stained with 2% lacto-propionic orcein, and squashed for cytological observation.

Potentilla polyphylloides H. Ikeda & H. Ohba, sp. nov. TYPE: China. Yunnan: Yangbi, Cangshan–a Fruit Garden–Yangbi, 3230 m, 19 Aug. 1997, *S. G. Wu, H. Ikeda, S. Akiyama, F. Miyamoto & W. Chen 91* (holotype, KUN; isotypes, A, E, HYO, MO, TI). Figures 1, 2.

Ab affini *P. polyphylla* Wallich ex Lehmann perspicue differt hypanthio, pedicellis et foliolis subtus glandulosis. Planta propter indumentum glandulosum *P. fallenti* Cardot appropinquat, sed episepalis 3–7-dentatis sepalis longioribus et stylis ovariis brevioribus satis distincta.

Perennial acaulescent herb with thick simple or sometimes branched rootstocks. Basal leaves oblanceolate, imparipinnate, 8–20 × 2–4 cm, petiolate, forming a rosette; lateral leaflets 10 to 15 pairs, serrate, gradually decreasing in size toward base, with alternating smaller leaflets; petioles 0.8–3.5 cm long, with ascending or patent unicellular hairs; base of uppermost leaflet pair cuneate. Leaflets with appressed or ascending unicellular hairs

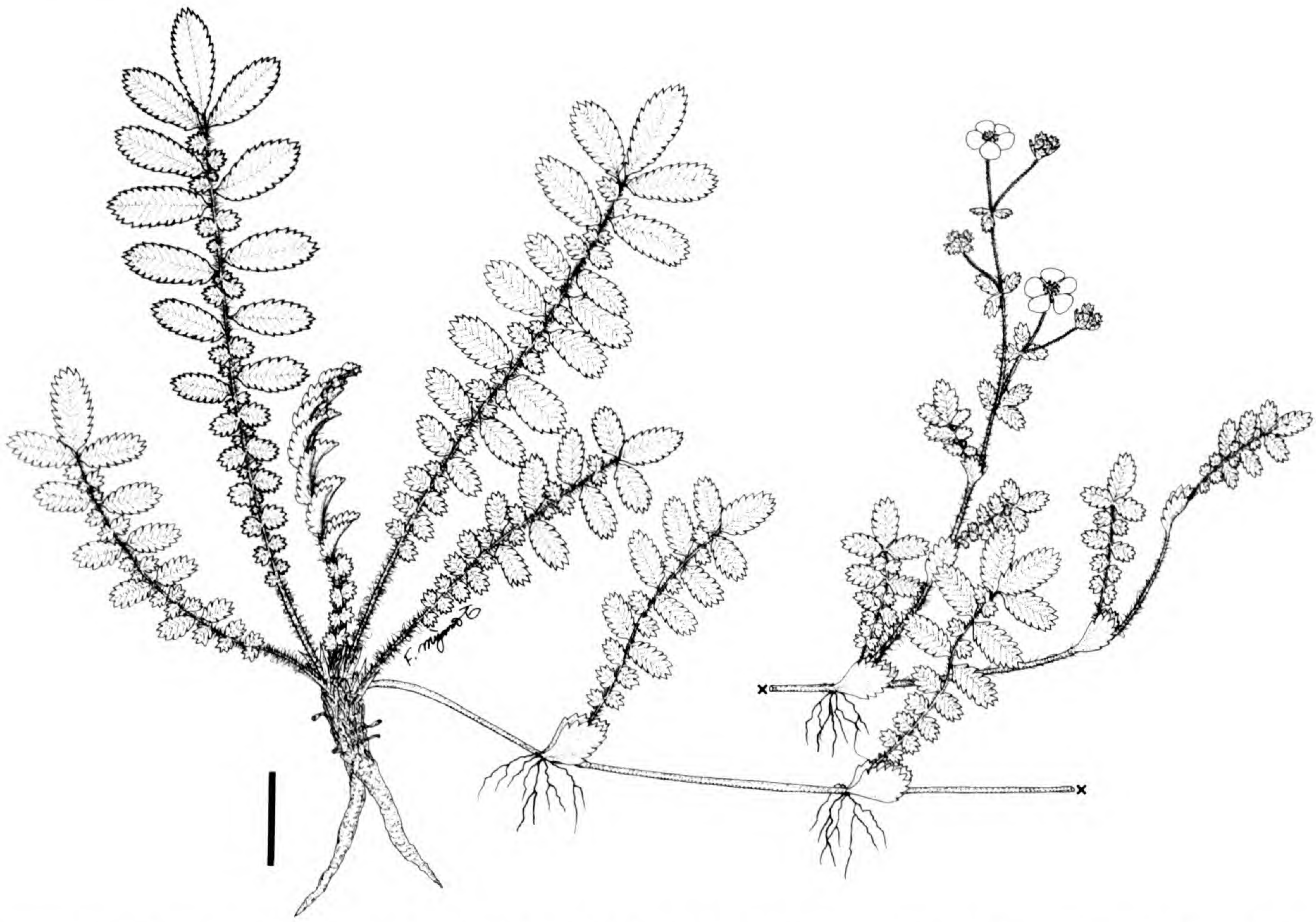


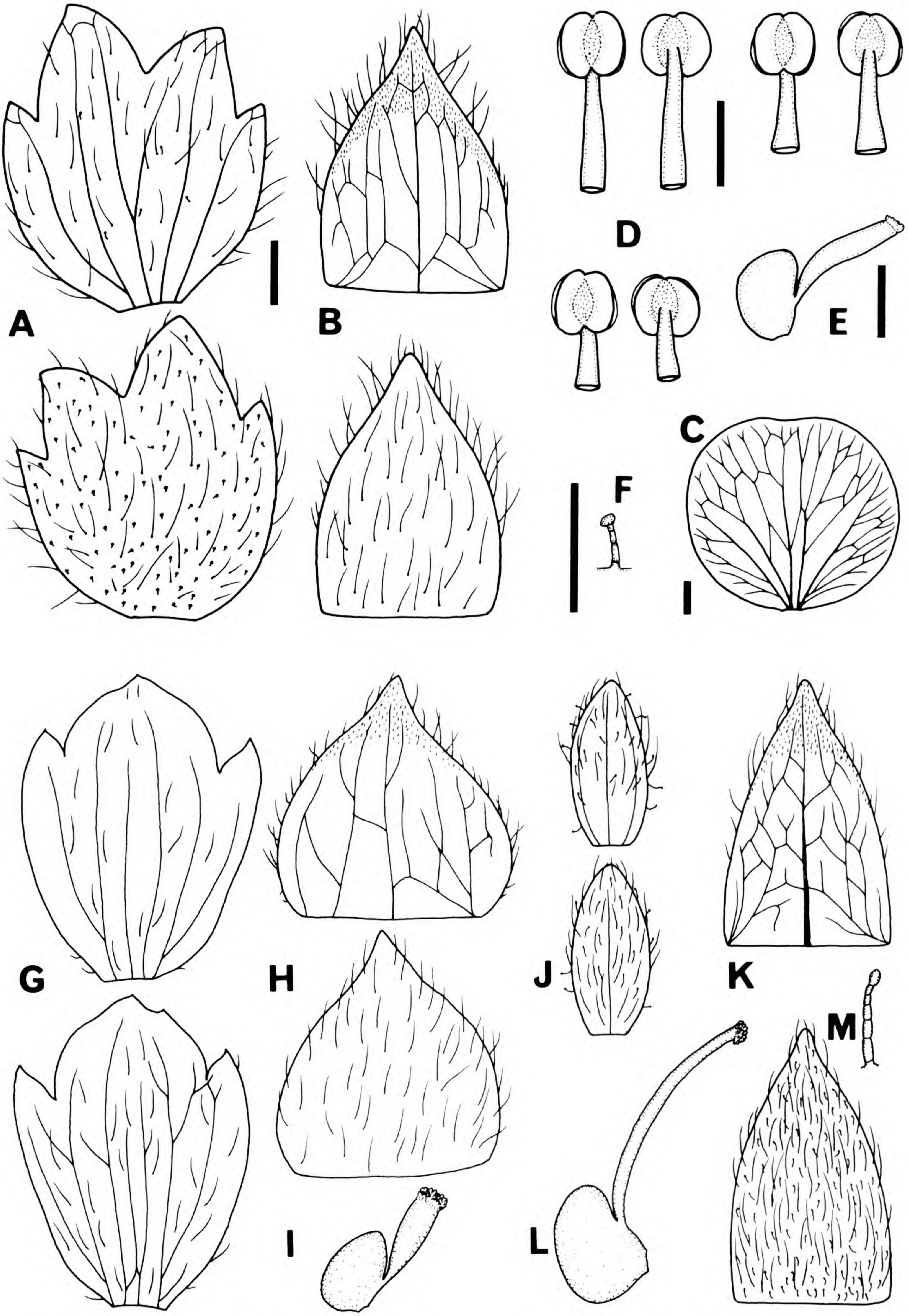
Figure 1. *Potentilla polyphylloides* H. Ikeda & H. Ohba, habit. Scale bar = 2 cm. Drawn from the *Wu et al. 91* isotype at TI.

on upper surface, glandular hairs and ascending unicellular hairs on lower surface; terminal leaflet subsessile, oblong to obovate, 1.2–2.4 × 0.7–1.4 cm, serrate with 17 to 33 teeth per leaflet. Auricles of stipules free. Peduncles 17–60 cm long, ascending or prostrate, with appressed or ascending unicellular hairs, occasionally rooting from the nodes. Cauline leaves trifoliolate or with 2 to 8 pairs of leaflets, sometimes with alternating smaller leaflets. Auricles of stipules entire or with a few teeth in lower ones, 10 to 20 teeth in upper ones. Pedicels 1.2–3.8 cm long, with glandular hairs and appressed or ascending unicellular hairs. Flowers in a dichasium, 1.1–1.5 cm across. Hypanthia 4–8 mm across. Episepals oblong to widely obovate, 2.5–5.5 × 2–4.5 mm, usually serrate with 3 to 7 teeth, rarely entire, apex acute, with glandular hairs and ascending unicellular hairs on both sides, usually longer than sepals. Sepals elliptic to ovate, 2.5–4 × 1.8–4 mm, entire, apex acute to obtuse, ascending unicellular hairs on outer side and margin, lanate apically, glabrous basally on inner side. Petals obovate to widely obovate with round or retuse apex, 5–6.5 × 3.5–7 mm. Stamens 20, in 3 whorls; antisepalous ones 5, from the inner whorl longer than others, 1.6–2.2 mm long; antipetalous stamens 5, from the middle whorl shorter than others, 1.2–1.3 mm long; those located between petals and sepals 10, from the outer whorl, 1.4–1.6 mm long; anthers spheroidal, subbasal, with 4 locules, 0.7–0.8 mm across. Ovaries ellipsoid, smooth, 0.5–0.6 × ca. 0.4 mm; style subbasal, 0.8–0.9 mm long; stigma slightly inflated, papillate; placenta located at ventro-lateral side near style base. Achenes many, on dome-shaped receptacle, obliquely ellipsoidal, smooth, 1.2–1.4 × 0.7–0.9 mm.

Potentilla polyphylloides resembles *P. polyphylla* in sharing 3- to 7-dentate episepals longer than sepals and relatively short styles (ca. 1.5× as long as ovaries). However, *P. polyphylloides* differs from *P. polyphylla* in having glandular hairs on the lower

→

Figure 2. Floral dissections comparing *Potentilla polyphylloides* (A–F), *P. polyphylla* (G–I), and *P. fallens* (J–M). —A, G, J. Episepals, inner surface (upper) and outer surface (lower). —B, H, K. Sepals, inner surface (upper) and outer surface (lower). —C. Petal. —D. Three types of stamens: antisepalous ones (upper left two), between petals and sepals



(upper right two), and antipetalous (lower two). For each stamen pair, inner surface (left) and outer surface (right). —E, I, L. Pistils. —F, M. Multicellular hairs with glandular tips. Scale bars: A, B, G, H, J, K to same scale bar = 1 mm; C, D scale bars = 1 mm; E, I, L to same scale bar = 0.5 mm; F, M to same scale bar = 0.5 mm.

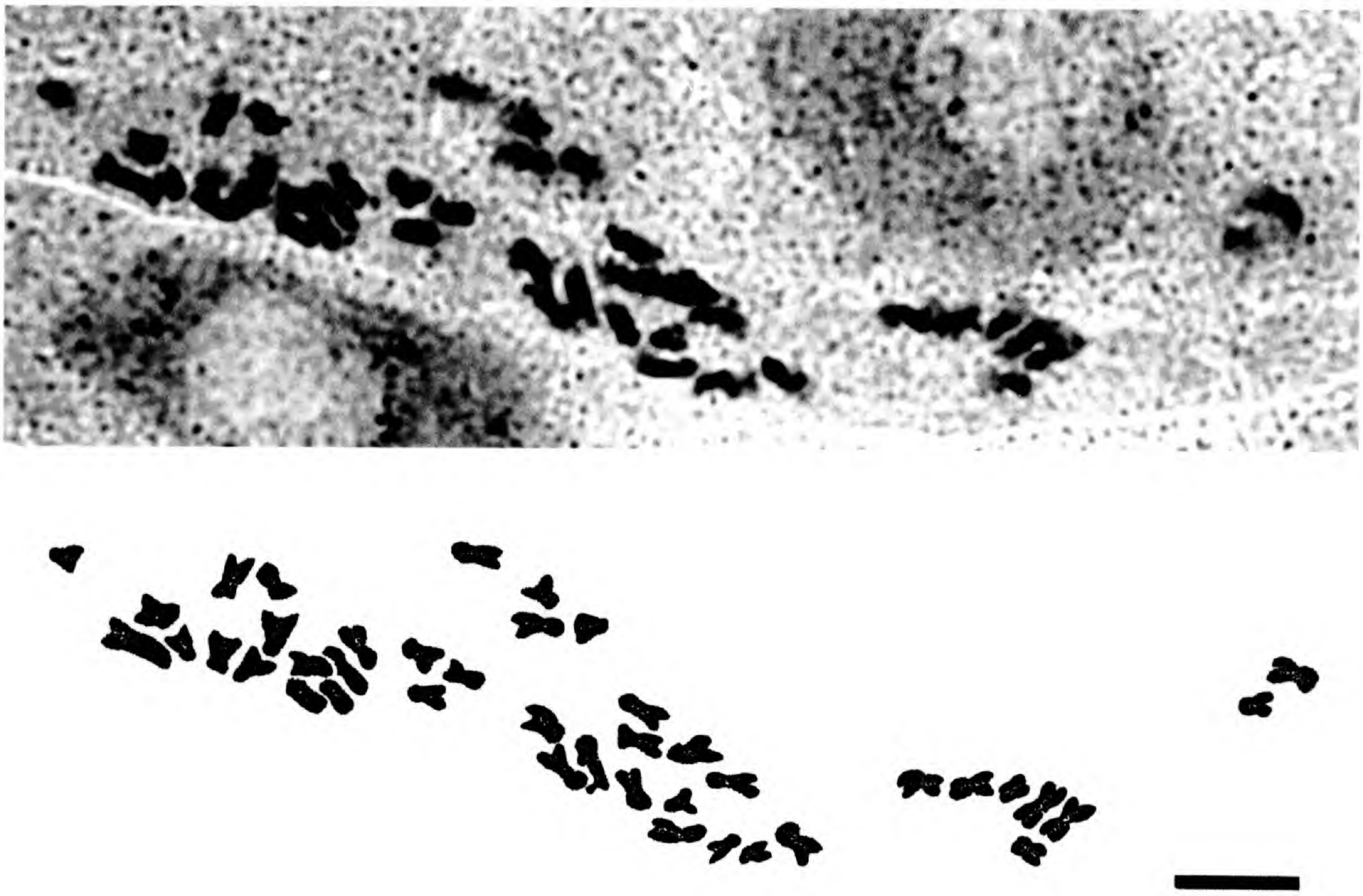


Figure 3. Somatic chromosomes at metaphase of *Potentilla polyphylloides*. Upper: microphotograph of chromosomes. Lower: drawing based on photograph. Scale bar = 5 μm.

surface of leaves, pedicels, and the outside of episepals, as well as occasional rooting at axils of cauline leaves along the lower portion of flowering stems. *Potentilla polyphylloides* resembles *P. fallens* Cardot in sharing glandular hairs, but *P. fallens* differs from *P. polyphylloides* by its nearly entire episepals shorter than the sepals and the styles nearly twice as long as the ovaries (Fig. 2).

Potentilla polyphylloides makes gregarious communities on grazed grassland slopes between 3200 and 3500 m altitude, and sometimes it becomes a dominant species. It bears flowers and fruit well in the field and may reproduce sexually by seeds as well as vegetatively by detaching from rooted nodes of flowering stems; *P. polyphylla* and *P. fallens* reproduce only by seeds.

Potentilla polyphylloides is known only from Mt. Cangshan. *Potentilla polyphylla* is distributed in the Himalaya, southwestern China (Yunnan Province), and southeastern Asia (Java); *P. fallens* occurs in southwestern China in Yunnan and Sichuan Provinces. These two species grow on grassland, similar to *P. polyphylloides*, but they have not been recorded from Mt. Cangshan (Ikeda & Ohba, 1993).

Figure 3 shows the somatic chromosomes of *P. polyphylloides*. The chromosome number of *P. polyphylloides* is $2n = 42$, different from the $2n = 28$ of *P. polyphylla* (Ikeda & Ohba, 1993) and *P. fallens* (Ikeda & Ohba, unpublished). Since the basic chromosome number of *Potentilla* is $x = 7$ (Shimotomai, 1930), *P. polyphylloides* is a hexaploid species while *P. polyphylla* and *P. fallens* are tetraploid taxa.

With the addition of *Potentilla polyphylloides*, the key to the species of *Potentilla* sect. *Leptostylae* series *Lineatae* presented in Ikeda and Ohba (1993, 1999) should be changed as follows.

KEY TO THE SPECIES OF *POTENTILLA* SECTION *LEPTOSTYLAE* SERIES *LINEATAE*

1a. Two auricles of stipules of basal leaves connate from base to middle . . . . *P. festiva* Soják
1b. Two auricles of stipules of basal leaves free from each other.
  2a. Base of uppermost leaflet pair decurrent . . . . *P. josephiana* H. Ikeda & H. Ohba
  2b. Base of uppermost leaflet pair cuneate.
    3a. Peduncles and hypanthia without glandular hairs . . . . *P. polyphylla* Wallich ex Lehmann
    3b. Peduncles and hypanthia with glandular hairs.
      4a. Stigma not inflated; leaves densely sericeous on lower surface . . . . *P. lineata* Treviranus
      4b. Stigma inflated; leaves sparsely strigose on lower surface.

5a. Episepals nearly entire, shorter than sepals; styles nearly twice as long as ovaries . . . . *P. fallens* Cardot
5b. Episepals with 3 to 7 teeth, longer than sepals; styles 1.5 times as long as ovaries . . . . . . *P. polyphylloides* H. Ikeda & H. Ohba

Paratypes. CHINA. **Yunnan:** Dali, Cangshan, Zhonghe Peak, 3390 m, 3 Oct. 1994, *S. G. Wu et al. 1305* (KUN, TI); Dali, Cangshan, 3440 m, 1 Sep. 1996, *S. G. Wu et al. 968* (KUN, TI); Yangbi, Cangshan–a Fruit Garden–Yangbi, 3500 m, 19 Aug. 1997, *S. G. Wu et al. 92* (KUN, TI).

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Taxonomic Status of *Acleisanthes*, *Selinocarpus*, and *Ammocodon* (Nyctaginaceae)

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ABSTRACT. Recent molecular and morphological studies suggest that neither *Acleisanthes* nor *Selinocarpus* (Nyctaginaceae) are monophyletic as currently circumscribed. Further, these data provide no basis for continued recognition of the monotypic genus *Ammocodon* as separate from these other two genera. Therefore, all 8 *Selinocarpus* species and the monospecific *Ammocodon* are transferred to *Acleisanthes*; 3 additional *Selinocarpus* species are reduced to synonymy. The genus *Acleisanthes* is now composed of 16 species, distributed primarily in the Chihuahuan Desert of North America. Diagnostic features of *Acleisanthes* include an herbaceous or woody perennial habit in arid environments, and the presence of both cleistogamous and chasmogamous flowers often simultaneously on an individual plant. Further, flowers are usually axillary and subtended by 1 to 4 subulate bracts, with chasmogamous flowers frequently white or yellow and funnelform to salverform.

Key words: *Acleisanthes*, *Ammocodon*, Chihuahuan Desert, Four o'clock, Nyctaginaceae, *Selinocarpus*.

The genus *Acleisanthes* A. Gray (Nyctaginaceae) consists of 7 species distributed from southern California east to the Texas coast and south to San Luis Potosí, Mexico, with its center of distribution in the Chihuahuan Desert (Smith, 1976). *Selinocarpus* A. Gray is another small genus of 11 species found in the southwestern United States and northern Mexico, with 1 species disjunct and endemic to Somalia (Fowler & Turner, 1977; Thulin, 1993; Turner, 1993). Like *Acleisanthes*, *Selinocarpus* is most species-rich in the Chihuahuan Desert of New Mexico, Texas, and Mexico. Within this region, many *Selinocarpus* species appear to prefer gypseous substrates (Fowler & Turner, 1977), whereas *Acleisanthes* inhabit a variety of soils, including those that are gypseous (Smith, 1976; Levin, pers. obs.). Although the genera are morphologically similar, *Selinocarpus* species have been characterized by the presence of winged fruits similar to those found in its namesake genus *Selinum* in Apiaceae (Gray, 1853). Further, the majority of *Selinocarpus* species are perennial shrubs, whereas *Acleisanthes* species are all herbaceous perennials. However, the genera are similar in other aspects, including the production of cleistogamous flowers in addition to the often funnelform, hawkmoth-pollinated, chasmogamous flowers with nocturnal anthesis. Since the original descriptions of these genera by Gray (1853), Standley (1916) segregated *Selinocarpus chenopodioides* A. Gray into the monotypic genus *Ammocodon* Standley as *A. chenopodioides* (A. Gray) Standley based on characters now understood to be autapomorphic, including a reduction in stamen number and its many-flowered inflorescences versus the usually solitary flowers found in other species of *Selinocarpus*.

Recent phylogenetic analyses (Levin, 2000) of these genera based on molecular sequence data including the nuclear ribosomal ITS region and a region of the chloroplast genome between the *rbc*L and *acc*D genes and confirmed by morphology suggest that their current taxonomic circumscriptions need to be reevaluated. For example, there is strong support for a sister taxon relationship between *A. wrightii* (A. Gray) Bentham & Hooker and *S. diffusus* A. Gray; in a combined parsimony analysis of nuclear and chloroplast data, this relationship was retrieved in 87% of bootstrap replicates (BS) (Levin, 2000: fig. 2). Morphologically this result is not surprising, as these species are very similar vegetatively. Leaf shape and color are nearly congruent, and *S. diffusus* shares an herbaceous habit with *Acleisanthes* species, in contrast to the woody, shrub habit commonly observed in the genus *Selinocarpus*. Further, phylogenetic results clearly split *Acleisanthes* into two groups. One group is composed of three *Acleisanthes* species: *A. anisophylla* A. Gray, *A. longiflora* A. Gray, and *A. obtusa* (Choisy) Standley (BS = 87, Levin, 2000: fig. 2). In addition to strong support for this clade from molecular data, a synapomorphy for this group of *Acleisanthes* is the presence of 5 stamens in cleistogamous flowers, in contrast to the 2 stamens found in the cleistogamous flowers of the four other *Acleisanthes* and many *Selinocarpus* species. Interestingly, plants of this lineage of three *Acleisanthes* species also have fruits lacking resinous glands. By contrast, all but the basal member of the other *Acleisanthes* group possess resinous glands on their fruits. The second group of *Acleisanthes* species includes the basal *A. crassifolia* A. Gray, *A. nana* I. M. Johnston, *A. acutifolia* Standley, *A. wrightii*, and *S. diffusus*. These taxa are more closely related to all other *Selinocarpus* species and *Ammocodon chenopodioides* than to the other three *Acleisanthes* species (BS = 100, Levin, 2000: fig. 2), which are sister to the second group of *Acleisanthes* plus *Selinocarpus* species and *Ammocodon chenopodioides*. Thus, there is robust evidence that *Selinocarpus* species and *Ammocodon chenopodioides* are nested within a paraphyletic *Acleisanthes*. Consequently, I suggest that a single taxon composed of *Acleisanthes* and *Selinocarpus* species and *Ammocodon chenopodioides* be recognized.

Asa Gray (1853) first described both *Acleisanthes* and *Selinocarpus* at the same time; thus, neither name has clear priority. Therefore, I propose that eight *Selinocarpus* species, including *S. angustifolius* Torrey, *S. diffusus*, *S. lanceolatus* Wooton, *S. palmeri* Hemsley, *S. parvifolius* Torrey, *S. purpusianus* Heimerl, *S. somalensis* Chiovenda, and *S. undulatus* B. A. Fowler & B. L. Turner, and *Ammocodon chenopodioides* be transferred into *Acleisanthes*. Based on morphological evidence (see below), an additional three *Selinocarpus* species, *S. nevadensis* (Standley) B. A. Fowler & B. L. Turner, *S. maloneanus* B. L. Turner, and *S. megaphyllus* B. L. Turner, are synonymized. With the proposed combinations and synonymy, *Acleisanthes* would now be composed of 16 species, all characterized by a perennial habit and the presence of both cleistogamous and chasmogamous flowers that are often present simultaneously. All species produce funnelform to salverform chasmogamous flowers that are frequently white or yellow, less often pink or purple, and each flower is subtended by 1 to 4 subulate bracts. Flowers are generally solitary and axillary, most are hawkmoth-pollinated and fragrant, and their single-seeded fruits are either ribbed or winged. Many of these species can be locally common, but are rare at the landscape level and tend to be limited to certain substrates. The following key to *Acleisanthes* is based upon my study of both fresh and herbarium material and relevant literature (Smith, 1976; Fowler & Turner, 1977; Thulin, 1993). The fruit characters included in the key to *Acleisanthes* are not difficult to observe, because plants are rarely found without fruits from either chasmogamous or cleistogamous flowers in various stages of maturity.

KEY TO THE SPECIES OF *ACLEISANTHES* (encompassing the former taxa *Selinocarpus* and *Ammocodon*)

1a. Plants herbaceous perennials.

2a. Fruits winged, not ribbed.

3a. Flowers in cymose inflorescences of few to numerous (10 or more) flowers; chasmogamous perianth magenta-purple, 4–5 mm long; stamens in chasmogamous flowers usually 2 (rarely 3) . . . . *A. chenopodioides* (A. Gray) R. A. Levin

3b. Flowers solitary to paired; chasmogamous perianth white, 20–50 mm long; stamens in chasmogamous flowers usually 5 (rarely 4).

4a. Chasmogamous perianth 30–50 mm long; plants found on various substrates in the southwestern United States . . . . . . *A. diffusus* (A. Gray) R. A. Levin

4b. Chasmogamous perianth 20–35 mm long; plants found in Somalia . . . . *A. somalensis* (Chiovenda) R. A. Levin

2b. Fruits ribbed, not winged.

5a. Fruits with resinous glands at or near proximal end.

6a. Plants with stems 2–8 cm long; chasmogamous perianth purple, 8–10 mm long . . . . *A. nana* I. M. Johnston

6b. Plants with stems 10–40 cm long; chasmogamous perianth white, 25–45 mm long.

7a. Plants upright; resinous glands occurring below proximal end of fruit; plants found from 750 to 2500 m in elevation . . . . *A. acutifolia* Standley

7b. Plants more prostrate; resinous glands occurring at proximal end of fruit; plants found from 250 to 1000 m in elevation . . . . *A. wrightii* (A. Gray) Bentham & Hooker

5b. Fruits without resinous glands.

8a. Veins of upper leaf surfaces with white, conspicuous trichomes; cleistogamous flowers with 2 stamens . . . . *A. crassifolia* A. Gray

8b. Veins of upper leaf surfaces glabrous; cleistogamous flowers with 5 stamens.

9a. Plants prostrate, stems to 15 cm long; leaf pairs at a node strongly unequal; veins deeply incising upper leaf surface; fruits with 10 ribs . . . *A. anisophylla* A. Gray

9b. Plants prostrate to clambering, stems to 100 cm long; leaf pairs equal to subequal; veins of upper leaf surface inconspicuous; fruits with 5 ribs.

10a. Flowers solitary; chasmogamous perianth to 17 cm long . . . . *A. longiflora* A. Gray

10b. Flowers solitary or in cymes of 2–5 flowers; chasmogamous perianth 2.5–5 cm long . . . . . *A. obtusa* (Choisy) Standley

1b. Plants woody perennial shrubs.

11a. Plants with divaricating branching, having profusely branched stems; chasmogamous perianth usually yellow, 30–50 mm long.

12a. Shrubs small, to 3 dm tall; leaves to 40 mm long; chasmogamous perianth yellow to white . . . . *A. lanceolatus* (Wooton) R. A. Levin

12b. Shrubs larger, to 6 dm tall; leaves to 20 mm long; chasmogamous perianth usually yellow, rarely white or pink.

13a. Stems grayish purple; leaves linear to lanceolate; chasmogamous perianth yellow, white, or pink; plants occurring on gypsum.

14a. Chasmogamous perianth pink; mature fruits 5–7 mm long . . . . *A. palmeri* (Hemsley) R. A. Levin

14b. Chasmogamous perianth yellow or white; mature fruits 7.5–10 mm long . . *A. purpusianus* (Heimerl) R. A. Levin

13b. Stems not gray; leaves ovate; chasmogamous perianth yellow; plants found on sandstone and limestone in addition to gypseous soil . . . . *A. parvifolius* (Torrey) R. A. Levin

11b. Plants virgate, stems having few branches; chasmogamous perianth green-yellow to red-orange, 6–12 mm long.

15a. Leaf margins sinuous; chasmogamous perianth ochreous . . . . *A. undulatus* (B. A. Fowler & B. L. Turner) R. A. Levin

15b. Leaf margins straight; chasmogamous perianth green-yellow . . . . . *A. angustifolius* (Torrey) R. A. Levin

Acleisanthes angustifolius (Torrey) R. A. Levin, comb. nov. Basionym: *Selinocarpus angustifolius* Torrey, Rep. U. S. Mex. Bound. Surv., Bot., 170. 1859. TYPE: Mexico. Chihuahua: Presidio del Norte (Ojinaga), July 1852, *C. C. Parry et al. s.n.* (lectotype, designated by Fowler & Turner (1977), NY not seen; isolectotype, US).

This species, together with *A. undulatus*, is distinctive among *Acleisanthes* due to the presence of short, relatively inconspicuous chasmogamous flowers. It is distinguished from its sister taxon, *A. undulatus*, in having flowers that are green-yellow rather than orange, straight leaf margins, greater edaphic tolerance, and occurring over a wider geographical range. I have observed this species growing in sympatry with *A. undulatus*, and in such areas both species are readily discerned.

Specimens examined. U.S.A. **Texas:** Brewster Co., Tornillo Creek in Big Bend National Park, *Levin 97-1* (ARIZ); ca. 75 mi. S of Alpine, *Powell 2180* (NMC); Presidio Co., 2 mi. N of Presidio, *Spellenberg & Moore 2623* (NMC). MEXICO. **Chihuahua:** base of N end of Sierra del Cuchillo Parado where crossed by Ojinaga–Cd. Chihuahua Hwy., 60 km W of Ojinaga, *Chiang, Wendt & Johnston 9772* (NMC). **Coahuila:** ca. 6.9 mi. SW of Cuatro Ciénegas on Hwy. to San Pedro, then 0.7 mi. E of Hwy. in first canyon on N side of limestone Sierra San Marcos del Pino, *Henrickson 20402* (ARIZ). **Durango:** ca. 0.5 mi. SW of Lerdo on first limestone road cut, *Spellenberg & Syvertsen 3763* (NMC).

Acleisanthes chenopodioides (A. Gray) R. A. Levin, comb. nov. Basionym: *Selinocarpus chenopodioides* A. Gray, Amer. J. Sci. Arts, ser. 2, 15: 262. 1853. *Ammocodon chenopodioides* (A. Gray) Standley, J. Wash. Acad. Sci. 6: 629. 1916. TYPE: U.S.A. Texas or New Mexico, 1851 or 1852, *C. Wright 1707*, left side of sheet (lectotype, designated by Fowler & Turner (1977), "left hand specimen on sheet," GH).

This taxon was one of the original species that defined the genus *Selinocarpus* by Gray (1853), having the characteristic winged fruits. Later this species was segregated into its own genus, *Ammocodon*, based upon flowers that were unique among *Selinocarpus*; flowers occur in many-flowered, cymose inflorescences, whereas solitary, axillary flowers are usual within the genus (Standley, 1916). Further, chasmogamous flowers are small and have a reduced number of stamens. However, other characters unite this species with *Acleisanthes* as here circumscribed. Plants are herbaceous, a habit shared with *Acleisanthes* s. str. as well as *A. diffusus* and *A. somalensis*. Molecular data suggest that this taxon clearly belongs nested within a broadly defined *Acleisanthes*, and that it may be sister to *A. somalensis* (Levin, 2000).

Specimens examined. U.S.A. **Arizona:** Cochise Co., Portal–Rodeo Rd., 4 mi. NW of Rodeo, near cattle guard, *McCormick & Assoc. 215* (ARIZ). **New Mexico:** Doña Ana Co., The Jornada LTER, G-BASN NPP site, NE corner, Lower Summerford Mtn. Bajada slope, *Levin 99–1* (ARIZ). **Texas:** Hudspeth Co., N end of the Quitman Mtns. at a roadside park along I-10, *Worthington 6694* (ARIZ).

Acleisanthes diffusus (A. Gray) R. A. Levin, comb. nov. Basionym: *Selinocarpus diffusus* A. Gray, Amer. J. Sci. Arts, ser. 2, 15: 262. 1853. TYPE: U.S.A. Texas: Pecos Co., 1851 or 1852, *C. Wright 1708* (lectotype, designated by Fowler & Turner (1977), GH).

Selinocarpus nevadensis (Standley) B. A. Fowler & B. L. Turner, Phytologia 37: 201. 1977. Syn. nov. *Selinocarpus diffusus* A. Gray subsp. *nevadensis* Standley, Contr. U.S. Natl. Herb. 12: 388. 1909. TYPE: U.S.A. Nevada: Lincoln Co., Overton, May 1891, *V. Bailey 1932* (holotype, US).

Fowler and Turner (1977) defined *S. nevadensis* as distinct from *S. diffusus* on the basis of having wider, rounder leaves and a more narrow, delicate chasmogamous perianth. However, these differences are likely due to environmental effects on plastic morphological traits. Therefore, I do not believe there is sufficient evidence that these species are separate, and I am reducing *S. nevadensis* to synonymy with *A. diffusus*.

Specimens examined. U.S.A. **Arizona:** Mohave Co., along US Hwy. 93 ca. 30 mi. NW of Chloride, *Barr 68–283* (ARIZ). **Nevada:** Clark Co., ca. 2 mi. N of Jean, off frontage road by I-15, *Levin 98–1* (ARIZ); Mt. Springs Summit, 2.1 mi. below Blue Diamond cutoff, *Niles & Plum 972* (ARIZ); Mojave Desert, ca. 30 mi. N of Las Vegas, 19 mi. S of Indian Springs, E side of US Hwy. 95, *Spellenberg 9482* (NMC). **New Mexico:** De Baca Co., 48 air km S of Fort Sumner, E side Pecos River, summit of Espia Peak, *Spellenberg & Zucker 12404* (NMC). **Oklahoma:** Harmon Co., on gypsum 6 mi. S of Hollis, *Waterfall 9001* (ARIZ).

Acleisanthes lanceolatus (Wooton) R. A. Levin, comb. nov. Basionym: *Selinocarpus lanceolatus* Wooton, Bull. Torrey Bot. Club 25: 304. 1898. TYPE: U.S.A. New Mexico: Doña Ana Co., just S of the White Sands, 26 Aug. 1897, *E. O. Wooton 389* (holotype, US; isotypes, NMC, US).

Selinocarpus maloneanus B. L. Turner, Phytologia 75: 239. 1993 [1994]. Syn. nov. TYPE: U.S.A. Texas: Hudspeth Co., N end of Malone Mtns., near Finley, 29 July 1958, *D. S. Correll & I. M. Johnston 20358* (holotype, LL not seen).

Selinocarpus megaphyllus (B. A. Fowler & B. L. Turner) B. L. Turner, Phytologia 75: 242. 1993 [1994]. Syn. nov. *Selinocarpus lanceolatus* Wooton var. *megaphyllus* B. A. Fowler & B. L. Turner, Phytologia 37: 181. 1977. TYPE: Mexico. Chihuahua: ca. 15 mi. SW of Estación Moreón on Río Conchos Lake Road, Sierra de las Monillas, 25 May 1971, *A. M. Powell 2105* (holotype, LL not seen).

The main distinctions between *S. maloneanus*, *S. megaphyllus*, and *A. lanceolatus* are in leaf shape and width, and *S. megaphyllus* is reportedly distinguished from the other two species by a larger, white chasmogamous perianth (Fowler & Turner, 1977; Turner, 1993). However, Fowler and Turner (1977) noted that there is morphological overlap between *S. megaphyllus* and *A. lanceolatus*, and the vegetative characters that have been used to separate these three species are known to be quite plastic. An excellent example of the wide variation in leaf shape within a population is the NMC collection of *Spellenberg & Syvertsen 3758*, listed below, that includes specimens from multiple individuals at the same locality. These individuals were clearly conspecific, with gradations in leaf width as the only distinction among the individuals. I have examined a specimen (*Spellenberg & Syvertsen 3753*) from the same locality as one (*Powell 2116*; Turner, 1993: 241) considered conspecific with *S. maloneanus* and a specimen (*Henrickson 6799*) collected from the type locality (Turner, 1993: 242) of *S. megaphyllus*. In addition to these, I have examined other specimens of *A. lanceolatus*, and I do not believe that the distinctions outlined by Turner (1993) warrant specific recognition.

Specimens examined. U.S.A. **New Mexico:** Otero Co., about 14 mi. W of Alamogordo on US Hwy., at Point of Sands just W of White Sands National Monument, *Spellenberg 3910* (NMC). **Texas:** Culberson Co., 36 mi. N of Van Horn on Hwy. 54, *Levin 97–5* (ARIZ); State Hwy. 54 N of Van Horn, 15 mi. S of junction with US Hwy. 62–180 in NW corner of county, *Spellenberg & Ward 9711* (NMC). MEXICO. **Chihuahua:** 12 mi. NE of Cuchillo Parado along old road in a gypsum outcropping N of Río Conchos, *Henrickson 6799* (NMC); 13.6 km W of Camargo on road to Lago Boquilla, on gypsum river terraces, *Spellenberg & Syvertsen 3758* (NMC); 17.4 mi. SW of Coyame, 8.8 mi. NE of railroad crossing, Chihuahua Hwy. 16, *Spellenberg & Syvertsen 3753* (NMC).

Acleisanthes palmeri (Hemsley) R. A. Levin, comb. nov. Basionym: *Selinocarpus palmeri* Hemsley, Biol. Cent.-Amer., Bot., 3: 6. 1882. TYPE: Mexico. Coahuila: San Lorenzo de Laguna, May 1880, *E. Palmer 1118* (holotype, K not seen; isotype, US).

The characters that appear to distinguish this species from *A. purpusianus* are a smaller fruit and the presence of a pink chasmogamous perianth, rather than the yellow or white perianth found in *A. purpusianus*. In addition to these morphological differences, *A. palmeri* is known only from two proximate localities in Coahuila, Mexico. Therefore, it may be more appropriate to synonymize *A. palmeri* with *A. purpusianus*, a similar species also limited to a few gypseous localities in Coahuila, although nomenclatural priority would be given to *A. palmeri*. However, as I have not observed *A. palmeri* in the field and have only viewed two herbarium specimens of this species, it does not seem appropriate at the present time to reduce these two species to synonymy.

Specimens examined. MEXICO. **Coahuila:** ca. 15 road mi. E of Torreón and about 2.6 mi. by winding road E of El Coyote, at the NW end of a small mtn. range, the Sierra de Solis, mostly on the tops of knolls, *Spellenberg & Syvertsen 3768* (NMC).

Acleisanthes parvifolius (Torrey) R. A. Levin, comb. nov. Basionym: *Selinocarpus diffusus* A. Gray var. *parvifolius* Torrey, Rep. U. S. Mex. Bound. Surv., Bot., 168. 1859. *Selinocarpus parvifolius* (Torrey) Standley, Contr. U.S. Natl. Herb. 12: 388. 1909. TYPE: U.S.A. Texas: Cañons of the Rio Grande or Presidio del Norte, 1852, *C. C. Parry et al. s.n.* (lectotype, designated by Fowler & Turner (1977), GH; isolectotype, US).

This species is similar morphologically to *A. lanceolatus*, *A. purpusianus*, and *A. palmeri*. Most notably, these four taxa share a distinctive divaricating branching pattern within a woody shrub, and they also have very similar flowers. However, whereas these other species appear confined to gypseous soils, *A. parvifolius* is not so restricted.

Specimens examined. U.S.A. **Texas:** Brewster Co., Tornillo Creek, Big Bend National Park, *Levin 97–2* (ARIZ); Hudspeth Co., 33 mi. SE from freeway on Texas Rd. 192, on county portion of road, between Quitman Mts. & the Rio Grande, *Spellenberg & Ward 9688* (NMC). MEXICO. **Chihuahua:** 10.7 road mi. S of Ojinaga along Hwy. 18 (Ojinaga–C. Camargo), open sandstone hill along Hwy., *Hendrickson 7704* (NMC).

Acleisanthes purpusianus (Heimerl) R. A. Levin, comb. nov. Basionym: *Selinocarpus purpusianus* Heimerl, Oesterr. Bot. Z. 63: 353. 1913. TYPE: Mexico. Coahuila: Sierra del Rey, June 1910, *C. A. Purpus 4505* (holotype, US).

As discussed in the entry for *A. palmeri*, these two taxa are very similar except for a difference in perianth color. This may likely be due to population-level differences, especially as there is known variation among populations of *A. purpusianus*, some of which have a yellow chasmogamous perianth, others a cream to white perianth (Fowler & Turner, 1977).

Specimens examined. MEXICO. **Coahuila:** Km 134 on Hwy. 30 towards Torreón, *Levin 98–6* (ARIZ); Hwy. 30, 68 mi. N of San Pedro, on gypseous flat, about 7 mi. S of Puente Arroyo Seco, *Spellenberg, Willson & Feather 4050* (NMC); ca. 12 (air) mi. SW of Cuatro Ciénegas (13.5 road mi.) along Hwy. to San Pedro and 4.4 mi. W on trail, *Henrickson 12552* (NMC); Hwy. 57, 1.2 mi. S of Hermanas, *Spellenberg & Syvertsen 3779* (NMC).

Acleisanthes somalensis (Chiovenda) R. A. Levin, comb. nov. Basionym: *Selinocarpus somalensis* Chiovenda, Flora Somala 284. 1929. TYPE: Somalia. Costa dei Migiurtini, dintorni di Biaddo, June 1924, *N. Puccioni & G. Stefanini 814* (holotype, FT not seen).

Despite its disjunct occurrence in Somalia, both morphological and molecular evidence support its inclusion within the genus *Selinocarpus* (Levin, 2000) and, thus, within a newly expanded *Acleisanthes*. With the other species formerly placed in *Selinocarpus*, this taxon shares a presence of winged fruits and a preference for gypseous soils. Surprisingly, *A. somalensis* looks remarkably similar to *A. diffusus*, although molecular sequence data suggest a close relationship with *A. chenopodioides*.

Specimens examined. SOMALIA. **Buran (Sorl):** 10–13°N, 48–47°E, *Collenette 125* (K). **Galguduud:** 4 km S of Ceelbuur (El Bur) on road to Gal Hareeri, gypsum plain, *Thulin & Dahir 6517* (K).

Acleisanthes undulatus (B. A. Fowler & B. L. Turner) R. A. Levin, comb. nov. Basionym: *Selinocarpus undulatus* B. A. Fowler & B. L. Turner, Phytologia 37: 194. 1977. TYPE: Mexico. Coahuila: 4 mi. W of Cuatro Ciénegas, mouth of canyon, 24–26 Aug. 1938, *I. M. Johnston 7159* (holotype, GH).

Although this species occurs in geographically proximate locations to *A. palmeri* and *A. purpusianus*, both morphological and molecular evidence closely ally *A. undulatus* with *A. angustifolius* (Levin, 2000). These sister taxa share a short chasmogamous perianth and virgate growth form, lacking the divaricating branching pattern of *A. lanceolatus*, *A. parvifolius*, *A. purpusianus*, and *A. palmeri*. *Acleisanthes undulatus* can be distinguished from *A. angustifolius* by its sinuate leaf margins and ochreous perianth.

Specimens examined. MEXICO. **Coahuila:** outside of Cuatro Ciénegas at Km 94 on Hwy. 30 towards Torreón, *Levin 98–7* (ARIZ); 8 km W of Cuatro Ciénegas on S slopes and foothills of Sierra de la Madera, *Johnston, Chiang & Morofka 12076* (NMC); Mpio. Parras, S side of Sierra Parras along road toward Menchaca, ca. 14 air km S of Parras, just N of Sierra Prieta, *Nesom 7651* (NMC).

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Three New Taxa of *Guadua* (Poaceae: Bambusoideae) from South America

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ABSTRACT. Two new species of *Guadua* from South America are described, illustrated, and compared with putatively related species. The two new species are *Guadua macrospiculata* from the western Amazon basin in southeastern Colombia, northwestern Brazil, and northern Peru, and *G. uncinata* from southern Colombia and central-eastern Ecuador. A description of the Brazilian species *G. tagoara* is included, establishing one new subspecies, *G. tagoara* subsp. *glaziovii*, from the Atlantic forests of the state of Rio de Janeiro. The empty bracts at the base of the spikelet proper of the pseudospikelet in *Guadua* are reinterpreted as sterile lemmas and not glumes.

RESUMEN. Dos nuevas especies de *Guadua* y una subespecie de *G. tagoara* son descritas para Sur America, incluyendo ilustraciones y datos comparativos con especies afines. Las nuevas especies son *Guadua macrospiculata*, que ocurre en la cuenca occidental Amazónica, específicamente en el suroriente de Colombia, noroccidente de Brasil y norte del Perú, y *G. uncinata* que habita el sur de Colombia y la región centro-oriental del Ecuador. Se hace una revisión de la especie brasileña *G. tagoara* estableciendo una nueva subespecie, *G. tagoara* subsp. *glaziovii*, que ocurre en la Mata Atlántica del estado de Rio de Janeiro en Brasil. Se reinterpretan las brácteas vacías en la base de la llamada espiguilla de la pseudoespiguilla en *Guadua* como lemas estériles y no glumas.

Key words: Andean foothill swamps, Atlantic forest, Bambusoideae, *Guadua*, *igapó*, Poaceae, pseudospikelet morphology, South America, *tahuampa*.

Guadua Kunth is distinguished among native New World bamboos by its large size, triangular culm leaves, light-colored supra- and infranodal bands of hair, thorny branches, pseudospikelets, and paleas with winged keels (Judziewicz et al., 1999). Its species are broadly distributed from Mexico to northern Argentina and Uruguay, with the greatest diversity below 1500 m in elevation in a variety of habitats, including lowland tropical and lower-montane forests, savannas, cerrado, and gallery forests. We here describe two new species, *G. macrospiculata* Londoño & L. G. Clark from the western Amazon basin of southeastern Colombia, northwestern Brazil, and northern Peru, and *G. uncinata* Londoño & L. G. Clark from southern Colombia and central-eastern Ecuador. We also provide a detailed description of *G. tagoara* (Nees) Kunth and establish a new subspecies. Including the 2 new species, *Guadua* comprises 26 described species, although a few names remain to be clarified and some species remain undescribed.

Like other woody bamboos, species of *Guadua* can be distinguished readily by a suite of vegetative and reproductive characters once complete material is available. It is often the case in *Guadua*, however, that pairs of species may be very similar vegetatively but distinct in their reproductive morphology (e.g., *G. macrospiculata* and *G. glomerata* Munro) or very similar in their reproductive morphology but distinct in their vegetative morphology (e.g., *G. paniculata* Munro and *G. weberbaueri* Pilger or *G. macrospiculata* and *G. ciliata* Londoño & Davidse). Thus, lack of flowering material or collection of only flowering branches without additional structures (usually due to the large size and thorniness of the plants) are especially problematic for elucidating the systematics of this genus. An additional compounding factor, which holds for all bamboos with pseudospikelets, is that reproductive morphology changes significantly during development, more dramatically than in bamboos with true spikelets. A corollary of this is that it is difficult to compare developmental stages among herbarium specimens. While the developmental problem is not easily resolved, the value and utility of *Guadua* specimens can be increased greatly by the inclusion of label data on culm size, thorn morphology, size, and distribution of supra- and infranodal

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bands, even if these structures are not actually collected.

Interpretation of the bamboo pseudospikelet is still debated. As discussed in Judziewicz et al. (1999: 39), McClure (1934) originally proposed the term to describe the "units in iterauctant synflorescences of woody bamboos that rebranch to produce successive orders of spikelets." Young and Judd (1992: 757) defined the pseudospikelet as a "shortened vegetative axis or branch that terminates in a single spike of florets." While definitions differ on what the pseudospikelet actually represents, most of the interpretations agree that the pseudospikelet includes at least a prophyll, a series of gemmiparous bracts, and a spikelet proper, this last considered homologous to the spikelets of other bamboos and grasses. Because of this presumed homology, any empty bracts at the base of the spikelet proper usually have been regarded as glumes (Judziewicz et al., 1999).

According to our present interpretation, a pseudospikelet of *Guadua* consists of a prophyll, one to several gemmiparous bracts, none to several sterile lemmas, one to several fertile florets, and a rudimentary floret; each coflorescence and pseudospikelet is subtended by a subtending bract. In contrast to previous interpretations (e.g., Soderstrom, 1981; Young & Judd, 1992; Judziewicz et al., 1999), we argue that the "empty" bracts distal to the gemmiparous bracts and proximal to the fertile florets are best regarded as sterile lemmas rather than glumes. Usually these "empty" bracts are comparable in size to the fertile lemmas, but most important, they often enclose a rudimentary palea in *Guadua*, evidence that they are comparable to or derived from fertile lemmas. Subtending bracts, gemmiparous bracts, glumes, and both sterile and fertile lemmas are all homologous at some level, but what are normally called glumes in bamboos and other grasses may have arisen in different ways in different lineages (Stapleton, 1997; Grass Phylogeny Working Group, 2001).

Guadua macrospiculata Londoño & L. G. Clark, sp. nov. TYPE: Colombia. Amazonas: Mpio. Puerto Nariño, lago de Tarapoto, crece en varzea, a orilla del lago, 16 Nov. 1990, *X. Londoño & M. Kobayashi 577* (holotype, COL; isotypes, ISC, US). Figure 1.

Bambusa lignosa, spinosa. Rhizoma sympodiale, pachymorphum. Culmi 8–15 m alti, 1.8–4 cm diam.; internodia (11–)20–32 cm longa, solida vel fere solida. Folia culmorum leviter coriacea, decidua; vagina 1.5–2.8-plo longior quam laminam; lamina (2–)5–10 cm longa, persistens, erecta, triangularis. Ramificatio intravaginalis. Folia cujusquisque complementi (5–)8–15; vagina pubescens vel glabrescens, biauriculata vel fimbriata, auriculis falcato-lanceolatis, fimbriatis; pseudopetiolus 1–1.5 mm longus, plerumque reflexus; ligula interior 0.25 mm longa; lamina (2–)5–10(–12) cm longa, (0.8–)1–2(–2.8) cm lata, ovato- vel lineari-lanceolata. Synflorescentiae ramos terminantes cum 1–9 coflorescentiis. Pseudospiculae (3–)6–12(–17) cm longae, lineari-lanceolatae, prophyllo singuli, bracteis gemmiferis 1–3(–6), lemmata sterilia 1–2, flosculis 6–11(–17); lemma 15–24 mm longum, ovato-lanceolatum, 18–25-nervatum, abaxialiter glabrum; palea sulco pubescenti, carinis alatis 2, alis 0.25–0.5 mm latis, puberulis. Lodiculae 3. Stamina 6. Ovarium fusiforme, infra glabrum, supra hispidulum, stigmatibus tribus plumosis.

Woody, thorny bamboo. *Rhizomes* sympodial, pachymorph, short-necked, the neck 3–5 cm long. *Culms* 8–15 m tall, 1.8–4 cm diam., clambering or scandent, the distal portion cascading down from trees, forming clumps 2 × 2 m with ca. 90–100 culms/clump, dark purple when young turning green later and yellow at maturity; *internodes* (11–)20–32 cm long, cylindrical, solid or with a small central lumen, slightly strigose, covered by white-tinged pubescence; *nodes* solitary, the nodal line horizontal, with appressed white hairs in a band 7–12 mm wide above and 3–8 mm wide below the nodal line; *supranodal ridge* manifest ca. 1 cm above the nodal line; *bud* single, triangular, the shoulders of the prophyll ciliate. *Culm leaves* (8–)11–18(–26.5) cm long, (4.5–)12–16 cm wide at base, slightly coriaceous, deciduous, sometimes the basal ones rotting on the culm, triangular, the youngest green-purple then stramineous; *sheaths* 6–14.5 cm long, 1.5–2.8 times as long as the blade, adaxially glabrous, shiny, with a band of hairs 1 cm wide close to the margin, abaxially pubescent, covered with mixed coarse, rigid, hyaline or red-tinged, easily removed hairs 1 mm long, and soft, wavy, white-tinged, shorter hairs, ciliolate on one margin, the summit incurved at the middle, continuous with the blade and confluent with the inner ligule, bearing small fimbriate auricles or not; *auricles* 1–3 mm long, brown, fimbriate, the fimbriae 3 mm long, basally scabrid and erect, apically smooth and curled; *inner ligule* 1–1.5 mm long, truncate, stramineous, abaxially pubescent, incurved at the middle, the margin ciliolate; *blades* (2–)5–10 × 2.5–9 cm, persistent, triangular, erect, abaxially pubescent, covered by soft, wavy, white appressed hairs less than 0.2 mm long, adaxially conspicuously nerved and pubescent between nerves, marginally ciliate especially toward the base, the apex mucronate, the mucro 2–2.5 mm long. *Branching* intravaginal, typically with one strong dominant branch, armed; thorns (1 to) 3 per node, the central one dominant and bigger, the other two usually slightly reflexed. *Foliage leaves* (5 to) 8 to 15 per complement, ±

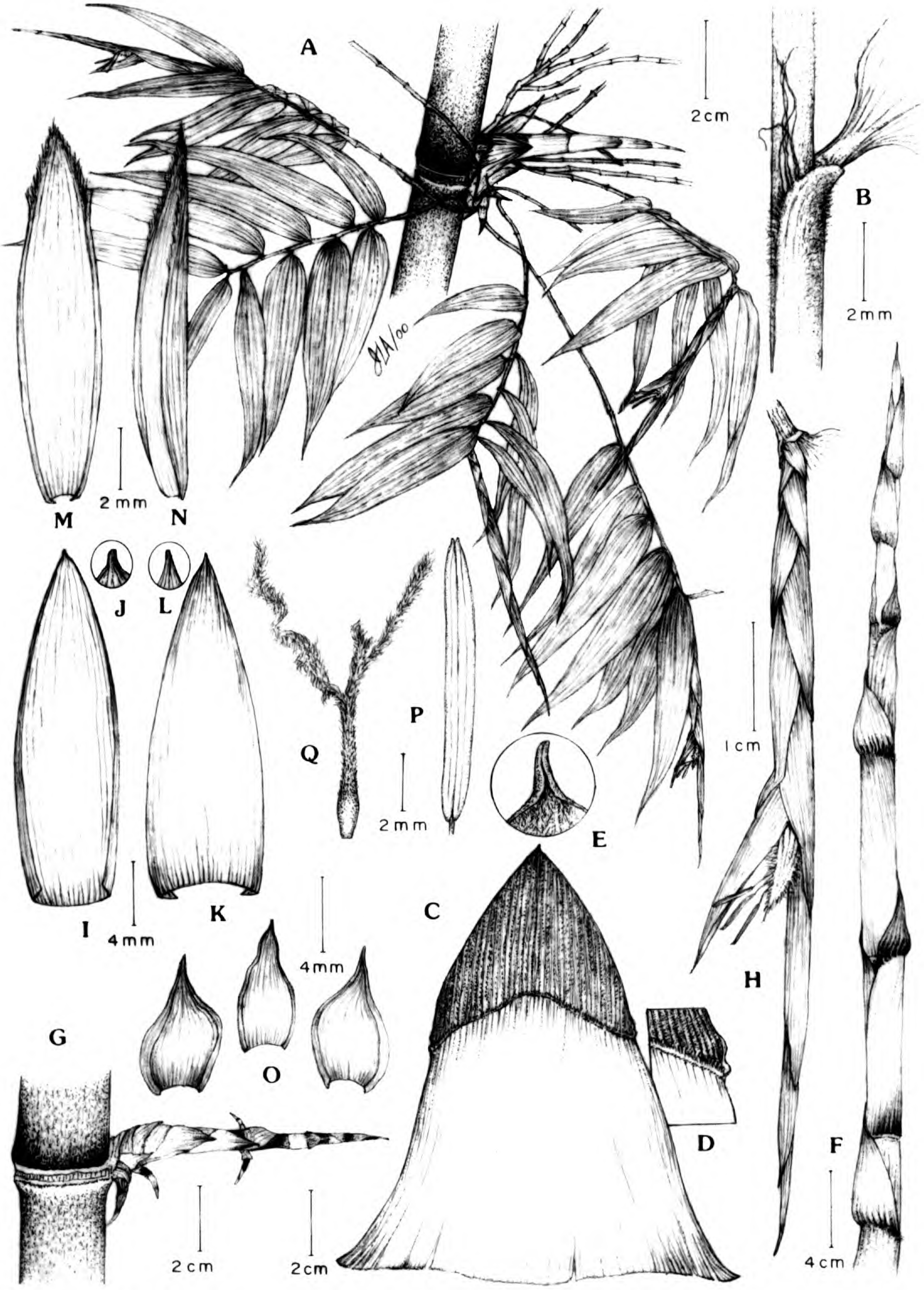

Figure 1. *Guadua macrospiculata* Londoño & L. G. Clark. —A. Mid-culm node with branch complement of leafy flowering axis. —B. Ligular area of the foliage leaf showing blade base and sheath summit with long fimbriae. —C. Culm leaf, adaxial view. —D. Detail of culm leaf inner ligule, adaxial surface. —E. Detail of culm leaf blade apex, adaxial view. —F. Actively growing new culm showing inflated blades. —G. Thorny culm node. —H. Pseudospikelet. —I. Lemma, adaxial view. —J. Detail of lemma apex, adaxial view. —K. Lemma, abaxial view. —L. Detail of lemma apex, abaxial view. —M. Palea showing the ciliolate winged keels, abaxial view. —N. Palea, abaxial/lateral view.

pendent or drooping; *sheath* densely pubescent to glabrescent, green when young becoming stramineous, marginally ciliate, bearing fimbriae or fimbriate auricles at the summit; *auricles* 0.5–1.25 mm long, usually present, falcate-lanceolate, dark brown to stramineous, fimbriate; *fimbriae* 3–10 mm long, ivory or brown, basally scabrid and erect, apically smooth and erect or curled; *inner ligule* 0.25 mm long, membranous, stramineous to brown, abaxially densely strigillose, the margin minutely ciliolate; *outer ligule* 0.5–0.75 mm long, stramineous, glabrous, shiny, the margin ciliolate to smooth; *pseudopetioles* 1–1.5 mm long, usually reflexed, adaxially hispidulous, abaxially hirsute to glabrous and pulvinate, the pulvinus yellow, shiny, hirsute to glabrous; *blade* (2–)5–10(–12) cm long, (0.8–)1–2(–2.8) cm wide, 12- to 14-nerved, ovate- or linear-lanceolate, adaxially scabrid to glabrous, with scattered, sparsely strigose, hyaline hairs 0.3–0.5 mm long, with 3 or 4 rows of prickle-hairs along one edge, abaxially pilose to glabrescent, covered with wavy hairs 0.2–0.3 mm long, the midnerve yellow and prominent in the middle lower portion, the base rounded-attenuate, the margins scabrous, the apex acuminate, with a mucro 1–2 mm long. *Synflorescences* terminating leafy or leafless branches, polytelic, consisting of 1 to 9 coflorescences each with 1 to 3 multiflowered pseudospikelets, occasionally forming ± dense aggregations of up to 10 pseudospikelets on leafless axes, coflorescences and pseudospikelets subtended by bracts; main axes pubescent; *subtending bracts* gemmiparous or not, varying throughout the main axes, fully developed and similar to a foliage leaf with a small blade or the blade a reduced apicule, the blades deciduous, the sheath abaxially pubescent to glabrescent, the margin ciliolate, the summit fimbriate. *Pseudospikelets* (3–)6–12(–17) cm long, 3–4(–5) mm wide, linear-lanceolate, usually straight, sometimes slightly curved at the base, green with purple spots when young, later stramineous, consisting of 1 prophyll, 1 to 3 (to 6) gemmiparous bracts, 1 or 2 sterile lemmas, 6 to 11 (to 17) fertile florets, and a terminal rudimentary floret; *prophyll* 0.75–2.5 × 1.3–3 mm, abaxially puberulent between the winged ciliolate keels; *gemmiparous bracts* 1 to 3 (to 6), 4–5(–8) mm long, 3–4(–6) mm wide, 11- to 17-nerved, ovate to ovate-lanceolate, sometimes empty, abaxially pubescent to glabrescent, adaxially densely strigillose toward the apex with inconspicuous transverse veins, the margins smooth, the apex apiculate with a mucro ca. 0.5 mm long; *sterile lemmas* 1 or 2, 6–14 × 5–7.5 mm, 17- to 20-nerved, rounded on the back, abaxially glabrous and shiny, adaxially densely strigillose toward the apex, always enclosing a rudimentary palea, the margins smooth and purple-tinged to stramineous, the apex acuminate with a mucro 0.25–0.5 mm long; *rachilla segments* (4–)7–9 mm long, 2 mm wide, segments between the lemmas glabrous, those between the prophyll and the gemmiparous bracts pubescent, usually longer between fertile florets, not disarticulating easily at the junction with the floret. *Fertile florets* 6 to 11 (to 17) with *lemmas* 15–24 × 7–9(–10) mm, 18- to 25-nerved, ovate-lanceolate, rounded on the back, abaxially glabrous with inconspicuous transverse veins, adaxially pubescent on the upper ⅓, the margins smooth and purple-tinged, completely embracing the palea, the apex acuminate with a mucro 0.25–0.5 mm long; *paleas* 10–16 × 2–3 mm, 11- to 13-nerved, shorter than the lemma, 2-keeled, the sulcus 6- to 8-nerved with inconspicuous transverse veins, pubescent, the enfolding margins glabrous, 3-nerved, the keels winged, the wings 0.25–0.5 mm wide, 1- or 2-nerved, puberulent on both surfaces toward the upper ½–⅓, marginally ciliolate above the middle, the cilia hyaline, the wings ending 1–1.5 mm before the apex. *Lodicules* 3, 4–8 × 1–2 mm, many-nerved, membranous, puberulent on the upper half, ciliolate on the upper part of the margin, the apex acute, the anterior pair a little longer and wider than the posterior one. *Stamens* 6, the anthers 6–7 mm long, ochre, basally sagittate, apically apiculate. *Ovary* 2–7 mm long, fusiform, basally thickened and glabrous, apically densely hispidulous to glabrescent at maturity; *style* 1, 4–5 mm long, densely antrorse hispidulous; stigmas 3, plumose, ca. 4–5 mm long, hyaline. *Caryopsis* 7 × 1.25 mm, fusiform, with a persistent hispidulous style base.

Etymology. The specific epithet refers to the very long pseudospikelets, which reach up to 17 cm in length.

Distribution and habitat. Western Amazon basin in southeastern Colombia (Amazonas), northwestern Brazil (Amazonas), and northern Peru (Loreto). This species occurs in the lowland forests of the Amazon region, mainly on riverbanks, in sta-

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—O. Lodicules. —P. An anther. —Q. Gynoecium with three plumose stigmas. (A–E and H–Q based on *Londoño & Kobayashi 577*; F, G based on *Londoño & Kobayashi 563*.)

Table 1. Morphological comparison of *Guadua macrospiculata*, *G. glomerata*, and *G. ciliata*.

Character	*G. macrospiculata*	*G. glomerata*	*G. ciliata*
Culms	solid or hollow with a small lumen	solid	hollow
Thorns per node	1–3	(1–)5–7	absent
Internodes	slightly strigose	strigose	usually glabrous
Culm leaf sheath, abaxial indument	pubescent	glabrous	glabrescent
Culm leaf sheath girdle	absent	absent	present
Foliage leaf sheath, abaxial indument	densely pubescent to glabrescent	glabrous	hirtellous to glabrous
Foliage leaf blade position	usually reflexed	erect	erect
Pseudopetiole, abaxial indument	hirsute to glabrous	subglabrous	glabrous
Foliage leaf blade size (cm), abaxial indument	2–12 × 0.8–2.8, pilose to glabrescent	7–22 × 1.3–4.5, glabrous	9–27.5 × 1.2–4.3, glabrous
Pseudospikelet size (cm)	3–17 × 0.3–0.5	4–7 × 0.35–0.6	3–11 × 0.3–0.5
Lemma margins	glabrous	glabrous	ciliate
Palea keel wing width (mm), indument	0.25–0.5, puberulent	ca. 1, glabrous to glabrescent	0.7–0.9, puberulent

tionary flooded forests called *igapó* in Brazil or *tahuampa* in Peru.

Common name. *Num-chí* in Ticuna dialect (Brazil, Colombia), and *maronilla* (Peru).

Uses. The Ticuna community in Colombia uses the culms of *G. macrospiculata* to make frames for drying and painting bark fabric, as planting sticks for yuca (*Manihot esculenta* Crantz), and to make arrows for bow hunting; the thorns are used to lance boils.

Phenology. The flowering cycle of *G. macrospiculata* is a very short interval for a woody bamboo. Observations of the flowering cycle in a cultivated stand in Quindío, Colombia, from 1990 to 2000 were made annually by the first author, who noted flowering approximately every two years. All the culms in a single clump flowered without interruption during the flowering cycle and remained green, and after flowering the culms did not die. The flowering cycle apparently does not respond to external weather conditions such as the alternation of wet and dry seasons. Flowering dates as determined from herbarium specimens from a single locality are consistent with a short flowering cycle but are not definitive.

Guadua macrospiculata is most similar to *G. glomerata* and *G. ciliata*. The three species share a climbing habit, relatively slender culms, and triangular culm leaves. They also all occur in the Amazon basin, along riverbanks that are flooded seasonally, with the bases of the plants submerged in water. The three species are compared and contrasted in Table 1.

Guadua macrospiculata differs from *G. glomerata* by its denser and bigger clumps (90 to 100 culms/clump, 2 × 2 m vs. 4 to 13 culms/clump, 1 × 0.5 m); the delicate and mostly uniform size of the foliage leaf blade (vs. conspicuous size variation); the glabrous enfolding margins of the palea (vs. pubescent); and the narrower palea keel wings, ending 1–1.5 mm before the apex with the margins ciliolate from the middle toward the apex (vs. ending at the apex with a tuft of hairs at the tip, the margins smooth in the lower and middle portions, but ciliolate at the apex). These two species have in common the inner ligule of the culm leaf curled in the middle, lowermost basal culm leaf sheaths that rot on the culm, green pseudospikelets with purple spots when young, a glabrous, many-nerved lemma with smooth margins, and a pubescent palea sulcus.

Guadua macrospiculata is distinguished from *G. ciliata* by having dark purple culms when young (vs. green when young), foliage leaf blades usually ovate-lanceolate and (2–)5–10 × 2.5–9 cm [vs. usually linear-lanceolate and (9–)12–27.5 × (1.2–)2–3.5(–4.3) cm], the main axes of synflorescence pubescent (vs. glabrescent), pseudospikelets green with purple spots when young (vs. olive green when young), and lemmas with smooth margins (vs. marginally ciliate with purple-tinged and hyaline hairs). These two species exhibit an inflated culm leaf blade (Fig. 1F, as seen in side view) when the new shoot is growing actively, but this condition disappears later as the culm leaf dries out. Both species also have a pulvinate foliage leaf pseudopetiole, the palea smaller than the lemma, and usually 1 to 3 pseudospikelets per coflorescence.

The new culms of *G. macrospiculata* are hosts to butterflies of the family Nymphalidae, subfamily

Satyrinae, tribe Pronophilini (D. Harvey, pers. comm.). The adult females deposit their eggs at the apex of the new culms. Several other bamboos of the genera *Otatea* (McClure & E. W. Smith) C. Calderón & Soderstrom, *Chusquea* Kunth, *Guadua*, and *Merostachys* Sprengel are also hosts to a wide variety of insects (Judziewicz et al., 1999).

Paratypes. BRAZIL. **Amazonas:** Rio Javari above mouth of Rio Taquari, 29 Oct. 1976 (fl), *Prance et al. 24202* (US); Igarapé Umarizal, Esperança, 8 Dec. 1945 (fl), *Murça & Black 842* (US). COLOMBIA. **Amazonas:** Mun. Leticia, Parque Nacional Natural de Amacayacu-INDERENA, a orilla de la Q. Bacaba, 100 m, 8 Nov. 1990 (fl), *Londoño & Kobayashi 536* (COL, ISC, TULV, US); Parque Nacional Natural Amacayacu-INDERENA, a orilla de Q. Matamatá, 100 m, 8 Nov. 1990 (fl), *Londoño & Kobayashi 537* (COL, ISC, TULV, US); a 30 m de distancia del INDERENA, sobre trocha Amacayacu-Matamatá, cerca de Q. Matamatá, 11 Nov. 1990 (fl), *Londoño & Kobayashi 563* (COL, ISC, TULV, US); San Martín de Amacayacu, 100 m, 12 Nov. 1990 (fl), *Londoño & Kobayashi 569* (COL, ISC, TULV, US). PERU. **Loreto:** Maynas, Iquitos, rio Nanay, Cocha de la Marina, 90 m, 2 Jan. 1983 (fl), *McDaniel & Rimachi 26601* (AMAZ, NY, US); Pto. Almendras, rio Nanay, 20 May 1981 (fl), *Ruiz 168* (AMAZ); Rio Nanay, Q. Moropon above Bellavista, 7 Jan. 1976 (fl), *McDaniel & Rimachi 20381* (AMAZ, NY); rio Nanay, slightly below Bellavista on left margin, 90 m, 7 Oct. 1980, *Rimachi 5344* (USM); Punchana, Rio Nanay, trocha de la Cocha a Manga Posa, frente al puerto de Picuruyacu, 90 m, 20 July 1994 (fl), *Rimachi 11035* (US); Rio Nanay, Albergue Isabel Loro Park, 3 Aug. 1991 (fl), *Londoño 675* (TULV, US); Tahuampa near rio Amazonas between Punchana y Sta. Clara de Nanay, outskirts of Iquitos, 120 m, 3 Feb. 1977 (fl), *Gentry et al. 21614* (MO, TULV, US); Alto rio Nanay, between Santa Maria de Nanay y Diamante Azul, 140 m, 25 Mar. 1979 (fl), *Gentry et al. 26213* (MO, TULV, US); Rio Itaya, below San Juan de Muniches, 120 m, 19 Mar. 1977 (fl), *Gentry et al. 18396* (MO, TULV, US); Rio Itaya from Iquitos to San Juan de Muniches, 100 m, 9 Mar. 1973 (fl), *McDaniel & Rimachi 16927* (AMAZ, MO); Rio Itaya, Moena caño, 4 km de Iquitos, 1 Apr. 1976 (fl), *Revilla 470* (MO, TULV, US); Yanomono explorama tourist camp, rio Amazonas, above mouth of rio Napo, 120 m, 28 Dec. 1982 (fl), *Gentry & Emmons 38746* (USM); Petrópolis, rio Yavaris, 12 Aug. 1976, *Revilla 1090* (MO). **Requena:** Caño Iricahua, abajo de Jenaro Herrera, margen izquierda rio Ucayali, 26 Nov. 1982 (fl), *Encarnación 25086* (AMAZ, NY, US); Rio Tapiche, tributario del Ucayali, ca. 1 hr. above Requena, 8 Dec. 1977 (fl), *Gentry et al. 21236* (MO, TULV, US, USM).

Guadua uncinata Londoño & L. G. Clark, sp. nov. TYPE: Ecuador. Tungurahua: found wild between San Francisco and Machay, along the road in the valley of the Pastaza River, 3500 ft., 13 July 1945 (fl), *F. A. McClure 21364* (holotype, US; isotypes, COL, ISC, MO, NY). Figure 2.

Bambusa lignosa, spinosa. Rhizoma sympodiale, pachymorphum. Culmi 3–8 m alti, 2–4(–6) cm diam.; internodia 20–40 cm longa, ad basim et apicem culmorum solida aliter cava. Folia culmorum leviter coriacea, decidua; vagina 2.8–7.5-plo longior quam laminam; lamina (1.7–)3–5(–8.5) cm longa, persistens, erecta, triangularis. Ramificatio intravaginalis; ramus dominans unus ramis minoribus 1–3, rami conspicue spinosi; spinae uncinatae. Folia cujusquisque complementi 7–9(–16); vagina glabra vel pubescens, biauriculata, fimbriata, auriculis (1–)2–4 mm longis; lamina (6.5–)10–15(–18) cm longa, (1.4–)2–3.5(–4.2) cm lata, ovato- vel lineari-lanceolata; pseudopetiolus 3–6 mm longus; ligula interior 0.2–0.5(–0.8) mm longa. Synflorescentiae ramos terminantes cum 1–5(–7) coflorescentiis. Pseudospiculae 3–6(–8) cm longae, lineari-lanceolatae, prophyllo singuli, bracteis gemmiferis 1–4(–6), lemmata sterilia 1–2(–3), flosculis (3–)4–5; lemma 10–15 mm longum, ovato-lanceolatum, 12–25-nervatum, supra glabrum vel puberulum; palea sulco pubescenti, carinis conspicue alatis 2, alis 0.5–1 mm latis, glabris. Lodiculae 3. Stamina 6. Ovarium fusiforme, infra glabrum, supra hispidulum, stigmatibus tribus plumosis.

Woody, thorny bamboo. *Rhizomes* pachymorph. *Culms* 3–8 m tall, 2–4(–6) cm diam., erect at the base, immediately arching to broadly arching apically and climbing on trees, white-green to green when young becoming stramineous; *internodes* 20–40 cm long, cylindrical, the basal and upper ones solid, the middle ones hollow with a small lumen ca. 5 mm diam., densely pubescent when young, covered by very appressed strigose, antrorse, hyaline or brown hairs, glabrous at maturity; *nodes* solitary, the nodal line horizontal, with appressed, white, soft, short, hairs in a band 5–10 mm wide above and 8–12 mm wide below the nodal line; *supranodal ridge* manifest; *bud* single, triangular, the shoulders of the prophyll ciliate. *Culm leaves* (14.5–)19–26(–35.5) cm long, 11–14 cm wide at the base, slightly coriaceous, deciduous, triangular, green-stramineous with yellow spots when young becoming stramineous; *sheaths* 13–28 cm long, 2.8–7.5 times as long as the blade, abaxially pubescent, covered by (1) strigose, antrorse, transparent or brown hairs 0.8–1.5 mm long that rub off easily, (2) shorter, strigose, mostly retrorse, hyaline or brown hairs, and (3) appressed, white-tinged, wavy, tiny hairs, the margins papery, ciliate or smooth, the cilia transparent to brown, up to 3 mm long, rubbing off easily, bearing fimbriate auricles and fimbriae at the summit; *auricles* 4–6 × 1–1.2 mm, falcate, puberulous, fimbriate; *fimbriae* 3–7 mm long, ivory, straight to curled, basally scabrid, apically smooth; *inner ligule* 0.5–1 mm long, truncate, straight, slightly curled, or inclined, dark brown to stramineous, abaxially pubescent, sometimes not extending completely from margin to margin, the margin ciliolate; *blades* (1.7–)3–5(–8.5) cm long, 1–6 cm wide, triangular, erect, abaxially pubescent, with white, wavy, appressed, tiny hairs, adaxially densely pubescent between the nerves, the margins basally fimbriate, otherwise ciliate to

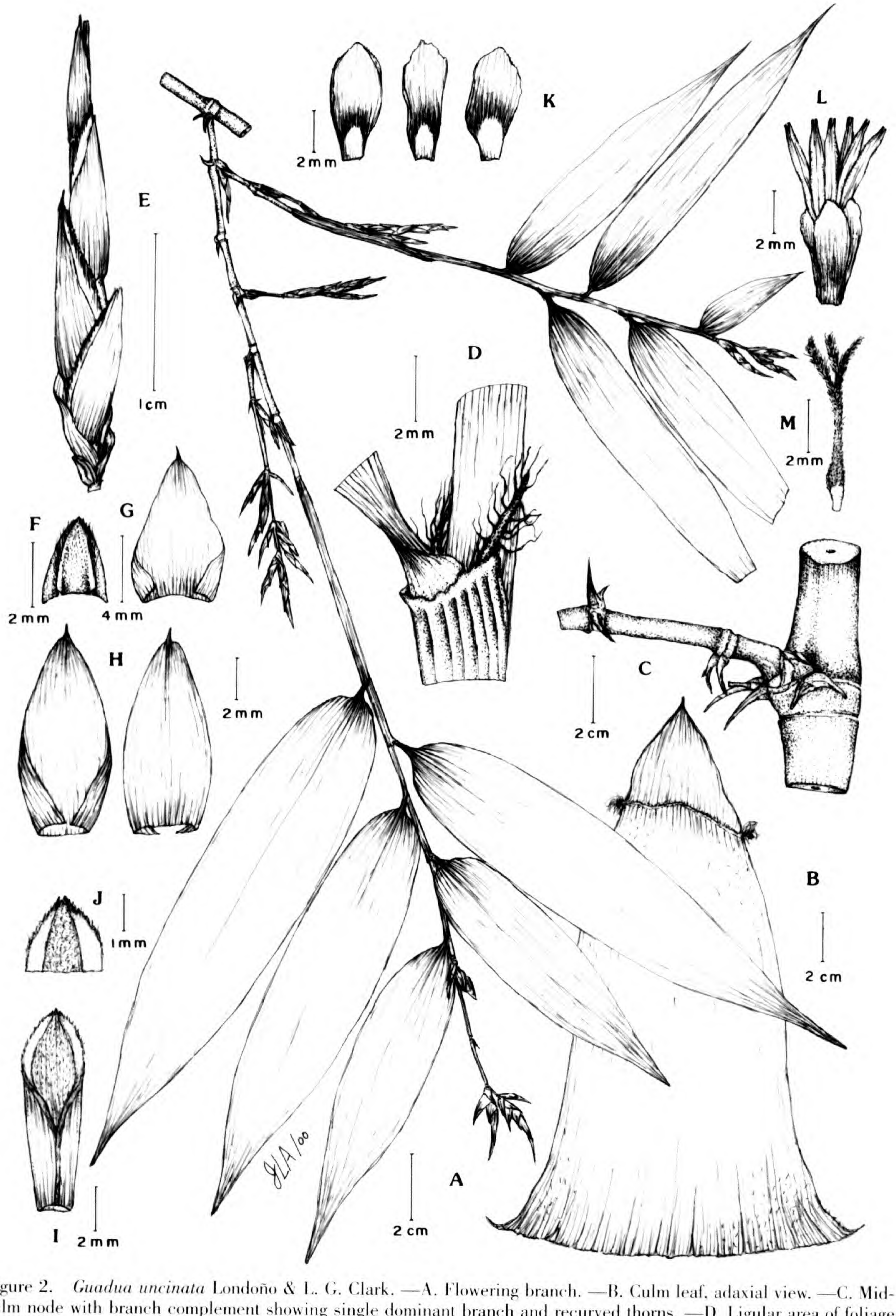

Figure 2. *Guadua uncinata* Londoño & L. G. Clark. —A. Flowering branch. —B. Culm leaf, adaxial view. —C. Midculm node with branch complement showing single dominant branch and recurved thorns. —D. Ligular area of foliage leaf, showing pseudopetiole, sheath summit, and auricles. —E. Pseudospikelet. —F. Prophyll, abaxial view. —G. Gemmiparous bract, adaxial view. —H. Lemma, adaxial (left) and abaxial (right) views. —I. Palea, abaxial view. —J. Apex of palea showing winged keels, abaxial view. —K. Lodicules. —L. Young androecium and gynoecium surrounded

smooth, the cilia easily removed, the apex mucronate, the mucro 1–1.5 mm long. *Branching* intravaginal, the branches manifestly thorny, consisting of one main branch and 1 to 3 secondary branches; thorns (1 to) 3 to 5 per node, recurved. *Foliage leaves* 7 to 9 (to 16) per complement, ± horizontal-drooping; *sheath* abaxially usually glabrous or sparsely covered by appressed, strigose, antrorse, transparent or brown hairs up to 1 mm long on the lower portion, bearing fimbriate auricles and fimbriae at the summit, the overlapping margin conspicuously ciliate, the underlapping margin ciliolate to smooth; *auricles* (1–)2–4 × 0.25–0.5 mm, ligulate, puberulous, dark purple to stramineous, fimbriate; *fimbriae* (3–)6–11 mm long, ivory, basally scabrid, straight, apically smooth, wavy to curled; *inner ligule* 0.2–0.5(–0.8) mm long, truncate, membranous, abaxially puberulous, the margin ciliolate to smooth; *outer ligule* 0.2–0.7 mm long, glabrous, shiny, stramineous, the margin ciliolate to smooth; *pseudopetioles* 3–6 mm long, adaxially glabrous except puberulous on the lower portion, abaxially glabrous, pulvinate, the pulvinus yellow, shiny, puberulous or glabrous; *blades* (6.5–)10–15(–18) × (1.4–)2–3.5(–4.2) cm, 15- to 17- (to 20)-nerved, juvenile leaves wider than adult leaves, ovate-lanceolate or linear-lanceolate, adaxially glabrous except with a few sparsely strigose, transparent hairs up to 1 mm long, with 3 or 4 raised scabrid submarginal nerves on one side, abaxially sparsely hairy, covered by strigose, straight, antrorse, hyaline or white-tinged hairs up to 1 mm long, tessellate, lighter green than adaxially, the midnerve yellow and conspicuous in the middle lower portion, the margins scabrous, the apex acuminate with a mucro 1.5–3 mm long. *Synflorescences* terminating leafy and leafless branches of all orders, polytelic, consisting of 1 to 5 (to 7) coflorescences each with 1 to 3 (to 15) multiflowered pseudospikelets, coflorescences and pseudospikelets subtended by bracts, the main axes hispidulous or glabrous; *subtending bracts* varying in size and shape throughout the main axes, fully developed and similar to a small foliage leaf with a small blade to triangular and apiculate, the blade when present deciduous, the sheath abaxially glabrous, ciliolate to glabrous along one margin and bearing fimbriae or not at the summit. *Pseudospikelets* 3–6(–8) × 0.3–0.5(–0.6) cm, linear-lanceolate, straight to slightly curved, green with purple spots when young becoming brown to stramineous, consisting of 1 prophyll, 1 to 4 (to 6) gemmiparous bracts, 1 to 2 (to 3) sterile lemmas, (3 to) 4 to 5 fertile florets, and a terminal rudimentary floret; *prophyll* 2–4 × 1.5–4 mm, abaxially puberulous between the winged keels, the wings ciliolate, pubescent on both sides, occasionally gemmiparous; *gemmiparous bracts* 1 to 4 (to 6), 3–8 × 3–4 mm, 10- to 15-nerved, ovate to ovate-lanceolate, sometimes with a small blade, deciduous or not, abaxially puberulous or glabrous, adaxially tessellate, densely pubescent toward the apex, the margins minutely ciliolate or smooth, the apex shortly mucronate, the mucro 0.2–0.5(–0.8) mm long; *sterile lemmas* 1 or 2 (to 3), 7–9(–11) × 5–6 mm, 15- to 16-nerved, ovate-lanceolate, lighter in color than the lemmas, abaxially puberulous or glabrous, adaxially pubescent, densely so toward the apex, the margins smooth, enclosing a rudimentary palea, mucronate, the mucro 0.5–0.8(–1) mm long; *rachilla segments* 4–6(–9) mm long, glabrous and shiny, apically with a rim of puberulous hairs, straight to slightly zigzag along the pseudospikelet, disarticulating below the attachment of each lemma and falling attached to the floret. *Fertile florets* (3 to) 4 to 5 with winged palea keels exceeding the lemma margins, basally thickened; *lemma* 10–15 × 6–9 mm, 12- to 25-nerved, ovate-lanceolate, abaxially puberulous or glabrous, adaxially densely pubescent at the tip otherwise puberulous or glabrous, the margins smooth and papery, the apex shortly mucronate, the mucro (0.2–)0.5–0.7 mm long; *palea* 9–14 × 2–2.5 mm, 9- to 13-nerved, 2-keeled, the sulcus 2 mm wide, 4- to 7-nerved, densely pubescent, tessellate, the enfolding margins 3- to 4-nerved, glabrous, tessellate, the keels winged, the wings 0.5–0.8(–1) mm wide, 2-nerved, shiny, glabrous except puberulous at the junction with the keels, the margins minutely ciliolate for the upper ⅓. *Lodicules* 3, 4–6 × 1–3.5 mm, many-nerved, concave, thicker below, membranous for the upper ⅓, bearing dark brown prickle hairs on the upper membranous portion, the margins apically ciliolate, acuminate, the posterior one symmetrical, narrower and slightly longer than the asymmetrical anterior pair. *Stamens* 6, the anthers 4–6(–7) mm long, when young white-yellow becoming creamy yellow with purple spots and ochraceous to stramineous, basally sagittate, apically apiculate. *Ovary* (1.5–)2–4 mm long, fusiform, basally yellow or purple and glabrous, apically densely hispidulous; *style* 1.5–

←

by lodicules. —M. Gynoecium with three plumose stigmas. (A, D–M based on *McClure 21364*; B, C based on *Londoño & Quintero 109*.)

3.5 mm long, densely antrorse hispidulous; stigmas 3, plumose, ca. 3–6 mm long, with the main nerve yellow to purple. *Caryopsis* not seen.

Etymology. The specific epithet refers to the strongly recurved thorns of the branches, like cat's claws, which help the plant to climb on trees.

Distribution and habitat. This species occurs in southern Colombia and central-eastern Ecuador, on the eastern side of the Andes (Eastern Cordillera in Colombia), in the foothills of the mountains, at elevations between 280 and 1200(–1500) m. It grows in swamps (locally called *chucuas*) associated with *Mauritia flexuosa* L. f., *Heliconia* L., and *Ficus* L., where it forms very dense and hard to penetrate clumps.

Common name. *Cachupenda.*

Uses. In Colombia this species is not used probably because of its poor wood quality. In Ecuador, however, according to *McClure 21364*, the species has many local uses.

Phenology. The flowering cycle of *G. uncinata* apparently is 10 years long. In late 1987, a plantlet from a flowering clump was taken from its natural habitat in Putumayo, Colombia, and planted at the Bamboo Germplasm bank of the Juan Maria Cespedes Botanical Garden, in Tuluá, Valle del Cauca, Colombia (*Londoño & Quintero 208*). During the first four years (1988–1992), the plantlet did not increase very much in size, reaching 0.6 cm in diameter and 2.5 m in height, but it continued to flower. Between 1992 and 1996 the plantlet increased in size, reaching 2.5 cm in diameter and 8 m in height, but it ceased flowering. In 1997, however, it started to flower again. Based on the 13 years of observations made by the first author, it can be inferred that *G. uncinata* has a flowering cycle of 10 years, it remains green and does not die after flowering, and it can continue to flower for approximately 5 years.

Guadua uncinata is most similar to *G. angustifolia.* The two have foliage leaf blades of similar size and shape, with sparse hairs on both surfaces; ciliolate margins on the foliage leaf sheath with the outer ligule abaxially pubescent; straight or slightly curved pseudospikelets; mature florets with the winged keels of the palea exceeding the margins of the lemma; lemmas with smooth, papery margins; paleas with a hairy sulcus and glabrous enfolded margins; and a basally glabrous, apically hispidulous, fusiform ovary.

Guadua uncinata is distinguished from *G. angustifolia* by having culms erect at the base then broadly nodding above and climbing apically (vs. erect); much shorter and thinner culms [3–8 m × 2–4(–6) cm vs. 10–30 m × 6–22 cm]; solid basal and apical internodes (vs. hollow); smaller culm leaves (14.5–35.5 × 11–14 cm vs. 30–60 × 20–50 cm) that are much less pubescent abaxially, lighter in color, and bear fimbriate auricles or fimbriae at the summit of the culm leaf sheath (vs. absence of auricles); fimbriate auricles at the summit of the foliage leaf sheath (vs. auricles absent); more congested coflorescences at maturity [1 to 3 (to 15) pseudospikelets/coflorescence vs. 1 to 4]; and the winged keels of the palea surpassing the apex of the palea (vs. ending at the apex). Additionally, although the strongly recurved thorns of *G. uncinata* are found in other climbing species, this feature contrasts with the longer, straighter thorns of *G. angustifolia.*

The size difference between *G. uncinata* and *G. angustifolia* persists even when both species are grown under the same conditions. As described under Phenology, plantlets of *G. uncinata* grown in cultivation reached to 2.5 cm in diameter and to 8 m in height after 13 years. Plantlets of *G. angustifolia* (*Londoño & Quintero 235*) planted at the same time (Mar. 1987), in the same soil and weather conditions, and coming from the same region (Putumayo), developed culms 12 cm in diameter and 18 m tall over the same period of time.

Paratypes. COLOMBIA. **Putumayo:** Puerto Caicedo, 1 km de Pto. Caicedo en la vía a Garzón, sobre la Q. El Achote, 340 m, 5 Mar. 1987 (fl), *Londoño & Quintero 208* (COL, TULV, US). **Caquetá:** vía Florencia–Belén de los Andaquíes, desviándose por la vía Morelia–San Jorge, a 2 km de Morelia, finca San Francisco, 280 m, 8 Feb. 1987, *Londoño & Quintero 109* (COL, TULV, US). ECUADOR. **Tungurahua:** on the trail up to Hacienda La Gloria from "Rio Negro," 5000 ft., 12 July 1945, *McClure 21361* (US); found wild along the trail leading from the "Rio Negro" bridge across the Pastaza River, 4000 ft., 12 July 1945 (fl), *McClure 21362* (COL, ISC, MO, US); valley of the Pastaza River, along the road from Rio Negro to the Hacienda La Gloria, 4000 ft., 12 July 1945 (fl), *McClure 21363* (NY, MO, US).

Guadua tagoara (Nees) Kunth, Enum. Pl. 1: 434. 1833. *Bambusa tagoara* Nees, Fl. Bras. Enum. Pl. 2: 532. 1829. *Arundarbor tagoara* (Nees) Kuntze, Revis. Gen. Pl. 2: 761. 1891. TYPE. Brazil. "Habitat in sylvis altitudine: 1800 ped in adscensu montis, Serra do mar dicti, euntibus versus Guarantingueta, provinciae S. Pauli," *Martius s.n.* (holotype, BR not seen).

Bambusa barbata Trinius, Mem. Acad. Imp. Sci. Saint-Petersbourg, Ser. 6, Sci. Math., Seconde Pt. Sci. Nat. 3, 1: 627. 1835. *Nastus barbatus* (Trinius) Ruprecht, Bambuseae 42, t. 17. 1939 [preprint]. TYPE. Brazil. "Hab. in sylvis provinc. Minarum Bras.," *L. Riedel 520* (holotype, LE not seen; isotypes, G, K, P not seen, US-fragment).

Bambusa distorta Nees, Linnaea 9: 470. 1834. *Arundarbor distorta* (Nees) Kuntze, Revis. Gen. Pl. 2: 761. 1891. *Guadua distorta* (Nees) Ruprecht, Bambuseae 41, t. 16, f. 59. 1939 [preprint]. TYPE. Brazil. S.d., *F. Sellow s.n.* (holotype, B not seen; isotype, US [flowering piece is *Guadua*, sterile pieces are Poaceae, not *Guadua*]).

Bambusa spinosissima Hackel, Oesterr. Bot. Z. 53: 197. 1903. *Guadua spinosissima* (Hackel) E.-G. Camus, Les Bambusées 1: 112. 1913. TYPE. Brazil. "In provincia Santa Catharina, prope Blumenau," July 1888, *E. Ule 878* (holotype, W; isotype, US-fragment).

Rhizomes sympodial, pachymorph, 30–40 cm long. *Culms* 10–15(–20) m tall, 5–10 cm diam., erect at the base, the apical portion arching after developing foliage leaves, with the secondary branches very elongate, leaning on or pendent from trees, glaucous when young, becoming green mottled with light yellow-green dashes at maturity; *internodes* (16–)20–60(–80) cm long, cylindrical, hollow, some filled with water, walls 5–10 mm thick, the surface roughened, striate and slightly tuberculate, covered by short, brown, antrorse hairs below the nodes when young then becoming glabrous; *nodes* solitary, the nodal line horizontal, with a supranodal band (0.8–)1.1–1.5(–1.9) cm wide of dense, white, antrorse, appressed hairs, and an infranodal band 0.7–1(–1.5) cm wide of brown-red to white retrorse, appressed hairs; *supranodal ridge* pronounced; *bud* single, positioned ca. 2 mm above the nodal line, triangular, plano-convex, the shoulders of the prophyll glabrous. *Culm leaves* slightly coriaceous, deciduous, pushed away by the developing axillary branches, but those at the lowermost nodes strongly attached to the culm, purple-green and maculate with yellow when young becoming brown to stramineous, usually lacking auricles and fimbriae; *sheaths* 17–38 × 10–44 cm, 5–12 times as long as the blade, abaxially pubescent with a mix of (1) coarse, rigid, irritating, brown-red hairs to 2.5 mm long, (2) prickly, retrorse, brown-red hairs less than 1 mm long, and (3) soft, wavy hyaline hairs, the margins entire; *inner ligule* 1–2 mm long, truncate, densely ciliolate, not extending to the culm leaf margins; *blades* (2–)3–5.5(–7) cm long, 9–10(–13) cm wide, very broadly triangular, erect, persistent, abaxially less pubescent than the sheath but densely covered with soft, appressed, hyaline hairs and some scattered coarse, shorter, rigid, antrorse, brown-red hairs, adaxially conspicuously nerved and densely strigose between the nerves, the margins entire, the apex strongly mucronate usually split in two parts, the mucro up to 2 mm long. *Branching* intravaginal, branches solitary and armed, usually not developing at the lower nodes, the middle and upper nodes with a dominant central branch held at a 45°–50° angle, with age developing 1 to 4 secondary branches from the basal nodes of the central branch, the secondary branches extending outward, clambering over trees to 2–6 m long; *thorns* usually on the lateral branches, 1 to 5 per node, absent from the lowermost nodes of the lateral branches on the main culm. *Foliage leaves* 5 to 8 (to 10) per complement; *sheaths* abaxially densely pubescent to glabrous, usually with a patch of hyaline hairs on one side of the midnerve near the apex, green when young, becoming stramineous, tessellate venation through the margins, the margins ciliate, the summit fimbriate, auricles usually absent; *auricles* when present 1–5 mm long, dark brown, marginally fimbriate; *fimbriae* 7–15 mm long, ivory, curled distally; *inner ligule* 0.5–2 mm long, pubescent, the margin finely ciliolate; *outer ligule* 0.5–1 mm long, usually glabrous and shiny, stramineous, the margin minutely ciliolate when young, becoming smooth; *pseudopetioles* 4–10(–15) mm long, pulvinate, adaxially hispidulous to glabrous, abaxially glabrous; *blades* (9–)15–25(–41) × (1.1–)2–5(–6) cm, L:W = 4–9:1, 15- to 29-nerved, linear-lanceolate to broadly ovate-lanceolate, adaxially glabrous, abaxially glabrous and strongly tessellate, the midnerve and primary nerves prominent and yellow, one margin scabrous, the other scabrid, the apex acuminate, ending in a mucro. *Synflorescences* terminating leafless or leafy branches of all orders, polytelic, consisting of 7 to 11 (to 13) coflorescences, each with 1 to 6 (to 9) multiflowered pseudospikelets, coflorescences and pseudospikelets subtended by bracts, the main axes glabrous; *subtending bracts* 7–13 × 4–6 mm, triangular, deciduous, mucronate, generally gemmiparous, abaxially pubescent to glabrous, adaxially pubescent toward the apex. *Pseudospikelets* (0.5–)1–3(–4) × 2–4(–6) mm, linear-lanceolate, glabrescent, yellow-green mottled with purple to stramineous, consisting of 1 prophyll, 2 to 3 (to 4) usually gemmiparous bracts, 1 (or/to 2) sterile lemma, 1 to 4 (to 6) fertile florets, and a terminal rudimentary floret; *prophyll* 1.5–2 × 3–4 mm, abaxially pubescent, usually gemmiparous, the keels ciliate; *gemmiparous bracts* 2 or 3 (to 4), 2–4 × 1.5–4 mm, 4- to 8- (to 10)-nerved, broadly ovate, abaxially puberulent to glabrous with the midnerve strongly marked, adaxially shortly pubescent throughout the upper ⅔ with antrorse, appressed hyaline hairs, the apex shortly mucronate; *sterile lemmas* 1 (or 2), 4.5–6(–7) × 4–6 mm, 10- to 12-nerved, broadly ovate to ovate, abaxially puberulent to glabrous, adaxially pubescent for the upper ⅔, usually enclosing a rudimentary palea, marginally ciliate especially on the upper ⅓, the cilia wavy and deciduous, the apex mucronate; *rachilla segments* less than 1 mm long between prophyll and glumes then elongated after the first floret up to 5 mm, hispid, disarticulating just below the juncture with the lemma. *Fertile florets* 1 to 4 (to 6) with the winged palea keels exceeding the lemma margins; *lemmas* (6–)7–11(–14) × (4–)5–7(–8) mm, (9- to) 11- to 13- (to 18)-nerved, ovate, rounded on the back, when mature not embracing the palea completely, abaxially glabrescent, usually glabrous with the nerves strongly manifest, adaxially pubescent for the upper ⅔ with antrorse, appressed, hyaline hairs, the margins ciliate, bearing a tuft of hyaline hairs distally below the mucro, the cilia wavy, soft, and deciduous, the mucro 0.5–1 mm long, the apex mucronate; *paleas* 7–11(–13) × 4–5 mm, 9- to 15-nerved, 2-keeled, abaxially and adaxially puberulent, the apex acute with a tuft of hyaline hairs, the sulcus 5- to 9-nerved, puberulent, the enfolding margins 2- to 4-nerved, glabrous and shiny, the keels winged, the wings 0.8–1.2 mm wide, wider apically than basally, puberulent on both surfaces, with very short, appressed, hyaline hairs, 1- to 2-nerved, ciliolate on the upper ⅓. *Lodicules* 3, 2.5–4 × 1–3 mm, 12- to 15-nerved basally, hyaline to yellow-brown, acute, the upper half covered with brown-red to hyaline prickles, ciliolate on the upper margin, thickened and darker below, thinner and membranous above, the anterior pair slightly asymmetrical, the posterior one symmetrical. *Stamens* 6, the anthers 5–6.5 mm long, yellow-brown, basally sagittate, apically emarginate. *Ovary* 3–6 mm long, fusiform, brown-red, antrorse hispidulous; style 1, hispidulous; stigmas 3, plumose. *Caryopsis* not seen.

Distribution. Atlantic and montane forests of the eastern coast of Brazil, from Bahia to Santa Catarina; 50–1200 m.

Uses. Split culms are used in the construction of mud huts and shelters, water pipes, sheathing of cart sides, and as a fire starter.

Common names. *Taquaraçu*; *taquara grossa* (Tupi-guaraní).

Phenology. The flowering cycle of this species has not been studied or reported. Based on herbarium specimens, however, it is probable that flowering occurs every two years. This species does not die after flowering, and only a few culms of the clump flower at the same time.

Guadua tagoara is characterized by apically climbing culms, glaucous new culms (Judziewicz et al., 1999: fig. 153), very broadly triangular culm leaf blades often with a split apex (Judziewicz et al., 1999: fig. 7E, F), and usually a patch of hyaline hairs toward the apex of the foliage leaf sheath. It most closely resembles *G. weberbaueri* and *G. sarcocarpa* Londoño & P. Peterson, which are restricted to the Amazon basin and eastern slope of the Andes. All three species share basally erect culms that are apically arching and branching, reaching over trees for support; a prominent supranodal ridge; adaxially appressed pubescence on lemmas and bracts; the pubescent sulcus of the palea; prickles on the upper portion of the lodicules; and antrorse-hispidulous ovary and styles.

Guadua tagoara is distinguished from *G. weberbaueri* and *G. sarcocarpa* by its culm leaves with the margins continuous at the junction of the sheath and blade (vs. culm leaves with the margins slightly discontinuous at the junction of the sheath and blade); and the very broadly triangular culm leaf blade with the apex usually split in two (or more) parts (vs. a triangular culm leaf blade with a strong mucro at the apex). In addition, *G. tagoara* differs from *G. weberbaueri* by the abaxially glabrous and conspicuously tessellate foliage leaf blades (vs. abaxially pilose and inconspicuously tessellate blades).

Considerable morphological variation exists among and within the populations of *G. tagoara*, perhaps related to the apparently short flowering cycle of this species. A study to evaluate the genetic variability of *G. tagoara* would be worthwhile, especially if these data could be related to flowering specimens and morphological variation. All variants show the distinctive culm leaf and other features mentioned above as characteristic of *G. tagoara*, and thus we have chosen to recognize a single species. Within the range of variation of *G. tagoara*, however, some specimens representing perhaps three or four populations from Rio de Janeiro show a distinctive correlation among extremes of variation in coflorescence congestion, pseudospikelet size, and the occurrence of fimbriate auricles on the foliage leaf sheaths. We recognize this set of populations as *G. tagoara* subsp. *glaziovii*. This subspecies is known from a limited number of populations from a restricted geographic range nested within the distribution of the autonymic *G. tagoara* subsp. *tagoara*; it is unknown whether populations of the two subspecies are strictly sympatric.

KEY TO THE SUBSPECIES OF *GUADUA TAGOARA*

1a. Pseudospikelets 9 to 15 (to 40) per coflorescence; pseudospikelets lanceolate, 1–3(–4) cm long, 3–6 mm wide; foliage leaf sheaths fimbriate

but not auriculate at the summit . . . .
. . . . *G. tagoara* subsp. *tagoara*

1b. Pseudospikelets usually 1 to 6 (to 9) per coflorescence; pseudospikelets narrowly lanceolate, 2.5–4 cm long, 2–3 mm wide; foliage leaf sheaths auriculate-fimbriate at the summit . . .
. . . . *G. tagoara* subsp. *glaziovii*

Guadua tagoara (Nees) Kunth subsp. **tagoara**

Foliage leaf sheaths bearing only fimbriae at the summit, the fimbriae 8–15 mm long. Pseudospikelets 9 to 15 (to 40) per coflorescence, 1–3(–4) cm long, 3–6 mm wide, lanceolate, with 1 to 4 fertile florets; sterile lemmas 5–6(–7) mm long; lemmas 7–11(–14) mm long, 5–7(–8) mm wide, the mucro 0.5–1 mm long; paleas 7–11(–13) mm long, 4–5 mm wide. Lodicules 2.5–4 mm long, 1–3 mm wide. Ovary 3–6 mm long.

Distribution. Atlantic and montane forests of the eastern coast of Brazil from Bahia to Santa Catarina; 50–1200 m.

One collection from Serra do Mar in São Paulo (*Medina 5*), with shorter pseudospikelets and very congested coflorescences with up to 40 pseudospikelets, and another from the Serra dos Órgãos in Rio de Janeiro (*Reitz 6926*), with robust pseudospikelets up to 3.6 cm long and 6 mm wide, differ from the remaining collections. However, populations of *G. tagoara* in the two areas were visited by both authors; only minor variations in vegetative features were observed and the specimens fit well within this subspecies in every other respect.

Specimens examined. BRAZIL. **Bahia:** Mun. Gandú, 2 km N of Gandú City, Faz. Santo Antonio, 90 m, 19 Apr. 1972, *Calderón & Pinheiro 2228* (CEPEC, K, MO, US); Mun. Itajuipe, 2 km S of Pimenteira on road to União Queimada, Fazenda São Jorge, 500 m, 5 May 1976, *Soderstrom et al. 2186* (CEPEC, F, K, MO, SP, US); Mun. Jequié, road Jequié–piaú, ca. 40 km SE of Jequié, 175 m, 16 May 1976, *Calderón et al. 2439* (INPA, K, MO, US); Mun. Mascote, 20 km E of Camaça, 9 km W of Santa Luzia do Salobro on road to Canavieiras, edge of rio Belém, 7 Apr. 1976, *Soderstrom et al. 2128* (CEPEC, F, K, SP, US). **Espírito Santo:** Vitória, Viana, 12 June 1987 (fl), *Gomez 84* (SP); Mun. Domingo Martins, km 42 before Marechal Floriano, 530 m, 21 Feb. 1990, *Clark & Morel 691* (ISC, MBML, MO, NY, RB, SJRP, SP, US). **Minas Gerais:** Mun. Marliéria, Parque Estadual do Rio Doce, 400 m, 18 Sep. 1975, *Heringer & Eiten 15024* (MO, US). **Paraná:** Capão Bonito, in silva primaria, 27 Mar. 1915 (fl), *Dusén 16878* (F, K, MO, NY, US); Mun. Campina Gde. do Sul, Figueira, rio Capivari, 19 Dec. 1972 (fl), *Hatschbach 31014* (ISC, MBM, SP, US); Mun. Antonina, rio Pequeno, 50 m, 10 Jan. 1974 (fl), *Hatschbach 33640* (ISC, MBM, US); Mun. Lima Duarte, Serra do Ibitipoca, about 110 m before the entrance to the Parque Estadual (Florestal) do Ibitipoca, 1220 m, 3 Feb. 1991, *Clark & Morel 784* (BHCB, ISC, MO, SJRP, SP, US). **Rio de Janeiro:** Mun. Resende, 27 Apr. 1926, *Gehrt & Hoehne 17589* (US); Parque Nac. de Itatiaia, 12 Nov. 1943 (fl), *McClure 21285* (ISC, K, US), *McClure 21291* (K, US); Parque Nac. de Itatiaia, road to Maromba, near Hotel Simon, 1000 m, 12 Feb. 1990, *Clark et al. 670* (AAU, ISC, K, MO, NY, RB, SJRP, SP, US); between Nova Friburgo and Cachoeiro de Macaco, 980 m, 30 Apr. 1972 (fl), *Soderstrom & Sucre 1978* (CEPEC, INPA, K, RB, US); Mun. Nova Friburgo, Macaé de Cima, nascente do Rio Macaé, 1000 m, 28 Nov. 1986, *Martinelli et al. 12008* (RB); Reserva Macaé de Cima, sítio Taquara-oca, trail to Cascada Preta, 710 m, 8 Mar. 1992, *Londoño & Sarahyba 720* (IBGE, RB, TULV, US); Parque Nac. de Itatiaia, 1050–1250 m, 30 Apr. 1985 (fl), *Zuloaga et al. 2344* (MO, US, WIS), 1110 m, 6 Mar. 1992, *Londoño & Sarahyba 707* (IBGE, RB, TULV, US); Nova Friburgo, 9 Dec. 1918, *Curran 622* (US); Mun. Teresópolis, Serra dos Órgãos, Rio Paquequer, 1000 m, 15 Aug. 1940 (fl), *Brade 16566* (IAN, RB), 12 June 1940 (fl), *Brade 16280* (IAN, R); Parque Nacional da Serra dos Órgãos, 16 Feb. 1990, *Clark et al. 685* (ISC, MO, NY, RB, SJRP, SP, US), 1170 m, 6 Mar. 1992, *Londoño & Sarahyba 713* (IBGE, RB, TULV, US); 16 km S of Itaipara, Serra dos Órgãos, 950 m, 26 Mar. 1976 (fl), *Davidse et al. 11420* (K, MBM, MO, NY, US); Serra dos Órgãos, s.d. (fl), *Reitz 6925* (SP, US); Soberbo, 13 July 1968 (fl), *Braga 28* (RB); Mun. Petrópolis, vale de Bom Sucesso, 720 m, 6 May 1972, *Soderstrom & Sucre 1985* (INPA, RB, US); Vassouras, 400 m, Apr. 1976 (fl), *Sucre 11192* (K, RB, US); Bom Jesus de Itabapoana, Carabuçu, 7 July 1982 (fl), *Carauta et al. 4293* (R); Rio de Janeiro, s.d. (fl), *Glaziou 20153* (K, SP, US); Rio de Janeiro (fl), s.d., *Glaziou 13324* (F, K); Rio, s.d. (fl), *Sello 17* (US). **Santa Catarina:** Teresópolis, S. Amaro, 400 m, 24 Aug. 1958 (fl), *Reitz & Klein 7058* (US); Rio Tavares, Ilha de S. Catarina, Florianópolis, 200 m, 28 July 1965 (fl), *Klein & Bresolin 6119* (US); Vargem Grande, Lauro Müller, 350 m, 11 July 1958 (fl), *Reitz & Klein 6732* (US); Mata da Cia. Hering, Blumenau, 23 Nov. 1954 (fl), *Reitz & Klein 2283* (US); Novo Horizonte, Lauro Müller, 350 m, 22 Aug. 1958 (fl), *Reitz & Klein 7036* (MBM, SP, UB, US); Parque Botánico do Morro Baú, Ilhota, 300 m, 1 Nov. 1968 (fl), *Reitz 6890* (SP, US); ca. 10 km from Aiure, 25 Feb. 1992, *Londoño & Clark 705* (IBGE, TULV, US); about 12–13 km along turn off from BR-101 to Brusque near Cunhas, 20 m, 9 Mar. 1991, *Clark & Oliveira 886* (HRB, ISC, SJRP, SP, US); road São Bento do Sul–Corupá, 17 km NW of Corupá, 590 m, 4 Mar. 1991, *Clark & Windisch 857* (HRB, ISC, MO, RB, SJRP, SP, US); Serra Geral, road Timbé do Sul to S. José dos Ausentes, 9.8 km from Timbé do Sul, Serra da Rocinha, 425 m, 6 Mar. 1991, *Clark & Windisch 873* (HRB, ISC, SJRP, SP, US). **São Paulo:** Taubaté et Lorena, Oct. 1833, *Riedel 1636* (K, NY, US-fragment); road between Piedade and Tapirai at Km 107 marker, 3 Mar. 1960, *Medina 10* (SP); Serra da Cantareira, 18 May 1901 (fl), *Hammar 6116* (SP, US), 14 June 1948 (fl), *Kuhlmann s.n.* (SP); between Taubaté & Ubatuba, Serra do Mar, 20 Nov. 1962 (fl), *Medina 5* (SP, US); Serra da Cantareira, 22 Oct. 1948 (fl), *Pickel 5891* (SP, US); Carlos Botelho State Park, Ribeirão Branco, km 55, ca. 23 km S of Park headquarters, 2 Sep. 1987, *Gentry et al. 58817* (MO); Reserva Forestal Carlos Botelho, Serra de Paranapiacaba, past Rio Bonito, 28 Jan. 1990, *Clark & Windisch 648* (ISC, K, MO, NY, RB, SJRP, SP, US), 185 m, 16 Feb. 1992, *Clark & Oliveira 1025* (ISC, SJRP, SP, US); Sta. Izabel, Igaratá, 26 June 1952 (fl), *Kuhlmann & Gonzalves 3147* (SP, UB), 26 Sep. 1950 (fl), *Kuhlmann 2549* (SP); Mun. de Salesópolis, Boracéia, 28 Apr. 1949 (fl), *Kuhlmann 3146* (SP); base of Serra da Bocaina, road Areias–

São José de Barreiro, km 251.5, 15 Jan. 1990, *Clark & Morel 624* (AAU, ISC, MO, NY, RB, SJRP, SP, US); Mun. Biritiba Mirim, Estação Biol. Boracéia, Casa Grande, 800 m, 24 Feb. 1991, *Clark & Morel 815* (ISC, MBM, MO, NY, RB, SJRP, SP, US); SP-183, road Piquete–Cruzeiro, about 10 km E of Piquete, near the gate of a fazenda, 570 m, 16 Jan. 1991, *Clark & Morel 749* (ISC, K, MO, RB, SJRP, SP, US); 5.5 km from the Paraná border, route BR116, 630 m, 17 Feb. 1992, *Londoño & Clark 689* (IBGE, SP, US).

Guadua tagoara subsp. **glaziovii** (Hackel) Londoño & L. G. Clark, comb. et stat. nov. Basionym: *Bambusa glaziovii* Hackel, Oesterr. Bot. Zeit. 53(5): 194. 1903. *Guadua glaziovii* (Hackel) E.-G. Camus (as *glaziowii*), Les Bambusées 1: 108, pl. 66, fig. A. 1913. TYPE. Brazil. Rio de Janeiro, s.d., *A. F. M. Glaziou 17450* (holotype, W; isotypes, K, MB, P, US-fragment).

Guadua longifimbriata E.-G. Camus, Les Bambusées 1: 113, pl. 64, fig. C. 1913. *Bambusa longifimbriata* (E.-G. Camus) McClure, Smithsonian Contr. Bot. 9: 66. 1973. TYPE: Brazil. Rio de Janeiro: Petrópolis, São Cristovão, 29 Feb. 1872, *A. F. M. Glaziou 5717* (holotype, P not found; isotypes, C, IAN, K, US-fragment).

Foliage leaf sheaths bearing fimbriate auricles at the summit, the auricles 2–5 mm long, dark brown, the fimbriae 6–15(–20) mm long. Pseudospikelets 1 to 6 (to 9) per coflorescence, 2.5–4 cm long, 2–3 mm wide, narrowly lanceolate, with 2–6 fertile florets; sterile lemmas 4.5–6 mm long; lemmas 7.5–9 mm long, 5–6 mm wide, the mucro 0.5 mm long; paleas 7–8.5 mm long, 3.5–4.5 mm wide. Lodicules 2.5–3.2 mm long, 1–2.5 mm wide. Ovary 3–4 mm long.

Etymology. This subspecies is named for Auguste F. M. Glaziou, a prolific French collector in Brazil during the 19th century.

Distribution. This subspecies occurs in the Atlantic forests only of the state of Rio de Janeiro.

Paratypes. BRAZIL. **Rio de Janeiro:** Mun. Nova Friburgo, Distr. de Macaé de Cima, a 3 km do Hotel Fazenda São João, 1000 m, 6 June 1989 (fl), *Lima et al. 3581* (MO, NY, R, RB, US), 960 m, 8 Mar. 1992, *Londoño & Sarahyba 716* (IBGE, RB, TULV, US); Parque Nacional da Tijuca, Bom Retiro, 575 m, 25 Feb. 1972, *Soderstrom et al. 1854* (CEPEC, INPA, K, RB, US); Rio de Janeiro, 24 May 1895 (fl), *Ule 4113* (IAN, US).

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Una Nueva Especie de *Echeandia* (Anthericaceae) de Guerrero, México

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RESUMEN. Se describe e ilustra *Echeandia magnifica* sp. nov. (Anthericaceae) con material proveniente del estado de Guerrero, México. La nueva especie, perteneciente al subgénero *Echeandia*, está relacionada con *E. michoacensis* (Poellnitz) Cruden y con *E. drepanoides* (Greenman) Cruden, pero es claramente distinguible de la primera por sus hojas con el margen largamente ciliado, por su inflorescencia ramificada y por sus flores grandes con los tépalos internos ampliamente elípticos. De *E. drepanoides* se distingue por el mayor tamaño de sus anteras y porque éstas abren por una hendidura apical.

ABSTRACT. A new species, *Echeandia magnifica* (Anthericaceae), from Guerrero, Mexico, is described and illustrated. The new species, included in the subgenus *Echeandia*, is related to *E. michoacensis* (Poellnitz) Cruden and *E. drepanoides* (Greenman) Cruden but is clearly distinguished from the former by its leaves long ciliate in the margins, its branched inflorescence, and its large flowers with the internal tepals widely elliptic in shape. From *E. drepanoides* it is distinguished by its larger anthers that dehisce through apical slits.

Key words: Anthericaceae, *Echeandia*, Guerrero, Mexico.

El género *Echeandia* con 78 especies (Cruden, 1999), es el segundo más grande dentro de las Anthericaceae (Dahlgren et al., 1985) y está restringido a América. En los últimos 20 años se han descrito cerca de 50 especies (Cruden, 1981, 1986, 1987, 1993, 1999), lo que equivale aproximadamente a la mitad de los taxa conocidos y al 75% de los presentes en México (Espejo & López-Ferrari, 1993).

En recientes viajes de campo al estado de Guerrero, recolectamos material del género que no pudo ser asignado a ninguna de las especies descritas y la revisión cuidadosa del mismo nos llevó a concluir que se trata de una especie nueva que a continuación describimos.

Echeandia magnifica López-Ferrari, Espejo & Ceja, sp. nov. TIPO: México. Guerrero: mun. Chilpancingo de los Bravo, ca. 2 km después de Xocomanatlán, rumbo a Omiltemi, vegetación arvense en bosque de pino-encino, 17°33′49″N, 99°38′19″W, 1950 m, 4 Sep. 1999, *J. Ceja, A. Espejo, A. R. López-Ferrari y A. Mendoza 907* (holótipo, UAMIZ; isótipos, BRIT, ENCB, FCME, IEB, MO, UC). Figura 1.

Herba ex radicibus 12–15 cm longis, folia basalia, linearia vel lanceolata, 50–60 cm longa, 4.5–5 cm lata, marginibus ciliatis. Inflorescentia scapo tereti, glabro, usque ad 100 cm longo; insidens tepalis flos flavis, 16–18.5 mm longis, 6–12 mm latis; filamentis muricatis; antheris liberis. Capsula oblongoidea, 12–15 mm longa, 7–10 mm diametro.

Hierba perenne, glabra, de hasta 1.8 (2.1) m de alto incluida la inflorescencia; raíces cilíndricas, de 12–15 cm de largo, engrosadas en la porción distal; cormo cubierto por las vainas persistentes de las hojas, que se vuelven fibrosas con la edad; hojas basales lineares a lanceoladas, de 50–60 × 4.5–5 cm, verdes en el haz, glaucas en el envés, sinuadas y largamente ciliadas en el margen con pelos de hasta 1 mm de largo; inflorescencia una panícula con numerosas flores, de ca. 90 cm de largo; escapo cilíndrico, glabro, de 90–160 cm de largo; brácteas del escapo triangulares, de 10–14 cm de largo; brácteas de la inflorescencia triangulares, de 5–7 cm de largo; brácteas florales angostamente triangulares, de ca. 5 mm de largo; pedicelos de ca. 1 cm de largo, articulados por debajo de la mitad, acrescentes en el fruto; flores amarillo-anaranjadas, divaricadas; tépalos externos elípticos, de 16–17 × 6–6.6 mm, acuminados, enteros, trinervados; tépalos internos ampliamente elípticos, de 18–18.5 × 12 mm, redondeados, enteros, trinervados; filamentos muricados, más conspicuamente en su mitad apical, de ca. 7.4 mm de largo; anteras libres, oblongas, de 4.5–5 mm de largo, con dehiscencia por una hendidura apical; ovario oblongo, de 4 mm de largo; estilo de ca. 1 cm de largo. Cápsula oblonga, triquetra, de 12–15 mm de largo, de 7–10

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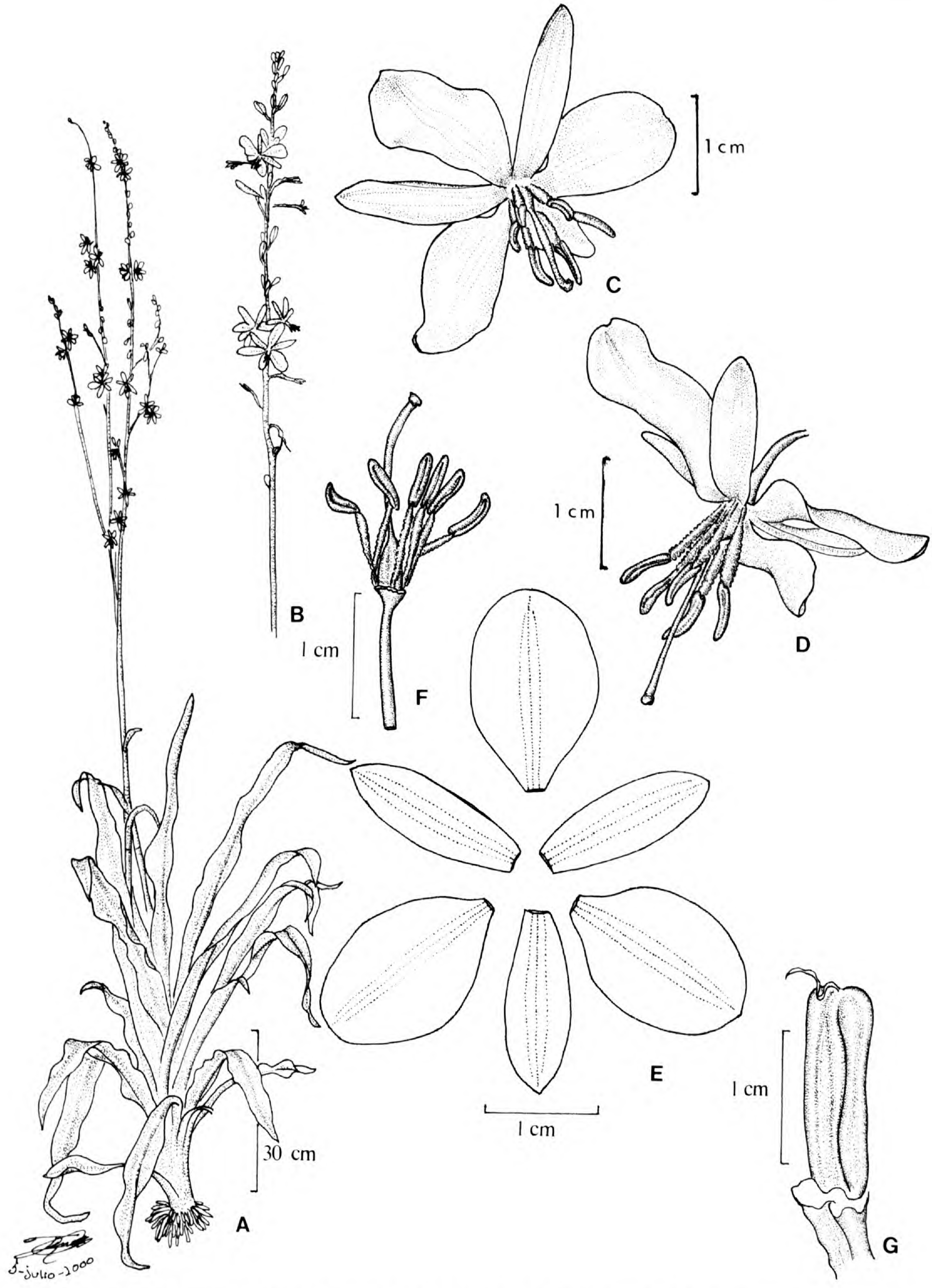

Figura 1. *Echeandia magnifica* López-Ferrari, Espejo & Ceja. —A. Hábito. —B. Detalle de la inflorescencia. —C y D. Flor. —E. Flor disecada. —F. Detalle del androceo y el gineceo. —G. Fruto. (Ilustración basada en el ejemplar *J. Ceja et al. 907*, holótipo.)

mm de diámetro; semillas numerosas, de ca. 2 mm de diámetro, con la testa negra, caliculosa. Número cromosómico n = 8 (*Cruden 1724*).

La especie aquí descrita pertenece al subgénero *Echeandia* ya que presenta flores amarillas y tépalos elípticos. *Echeandia magnifica* muestra similitudes, tanto en caracteres vegetativos como florales, con *E. michoacensis* (Cruden, 1993; von Poellnitz, 1943); sin embargo esta última presenta el escapo generalmente simple y el margen de las hojas entero a más o menos muricado o denticulado, a diferencia de la primera que lo tiene largamente ciliado.

Echeandia magnifica presenta también semejanzas con *E. drepanoides*, a la cual se parece mucho vegetativamente debido a sus hojas con el margen largamente ciliado, pero de la cual difiere en el tamaño mayor de las anteras y en que éstas abren por una hendidura apical. Además, *E. drepanoides* se conoce sólo de algunas localidades dispersas en el estado de Oaxaca.

Otro taxon con el que la nueva especie podría confundirse, dada su distribución geográfica, es *Echeandia echeandioides* (Schlechtendal) Cruden; sin embargo, las anteras de esta especie presentan dehiscencia lateral y no apical y las hojas son mucho más angostas y tienen el margen diminutamente denticulado a cortamente ciliado.

Echeandia magnifica se conoce hasta ahora únicamente de los alrededores de Chilpancingo, en el estado de Guerrero, en donde crece abundantemente en sitios encharcados dentro de las áreas perturbadas del bosque de pino-encino. El epíteto específico hace referencia al tamaño de las plantas y de las flores que caracterizan a la especie.

Parátipos. MÉXICO. **Guerrero:** mun. Chilpancingo de los Bravo, ca. 2 km después de Xocomanatlán, rumbo a Omiltemi, 4 Nov. 1999, *J. Ceja, A. Espejo, A. R. López-Ferrari y A. Mendoza 1023* (ENCB, MEXU, UAMIZ); mun. Chilpancingo de los Bravo, ca. 23 km S of Chilpancingo, ca. 1090 m, 2 Aug. 1970, *R. W. Cruden 1724* (ENCB, GH, K, UC).

Agradecimientos. Agradecemos a Victoria Sosa la revisión crítica del manuscrito. Robert W. Cruden examinó el trabajo y puso amablemente a nuestra disposición sus notas así como material adicional de la nueva especie aquí descrita. Roy Gereau corrigió y complementó la diagnosis latina y Rolando Jiménez Machorro elaboró la ilustración que acompaña al trabajo.

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Macrocarpaea angustifolia (Gentianaceae), a New Species from Peru

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ABSTRACT. *Macrocarpaea angustifolia,* known only from the Departamento de Pasco, Peru, differs from the sympatric *M. revoluta* in having glabrous, narrower, acuminate leaves with obscure secondary venation. It further differs in its verrucose (*Rusbyanthus*-type) pollen, which suggests a closer relationship to such species as *M. corymbosa* and *M. viscosa.*

Key words: Gentianaceae, *Macrocarpaea,* Peru.

Macrocarpaea angustifolia J. S. Pringle, sp. nov. TYPE: Peru. Pasco: Prov. Oxapampa, headwaters of Río Tunqui, trail to Chuchurras-Palcazu, 75°28′W, 10°14′S, shrubby vegetation on ridge, 1900 m, 2 Jan. 1984, *R. Foster, M. Chanco, J. Alban & D. N. Smith 7747* (holotype, MO; isotype, USM photocopy seen). Figure 1.

Frutex glabra. Folia subcoriacea, laminis elliptico-lanceolatis, 10–14 × 1.5–3 cm, marginibus incrassatis revolutisque, apicem versus peracuminatis, et petiolo angusto circa 1 cm longo. Calyx 6–10 mm, lobis semiorbicularibus tubo duplo brevioribus, margine scarioso. Corolla 35–45 mm, lobis ovato-oblongis, 7–10 mm longis. Exinium pollinis verrucosum.

Shrub to ca. 3 m, glabrous throughout. Stems nearly terete, striate. Leaves firm, blades dark green above, paler beneath, elliptic-lanceolate, 10–14 × 1.5–3 cm, only midrib conspicuous, secondary and lesser veins obscure; margins thickened, revolute; base tapering to a slender petiole up to ca. 1 cm long; apex strongly acuminate. Inflorescence a terminal, open, paniculate cyme of ca. 15–25 flowers. Flowers ± nodding, on pedicels 15–25 mm long. Calyx campanulate, 6–10 mm long, lobed ca. ⅓ of its length; lobes equal or nearly so, semicircular, slightly overlapping, scarious-margined. Corolla pale yellowish green, 35–45 mm long; tube expanding rather abruptly 2–4 mm above summit of calyx; lobes oblong-ovate, 7–10 mm long. Anthers seen after dehiscence, estimated ca. 5.0 mm long when straight. Exine of pollen verrucose. Mature fruit not seen.

Known only from the type collection.

Superficially, *M. angustifolia* somewhat resembles the Venezuelan species formerly known as *M. salicifolia* Ewan. The latter, however, has pollen in tetrads, and is now placed in *Chelonanthus* or, by those more narrowly defining the genera in this complex, in *Rogersonanthus,* whereas *M. angustifolia* has separate pollen grains, like all other species of *Macrocarpaea* as the genus is now circumscribed. Also, in *M. angustifolia* as in *Macrocarpaea* species generally, the bracts in the inflorescence are gradually reduced, the proximal bracts being distinctly leaflike, whereas in those species transferred to *Chelonanthus* or *Rogersonanthus* all of the inflorescence bracts are greatly reduced and scalelike. Among species retained in *Macrocarpaea, M. angustifolia* exhibits some similarity to *M. revoluta* (Ruiz & Pavón) Gilg, which is native to the same part of Peru. The leaves of *M. angustifolia* differ in being glabrous, much narrower, and strongly acuminate, with obscure secondary venation and with more slender petioles, and, at least as seen through comparison of the respective type specimens, its inflorescence is fewer-flowered and more open. It also resembles *M. subcaudata* Ewan, of Costa Rica and Panama, especially in its narrow, acuminate leaves but differs in its terrestrial rather than epiphytic habit, its much longer pedicels, and its glabrous calyx.

Another somewhat similar species is *M. bangiana* Gilg of Bolivia, from which *M. angustifolia* differs in its narrower, glabrous, strongly acuminate leaves of thicker texture, without the conspicuous secondary venation of the Bolivian species, and in its smaller flowers. The pollen of *M. angustifolia* is conspicuously verrucose, thus being of the *M. corymbosa*-type or *Rusbyanthus*-type of Nilsson (1968, 1972), whereas that of *M. revoluta, M. subcaudata,* and *M. bangiana* is of Nilsson's *M. glabra*-type (Nilsson, 1968, 1972; Weaver, 1972). Palynology suggests that the closest relationships of *M. angustifolia* are with *M. cinchonifolia* (Gilg) Weaver (Ecuador to Bolivia), *M. corymbosa* (Ruiz & Pavón) Ewan (S Peru), *M. pachystyla* Gilg (S Peru), and *M. viscosa* (Ruiz & Pavón) Gilg (Peru), which also have the *M. corymbosa* pollen type.

Acknowledgments. I am very grateful to Jason

HOLOTYPE

ROYAL BOTANICAL GARDENS
HAMILTON, ONTARIO, CANADA

Macrocarpaea angustifolia J.S. Pri

James S. Pringle Feb

PERU

GENTIANACEAE
Macrocarpaea

Dept. Pasco. Prov. Oxapampa.
Headwaters of Río Tunqui, trail to
Chuchurras-Palcazu.
75°28'W, 10°14'S.
Shrubby vegetation on ridge.
Alt. 1900 m.

Shrub, 3 m; flowers pale yellowish-

Robin Foster, M. Chanco, 2 Jan. 19
J. Alban & D.N. Smith 7747
MISSOURI BOTANICAL GARDEN HERBARI

Figure 1. *Macrocarpaea angustifolia* J. S. Pringle, *Foster et al. 7747* (holotype, MO).

R. Grant of l'Université de Neuchâtel, Switzerland, for discussions about *Macrocarpaea*, comments on the manuscript, and photocopies of the isotype. The type specimen of the name *M. angustifolia* was collected under the auspices of the Flora of Peru project, a collaborative effort of the Missouri Botanical Garden, the Universidad Nacional Mayor de San Marcos, and the Universidad Nacional de Amazonia Peruana. Fieldwork by Robin Foster et al. was supported by USAID. This is Contribution no. 88 from the Royal Botanical Gardens, Hamilton, Ontario.

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Pseudostellaria sierrae (Caryophyllaceae), a New Species from California

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ABSTRACT. *Pseudostellaria sierrae* is described as new from northern California. Glabrous stems and leaves, a V-shaped apical notch in each ligulate petal, five yellow anthers, and seeds with minute projections on each tubercle are features useful in distinguishing *P. sierrae* from *P. jamesiana* (Torrey) W. A. Weber & R. L. Hartman, the congener widely distributed in the western United States. *Pseudostellaria sierrae* is found in mixed oak or conifer forests.

Key words: California, Caryophyllaceae, North America, *Pseudostellaria*, Sierra Nevada, *Stellaria*, United States.

Pseudostellaria is a genus of 16 (Bittrich, 1993) to 20 species (Rabeler, pers. compilation), all but 3 of which are restricted to Asia (Afghanistan and Siberia east to Japan and Korea). Two additional species from Korea were recently described and effectively, but not validly, published (Lee, 1998). *Pseudostellaria europaea* Schaeftlein occurs in southeastern Europe, while two species, *P. jamesiana* (Torrey) W. A. Weber & R. L. Hartman and this novelty, are known in western North America. The chief feature distinguishing *Pseudostellaria* is the presence of thickened root sections, often as small tubers near the base of the stem (*P. jamesiana*, Weber & Hartman, 1979) or as tuberous, cigar-like, thickened roots arising periodically along the rhizome (*P. sierrae*, Fig. 1). While most species of the genus have both chasmogamous and cleistogamous flowers, the North American species lack the latter. *Pseudostellaria jamesiana* and *P. sierrae* share an unusual pattern of fruit dehiscence with the six valves usually rolling back 2 or 3 revolutions, forming a shallow dish (Fig. 1C; Weber & Hartman, 1979). This mechanism may insure the release of the 1 or 2 seeds that are quite large.

Pseudostellaria sierrae Rabeler & R. L. Hartman, sp. nov. TYPE: U.S.A. California: Plumas Co., in litter under *Pinus lambertiana*, mixed oak-pine-fir forest, 150 ft. S of FS road 26N49Y, 0.9 mi. E of Plumas Co. 204 (Dixie Canyon Rd.), 1.95 mi. N of California 89, W of Crescent Mills, 40°06′24″N, 120°55′45″W, T26N, R9E, sec. 14, SE ¼, ca. 1456 m, 14 June 1997, *R. K. Rabeler 1290* [with B. Ertter, T. Morosco, J. Shevock] (holotype, MICH; isotypes, GH, MO, RM, RSA, UC). Figure 1.

Herbae perennis omnino glabra; radices verticales carnosi rhizomatibus. Folia lanceolata ad elliptica marginibus integris tenuiter scariosis. Flores perfecti actinomorphi 1–3 per caulem vel ramum; sepala lanceolata ad anguste ovata marginibus scariosis; petala 5, ligulata apice inciso V-formo; stamina 5, antherae flava; styli 3 distincti, stigmatibus quasi terminalibus. Capsule ovoidea, valvis 6 pauxillum recurvis ad arcte 2- vel 3-plo revolutis; semina 1 vel fortasse 2 brunneola circularia ad oblonga lateraliter complanata tuberculata aliquot tuberculis 6–12 verrucis rubris minutis; verrucae saepe 5–8 projecturis conicis minutis; radicula prominens.

Perennial, glabrous herb 9–27 cm tall, with stems arising singly, at varying intervals along rhizome. Roots vertical or nearly so, 5–15 cm long, ca. 0.3 mm thick near point of attachment to rhizome, enlarging to 2–3 mm thick below, fleshy; rhizomes white to tan, 0.5–2 mm diam., shiny, usually with 1 to several scaly buds at the nodes. Stems simple or branched, rounded, obtusely angled or grooved when pressed, internodes 1–4 cm long or more below, often 0.3–1 mm long in upper ⅓–½, axillary branches 1 to 3(7), 1–5(9.5) cm long. Leaves opposite, exstipulate, the lowest 2 to 6 and those of the rhizome rudimentary, connate for 0.5–1.5 mm, 3–8 mm long, the primary leaves in 5 to 10 pairs on main stem with bases weakly fused, those of the upper stem and especially branches generally much more closely spaced, narrowly lanceolate or elliptic, 0.7–3.5 cm long, 1–5(8) mm

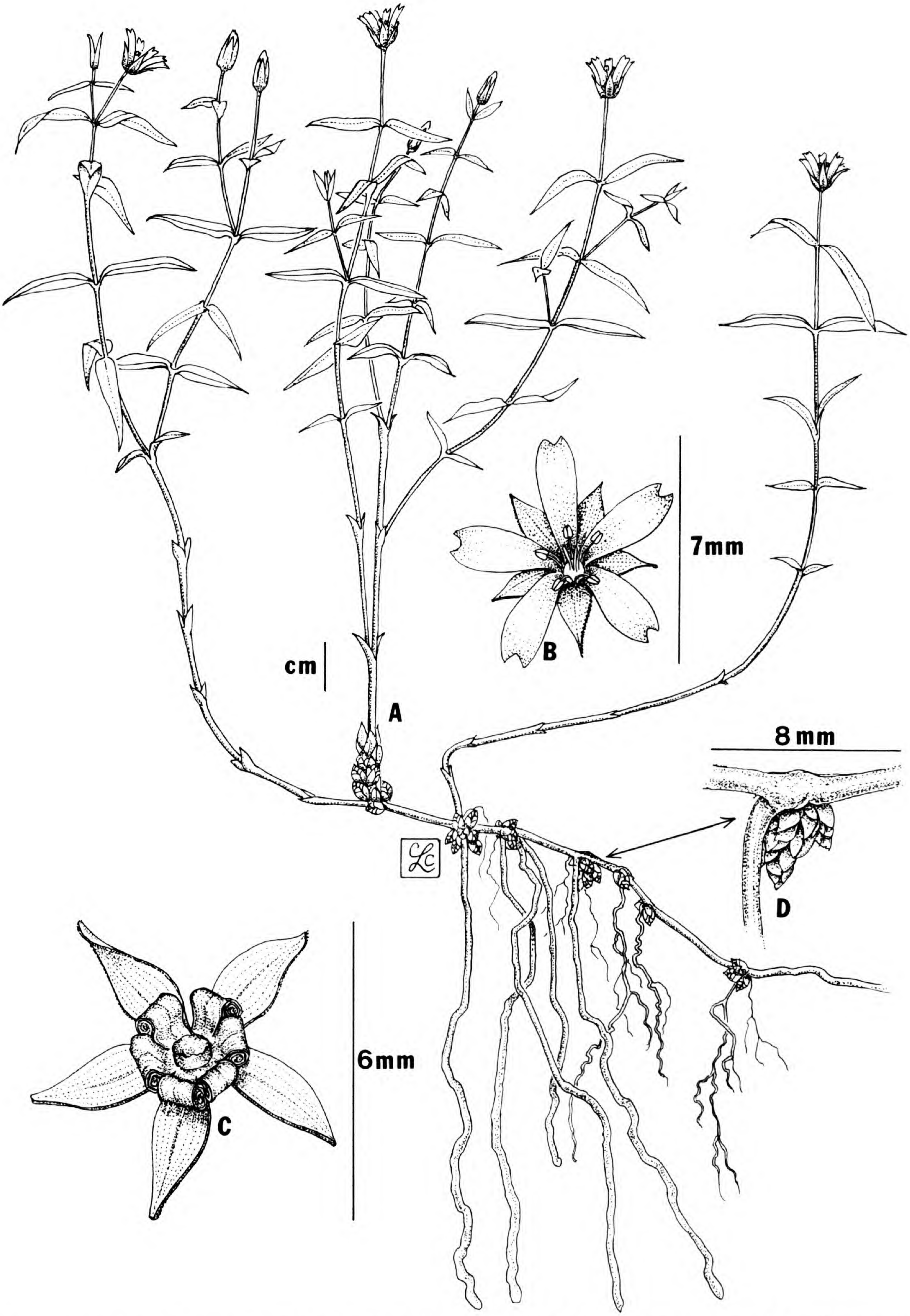

Figure 1. *Pseudostellaria sierrae* Rabeler & R. L. Hartman. —A. Habit. —B. Flower. —C. Dehisced fruit with subtending sepals. —D. Rhizome segment with buds and root at node. (From holotype, *Rabeler 1290*, MICH.)

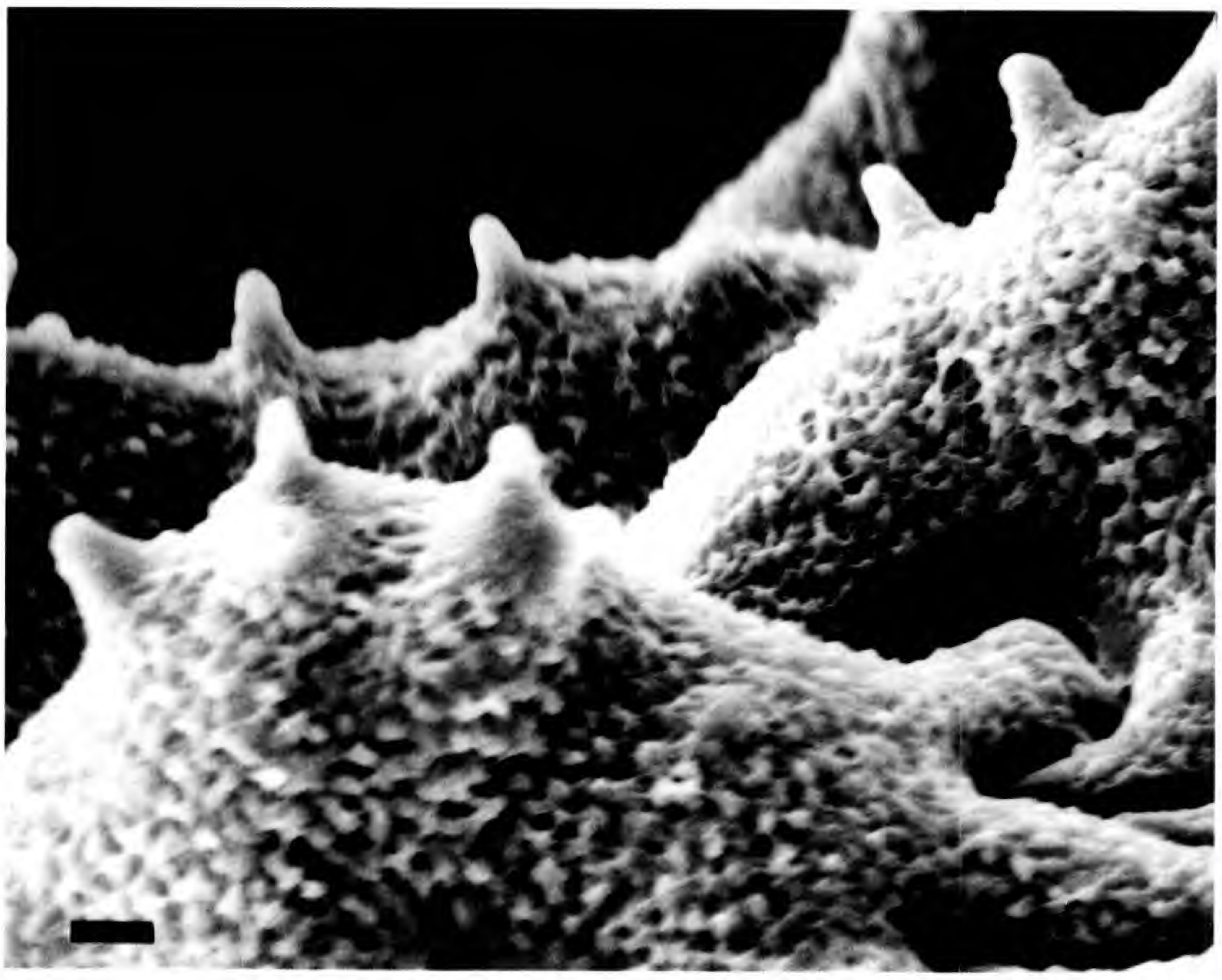

Figure 2. Scanning electron micrograph of seed of *Pseudostellaria sierrae* (*Hartman 58546*, RM) showing the minute projections on each tubercle. Scale line represents 10 μm.

wide, lower surface of blade finely reticulate, pustulate (30× magnification), margin entire, thinly scarious. Flowers perfect, chasmogamous, regular, solitary, terminal and axillary on main stem and often 1 or 2 (to 6) axillary branches, sometimes abortive; sepals lanceolate to narrowly ovate, 4–6.5 mm long, to 7 mm in fruit, shiny, glabrous, margins scarious, with midvein and 4 to 6 weaker veins arising from base, apex acute or acuminate; petals 5, white, ligulate, 5–8(9) × 1–1.5 mm, apex with a V-shaped notch 0.2–0.7 mm deep; stamens 5, each with a circular, thickened, basal gland 2–2.5 times the filament width, anthers yellow, 0.6–0.7 mm long; styles 3, distinct, 2–3.5 mm long, stigma terminal, 0.1–0.2 mm long; ovary 3-carpellate; ovules 3 to 6, most abortive. Capsule ovoid, 4–4.5 mm long, valves 6, dehiscing by recurving somewhat to rolling back tightly 2 or 3 revolutions or for ⅔ of length with the lower portions forming a shallow dish, exposing the basal placenta, a broad, irregular column 0.5–1 mm tall. Seeds 1, possibly 2, light brown, 3–3.4 mm long, circular to somewhat oblong, flattened laterally, radicle prominent, mature seeds with most tubercles broadly conical to elongate, rounded, interdigitating, each with 6 to 12 minute red bumps that develop into 5 to 8 conical projections ca. 0.02 mm long (50× magnification).

Pseudostellaria sierrae exhibits two features that make placement within the most recent infrageneric classification (Mizushima, 1965) problematic. First, 5 rather than (8) 10 stamens appears to be unique in the genus. Mizushima (1965) divided *Pseudostellaria* into two sections on the basis of seed tubercle ornamentation. In section *Pseudostellaria*, including only *P. rupestris* (Turczaninow) Pax, the seed tubercles each end in an apically barbed glochid, while in section *Mamillatae* (Ohwi) M. Mizushima the seed tubercles end in a single deciduous spinule. Second, the minute conical projections from the end of each tubercle in *P. sierrae* may be an intermediate condition (Fig. 2).

The paratypes cited below include all other collections we have found. Habitat information suggests *P. sierrae* to be a plant of the woodland floor, either in mixed oak-pine or fir forests, at 1250–1970 m elevation. At both sites we visited, the ground cover was sparse and mostly consisted of *P. sierrae*. All collections occur in the Northern High Sierra Nevada subregion of the California Floristic Province (Hickman, 1993), the eight localities spanning a latitudinal range of 285 km (Fig. 3).

Pseudostellaria sierrae may be more common than suggested by the few collections cited. In describing his efforts to locate *P. sierrae*, Lowell Ahart (pers. comm.), an experienced amateur familiar with the Bowman Lake area, stated: "Both sides of the road under Red Firs [*Abies magnifica* A. Murray bis] are massive stands of *Pseudostellaria*." Given the similarity of the range of these taxa (see Hickman, 1993, and Map 8W in Little, 1971), we suspect additional fieldwork may show *P. sierrae* occupying a somewhat larger area.

Botanists have collected *P. sierrae* occasionally

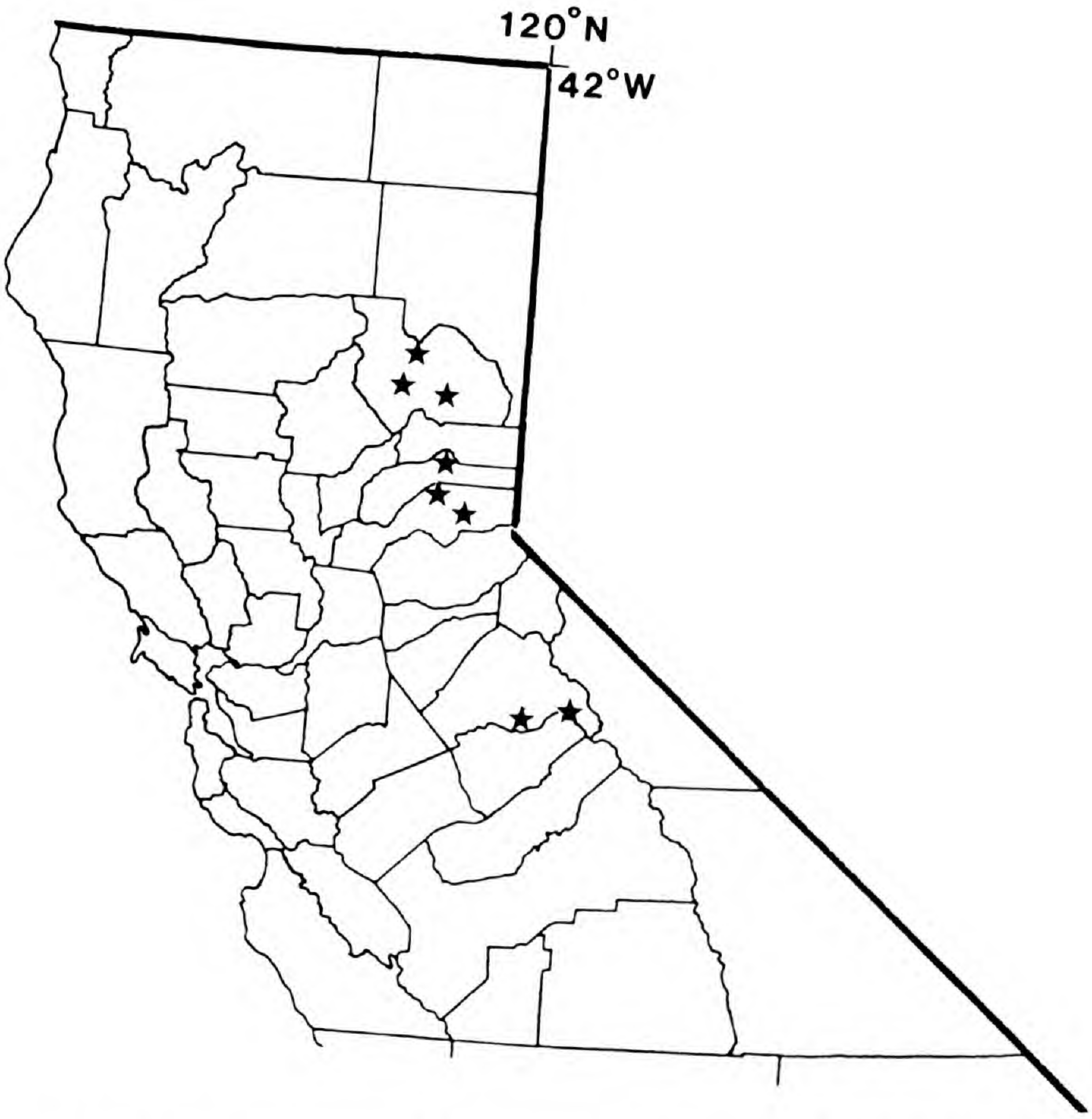

Figure 3. Distribution of *Pseudostellaria sierrae*. Area shown is the northern two-thirds of California.

since 1878. The most widely distributed collection prior to our own collections, *M. E. Jones 3287*, introduced each of the authors independently to this species. Rabeler first noticed *P. sierrae* when he received seven specimens of *Jones 3287* among the loans requested for his dissertation research on the *Stellaria calycantha* (Ledebour) Bongard complex (Rabeler, 1986). Although they were clearly not *Stellaria crispa* Chamisso & Schlechtendal, Rabeler was not able to identify them beyond "cf. *Pseudostellaria*?" in 1986. Hartman was introduced to *Pseudostellaria sierrae* via the UC specimen of *Jones 3287*. When the UC loan to Rabeler was returned in late 1986, Hartman was working on the Caryophyllaceae treatment for the *Jepson Manual* (Hartman, 1993). The UC specimen of *Jones 3287* that Rabeler had annotated as "cf. *Pseudostellaria*" caught Hartman's eye as well as the following curatorial note: "*Pseudostellaria* is from Asia. File in Caryophyllaceae indet." Hartman also was unable to place it in an existing taxon.

With the exception of *Jones 3287*, all of the collections of *P. sierrae* identified to species we have seen have been either misidentified as *Stellaria jamesiana* Torrey (≡ *P. jamesiana*) or *Arenaria macrophylla* Hooker (≡ *Moehringia macrophylla* (Hooker) Fenzl) or identified only to one of these genera (see Hartman, 1993, for generic delimitations). The only evidence that we have seen of previous recognition of this species as new was from the USFS (at RM) sheet of Bolt's 1934 collection from Tadpole Spring. Identifying it as "*Moehringia*?", M. L. Bombard had penciled a series of notes on the sheet in 1939 ending with "possibly a new species." While all three taxa can be found in Sierran coniferous forests, they can be easily separated by the characters given in the following key.

KEY TO *PSEUDOSTELLARIA SIERRAE* AND SPECIES WITH WHICH IT HAS BEEN CONFUSED

1a. Plants glabrous throughout; flowers solitary, mostly terminal; stamens 5 *Pseudostellaria sierrae*
1b. Plants either with dense glandular hairs (especially above) or peg-like hairs; flowers in cymes; stamens 10.
  2a. Plants with dense glandular hairs (sometimes glabrous below); inflorescence bracts large, leafy; petals shallowly notched . . . . *Pseudostellaria jamesiana*
  2b. Plants with short, peg-like hairs; inflorescence bracts tiny, scarious; petals entire . . . . *Moehringia macrophylla*

Paratypes. U.S.A. **California:** Nevada Co., Truckee, May 1878, *J. P. Moore s.n.* (CAS); dry soil, shaded slopes below sphagnum bog, Fall Creek, just E of Lake Bowman Road, ca. 5 mi. N of Yuba Gap, 14 July 1965, *G. H. True 2257* [with J. T. Howell] (CAS, MICH, NY); in yellow pine forest, dry rocky slope on mountain near dirt road and dry flat S of cement dam across Fall Creek, ca. ¼ mi. E of Bowman Lake Road, T17N, R12E, NW ¼ of sec. 6, 5600 ft., 10 Aug. 2000, *L. Ahart 8650* (BRIT, CDA, CHSC, DAV, ID, JEPS, MICH, MSC, RM, UC, V); Placer Co., Emigrant Gap, 28 June 1882, *M. E. Jones 3287* (CAS, MO, MSC, NY, POM, UC, US); timberland-chaparral, 1 mi. N of Tadpole Spring, T15N, R13E, sec. 5, 6500 ft., 19 July 1934, *B. Bolt s.n.* (USFS at RM) but *B. Bolt 146* (UC); under sparse canopy of *Abies magnifica*, especially common in shaded areas or along large logs in the drip zone, often forming a monoculture, near campsite, ca. 200 yards from Foresthill Road, 2–2.5 road mi. W from Sailor Flat trail turn-off, T15N, R13E, sec. 5, ca. 6500 ft., 11 July 1997, *R. L. Hartman 58546* (BRY, CAS, COLO, MICH, NY, RM, US); Plumas Co., rocky hillside, Grizzly Ridge, 6500 ft., 29 June 1919, *W. W. Wagner s.n.* (DS); forest of mixed conifer, oak, maple, E side of mountain above Crescent Mills, E of Round Valley Reservoir, T26N, R9E, sec. 23, ca. 4500 ft., 14 May 1990, *B. Ertter 8984* [with G. Schoolcraft] (OSC, RM); shaded slopes in coniferous forest surrounding Snake Lake, 39°58′N, 120°59′W, 1250 m, 30 May 1993, *G. F. Hrusa 11139 & E. Sandoval* (CDA, JEPS); Tuolumne Co., Tioga Road, 6 June 1951, *H. & M. Dearing 6923* (SBBG); Gin Flat near Yosemite Valley, June 1964, *M. Ackley s.n.* (CAS).

Acknowledgments. We thank David J. Keil for assistance with the Latin description; Barbara Ertter (UC) for hospitality and logistics support in arranging the expedition for Rabeler to collect the type; James R. Shevock and Kathy Van Zuuk (U.S. Forest Service) for arranging appropriate permitting for Rabeler and Hartman, respectively; Larry Janeway (CHSC) for introducing the plant to Lowell Ahart and for forwarding his collection and correspondence to MICH; Greg Brown for assistance with the SEM photo; and Carolyn Crawford for the illustration. We also thank the curators of CAS, MO, RSA/POM, SBBG, and UC/JEPS for hospitality during visits by Rabeler and/or Hartman and CAS, CHSC, DAV, F, GH, HSC, MO, MSC, NSMC, NY, RENO, RSA/POM, SBBG, UC/JEPS, and US for loans to MICH (all) or RM (UC) for this study.

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Eriogonum diatomaceum (Polygonaceae: Eriogonoideae), a New Species from Western Nevada, U.S.A.

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ABSTRACT. A new species of *Eriogonum* subg. *Eucycla* (Polygonaceae, Eriogonoideae), *E. diatomaceum*, is described from the Pine Nut Range, Lyon County, Nevada, U.S.A. It is an edaphic endemic species restricted to chalky, diatomaceous outcrops of the Coal Valley Formation in Churchill Narrows south of Fort Churchill State Park. The new species is outwardly similar to the Great Plains species *E. pauciflorum* (sect. *Capitata*), but is more closely related to *E. ochrocephalum* and its relatives. *Eriogonum diatomaceum* may be distinguished by its sheathing, elliptic, densely gray-tomentose leaves, erect scapose and white-tinged tomentose flowering stems, capitate inflorescences, glabrous and creamy white flowers, and glabrous achenes.

Key words: Eriogonoideae, *Eriogonum*, Nevada, Polygonaceae, U.S.A.

Picciani and Reynolds first found *Eriogonum diatomaceum* (Polygonaceae Jussieu; Eriogonoideae Arnott) in June 1997 near Churchill Narrows in the Pine Nut Range of Lyon County, Nevada. The material was identified subsequently as an undescribed species by Reveal during a workshop session on wild buckwheats sponsored by the Jepson Herbarium in July 1997.

Eriogonum diatomaceum Reveal, J. Reynolds & Picciani, sp. nov. TYPE: U.S.A. Nevada: Lyon Co., 2.6 mi. (1.5 air mi.) SSW of Churchill (abandoned historic site along the railroad), 0.6 air mi. SW of Mill Canyon Creek crossing along the dirt road into Churchill Narrows, on barren slopes associated with *Atriplex*, T16N, R24E, sec. 21 SE¼ of the NE¼ (N39°14′30″, W119°17′15″), 4425 ft. elev., 29 June 2001, *J. L. Reveal 8306* (holotype, US; isotypes, BRY, GH, K, MARY, MO, NY, RENO, UC, US, UTC). Figure 1.

Ab *E. ochrocephalo* floribus albis et ab *E. anemophilo* foliis caulibus vaginantibus differt.

Low, matted, herbaceous perennials with a branched, woody caudex forming a loosely branched mat 0.5–2.5 dm across, arising from a stout woody taproot; *leaves* sheathing up the stems for (1.5)2–4 cm with the lower stems densely white-tinged tomentose among the petiole bases and persistent leaves, the leaf blade elliptic, (0.5)0.8–2(2.3) × (0.3)0.5–1.2(1.8) cm, equally densely grayish tomentose on both surfaces, the margins entire and plane, the apex broadly acute, the base cuneate, the petiole slender, (0.3)0.5–1.5(1.8) cm long, tomentose, the petiole base elongate-triangular to triangular, 3–5 × 2–4 mm, densely white-tomentose abaxially, glabrous adaxially except for a band of long hairs across the base; *flowering stems* scapose, erect, (0.4)0.5–1.5(2) dm long, white-tinged tomentose; *inflorescences* capitate, the heads 1–1.5 cm across; *bracts* scale-like, 3 to 8, elongate-triangular to triangular, 1–3 × 0.7–1.2 mm, white tomentose abaxially, green and essentially glabrous adaxially except for the thinly tomentose margins and sparsely tomentose apices, slightly acute basally; *peduncles* lacking; *involucres* congested, 5 to 10 per head, turbinate, rigid, (2.5)3–4.5 × 2–3 mm, tomentose abaxially, glabrous adaxially, the 5 to 7 acute teeth 0.6–1 mm long, the bractlets linear, 3–4 mm long, minutely fringed with minute gland-tipped cells, the pedicel 3–5 mm long, glabrous; *flowers* numerous, creamy white with green-tan (in anthesis) to red-tinged (in fruit) bases and midribs, becoming rose-red in late fruit, (1.5)2.5–3 mm long, glabrous except for minute glands along the midribs adaxially, the tepals essentially similar, ovate-oblong, those of the inner whorl slightly narrower and

Figure 1. Habit of *Eriogonum diatomaceum* Reveal, J. Reynolds & Picciani. Photograph by J. L. Reveal.

more distinctly oblong than those of the outer whorl, united ⅓–½ their length with the fused basal portion distinctly pustulose in fruit; *stamens* exserted, 3–3.5 mm long, the filaments sparsely pilose basally, the anthers cream-white to pale yellow, 0.6–0.7 mm long, broadly oblong to ovate; *achenes* light brown, 2–2.5 mm long, glabrous, the subglobose base tapering to a long, 3-angled beak.

Etymology. From *diatoma* NL (New Latin), diatom, and by extension *diatomacea* NL for diatomaceous earth, as to the substrate on which the plant is restricted. Both words are derived from the Greek *diatomos*, cut in half.

Eriogonum diatomaceum is known from a single population on low hills south and southwest of Churchill, Lyon Co., Nevada. This single population encompasses 15 more or less distinct occurrences restricted to the northeastern portion of the Pine Nut Range. The population is scattered over approximately three square miles of Bureau of Land Management lands. Less than 50,000 individual plants are known (Reynolds, 2001).

The new species, informally called Churchill Narrows buckwheat, is restricted to diatomaceous soils of the Coal Valley Formation on relatively undisturbed dry barren exposed knolls and drainages on all aspects between 4300 and 4560 feet in elevation. The habitat supports a sparse vegetation cover dominated by Churchill Narrows buckwheat in association with shadscale (*Atriplex confertifolia* (Torrey & Frémont) S. Watson), princes plume (*Stanleya pinnata* Nuttall var. *pinnata*), Bailey's greasewood (*Sarcobates baileyi* Coville), and budsage (*Picrothamnus desertorum* Nuttall) and other species such as *Kochia americana* S. Watson, *Tetradymia glabrata* Torrey & A. Gray, *Psathyrotes annua* (Nuttall) A. Gray, *Eriogonum deflexum* Torrey var. *nevadense* Reveal and *E. lemmonii* S. Watson.

The Coal Valley Formation is a fluviolacustrine deposit of soft lake beds, sandstone, conglomerate, and sedimentary breccia. Andesite and andesitic sediments are commonly imbedded. The formation contains a unique fossil flora of aquatic plants and mammalian remains (Berry, 1927). The deposit is part of the series of Tertiary diatomites that filled the subsidiary basins within the Basin and Range extensional tetonic system of Nevada. The known aerial extent of outcrop where the Churchill Narrows buckwheat is found includes approximately 150 acres of variable thickness (8 to 30 feet) (Carpenter, 1997). The volcanic sedimentary rock associated with this formation is generally described as late Miocene to early Pliocene in age, and consists of stream and lake deposits of silty shale, diatomaceous shale, pebbly conglomerate, siltstone, and sandstone. The major components are fossil diatoms (amorphous silica), calcium montmorillonite, feldspar, and gypsum.

The new species was found during an impact survey for the Bureau of Land Management prior to granting a mining lease. If mining were permitted, *Eriogonum diatomaceum* instantly would be endangered. Even if the area is not mined, current off-road vehicle activity in the region is sufficient to threaten the long-term survival of the species. Current consultation between the Bureau of Land Management and the State of Nevada (which already considers the taxon to be a "sensitive plant") may mean that a formal proposal for federal protection may not be necessary. Nonetheless, monitoring will be necessary to assure the species' long-term survival.

Eriogonum diatomaceum is a member of the subgenus *Eucycla* (Nuttall) Kuntze. The new species is outwardly similar to the Great Plains species, *E. pauciflorum* Pursh, and especially the densely tomentose, more compact phase, variety *gnaphaloides* (Bentham) Reveal of southeastern Wyoming and adjacent western Nebraska. The similarity of the sheathing leaves is particularly striking. These leaves, plus the long scapose, tomentose flowering stems, capitate inflorescences, and creamy white flowers add to the impression. Nonetheless, *E. diatomaceum* is more closely allied to *E. ochrocephalum* S. Watson and its numerous relatives common to the Great Basin of Nevada and adjacent states. Also outwardly similar to the new species in general appearance are *E. loganum* A. Nelson, a narrow endemic of northern Utah, and *E. brandegei* Rydberg of Colorado. Both belong to the *E. brevicaule* Nuttall complex and as such are unrelated.

The new species is allied to those species of the *Eriogonum ochrocephalum* complex that may be characterized as matted perennials with scapose stems and capitate inflorescences, and specifically with those that have a rigid, usually turbinate involucral tube. The majority of these eight species have bright yellow flowers and generally glabrous and/or glandular flowering stems. Of the various entities found in western Nevada, *E. ochrocephalum* var. *alexandrae* Reveal has tomentose stems, and both *E. anemophilum* Greene and *E. tiehmii* Reveal have creamy white flowers. None of these species have sheathing leaves. The long scapose flowering stem of *E. diatomaceum* rivals the lengths observed in *E. ochrocephalum* var. *sceptrum* Reveal of southwestern Idaho, and the two share the long, narrow, turbinate involucre. From all of these species, the new species also may be readily distinguished by the dense, essentially lanate tomentum of the leaves, which is evenly distributed on both surfaces. The remaining 12 species of the *E. ochrocephalum* complex have membranaceous rather than rigid involucres.

In Reveal's (1985) key to Nevada wild buckwheats, the new species may be keyed as follows:

20(16). Involucres 2–2.5 mm long, floccose without; leaf blades broadly elliptic to obovate or suborbicular; flowers glabrous; Eureka, Lander, Pershing, and southwestern Humboldt Cos. . . . . 14. *E. anemophilum*

— Involucres (2.5)3–4.5 mm long, densely tomentose or sparsely floccose without; leaf blades elliptic to oblong; flowers glabrous or sparsely glandular 20a

20a(20). Flowers glabrous; leaves sheathing up the stems (1.5)2–4 cm; involucres turbinate, 2–3 mm wide, the teeth 0.6–1 mm long; Lyon Co. . . . . 14a. *E. diatomaceum*

— Flowers sparsely glandular; leaves strictly basal; involucres turbinate-campanulate, 3–4 mm wide, the teeth 1.5–2 mm long; Esmeralda Co. . . . . 15. *E. tiehmii*

Paratypes. U.S.A. **Nevada:** Lyon County, S end of Churchill Narrows, 1.5 air mi. S of Churchill, T16N, R24E, sec. 22, 4275 ft. elev., *Picciani 1* (K, MARY, NY, RENO, UC, US); 2 air mi. W of Churchill Narrows, 2 air mi. SSW of Churchill, T16N, R24E, sec. 21, 4480 ft. elev., *Picciani 2* (BRY, GH, K, MARY, MO, NY, RENO, UC, US).

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A New Species of *Oxalis* (Oxalidaceae) from El Salvador

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ABSTRACT. *Oxalis salvadorensis*, a new species from the mixed lowland forests of western El Salvador, is described. An illustration is provided, and the differences between this and other morphologically similar Mesoamerican species of *Oxalis* are discussed.

Key words: El Salvador, Mesoamerica, Oxalidaceae, *Oxalis*.

The genus *Oxalis* L. consists of around 500–800 species, mainly herbs, often with underground bulbs or tubers, distributed worldwide. Current estimates of the number of species of *Oxalis* cover a large range and highlight the need for research on species delimitation and relationships in this group. In his comprehensive treatment of the family Oxalidaceae, Knuth (1930) recognized 7 genera in the family, of which *Oxalis* was by far the largest with 791 species. In his subgeneric classification, Knuth divided *Oxalis* into 37 sections, based principally on habit and leaf characters; his treatment is the only worldwide subgeneric classification of the genus. Since publication of Knuth's work, research on *Oxalis* has largely consisted of traditional taxonomic revisions of Knuth's sections (for example, Eiten, 1963; Denton, 1973; Lourteig, 1975, 1979). More recently, Lourteig (1994, 1995, 2000) has revised the American species of the genus and has provided a comprehensive new subgeneric and sectional classification.

While preparing a treatment of Oxalidaceae for *Flora Mesoamericana*, a new species, herein described as *Oxalis salvadorensis*, was found.

Oxalis salvadorensis Sidwell, sp. nov. TYPE: El Salvador. Ahuachapán: P.N. El Imposible, San Benito al N del pie del bajadero de los escobos, 13°49′N, 89°56′W, 19 June 1992, *E. Sandoval & F. Chinchilla 453* (holotype, LAGU; isotypes, B, F, MO). Figure 1.

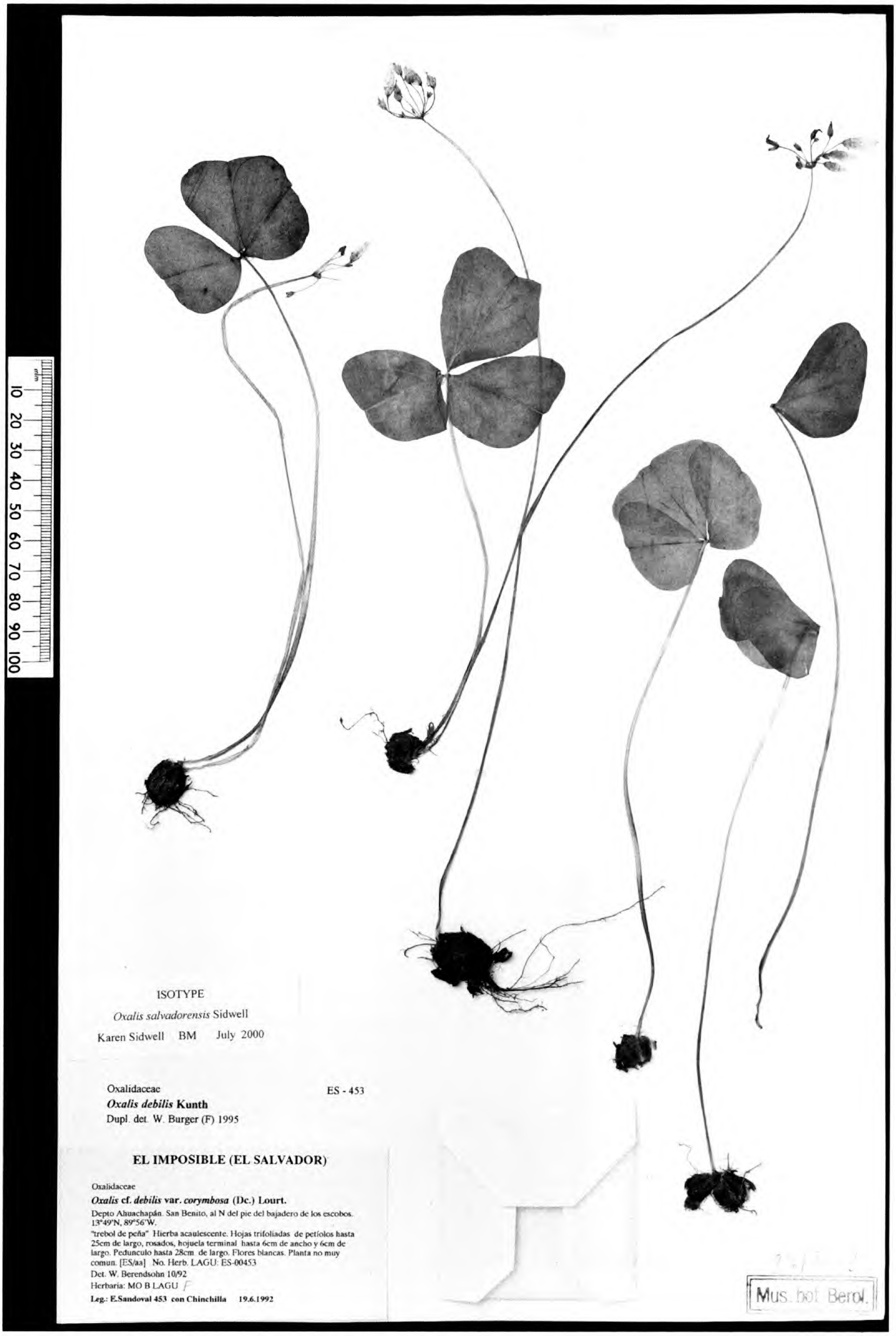
Herba acaulis scaposa bulbo squamoso; foliola terminalia symmetrica obcordata sinu non profundo; foliola lateralia asymmetrica basiscopo reducto; flores albi; semina lateraliter longitudinaliterque pocata.

Stemless herb, 25–50 cm; bulbs ca. 20 × 20 mm; bulb scales 2–15 × 2.4–22 mm, linear to narrowly triangular, with 1–3 veins converging just short of apex, drying reddish brown, membranous at edges, the margins ciliate. Leaves basal, 1–5 per plant, palmate; petioles 8–32 cm, sparsely pubescent with simple, slender, transparent trichomes 2–5 mm long; leaflets 3, unequal, glabrous, or sparsely pubescent with slender trichomes like those of the petiole, the lamina minutely pitted, especially below; terminal leaflet 30–53(–80) × 32–48(–64) mm, obcordate, symmetrical, the base acute, the apex with rounded lobes 21–35(–66) mm apart, and a shallow sinus 2–5 mm; lateral leaflets 23–35(–62) × 30–40(–100) mm, obcordate, asymmetrical, more elongate acroscopically, the sinus 1–3 mm. Inflorescences umbelliform, with 4–11 flowers; peduncles 11–27 cm; bracts 1.5–2.5 × 0.4–0.6 mm, triangular to narrowly triangular, the apex acute, with scattered oxalate deposits. Pedicels 8–12(–14) mm, glabrous; sepals to 2.5–3 × 0.7–1 mm, linear, the apex obtuse to slightly rounded, with oxalate deposits appearing as scattered orange dots, the margins sparsely ciliate with ciliae ca. 0.5 mm long; petals 8–11 × 3.5–4 mm, white; filaments in two whorls, one whorl ca. 2.5 mm, the other 4–5.5 mm; anthers globose, ca. 0.75 mm long; styles 5, 0.5–0.8 mm or 2.5–3 mm, pubescent, the plants distylous or semi-homostylous(?). Capsules 8–10 × 2–3 mm, ovoid, glabrous, pubescent at apex and on styles; seeds ca. 6 per locule, the surfaces appearing pitted due to the presence of both longitudinal and lateral ridges.

Distribution. Known only from mixed lowland forest in the El Imposible National Park in western El Salvador at ca. 700 m.

The species is easily distinguished from other stemless *Oxalis* species in Mesoamerica by the large, clearly asymmetric lateral leaflets with rounded lobes. *Oxalis salvadorensis* is morphologically similar to several other Mesoamerican species: *O. gregaria* (Rose) Knuth (W Mexico), *O. dimidiata* Donnell Smith (Guatemala), *O. debilis* Kunth (Guatemala to Peru), and the widespread and variable *O. latifolia* Kunth s.l. (see Table 1).

Heterostyly is important taxonomically in *Oxalis*,



ISOTYPE
Oxalis salvadorensis Sidwell
Karen Sidwell BM July 2000

Oxalidaceae ES - 453
Oxalis debilis **Kunth**
Dupl. det. W. Burger (F) 1995

EL IMPOSIBLE (EL SALVADOR)

Oxalidaceae
***Oxalis* cf. *debilis* var. *corymbosa* (Dc.) Lourt.**
Depto Ahuachapán. San Benito, al N del pie del bajadero de los escobos. 13°49'N, 89°56'W.
"trebol de peña" Hierba acaulescente. Hojas trifoliadas de petíolos hasta 25cm de largo, rosados, hojuela terminal hasta 6cm de ancho y 6cm de largo. Peduncúlo hasta 28cm de largo. Flores blancas. Planta no muy comun. [ES/aa] No. Herb. LAGU: ES-00453
Det. W. Berendsohn 10/92
Herbaria: MO B LAGU F
Leg.: E.Sandoval 453 con Chinchilla 19.6.1992

Figure 1. *Oxalis salvadorensis* K. Sidwell. Photograph of the isotype at B.

Table 1. Key differences between *Oxalis salvadorensis* and other similar Mesoamerican and Mexican *Oxalis* species (sect. *Oxalis* subsect. *Dimidiatae* (Knuth) Lourteig and sect. *Ionoxalis* (Small) Knuth). The oxalate deposits at the sepal tips are referred to as "calli" by Lourteig (2000) and Burger (1991).

	Oxalis salvadorensis	*Oxalis dimidiata*	*Oxalis gregaria*	*Oxalis debilis*	*Oxalis latifolia* s.l.
Sectional membership according to Lourteig (2000)		Section *Oxalis* subsect. *Dimidiatae* (Knuth) Lourteig	Section *Ionoxalis* (Small) Knuth	Section *Ionoxalis* (Small) Knuth	Section *Ionoxalis* (Small) Knuth
Elevation	700 m	1200–1450 m	20–1900 m, mossy cliffs	0–1400 m	800–3050 m
Growth form	bulb	scaly rhizome	bulb	bulb	bulb
Leaflet shape and sinus	rounded, shallow	angular, shallow	rounded, deep	rounded, shallow	angular, deep
Lateral leaflet symmetry	asymmetric	asymmetric	asymmetric	symmetric	symmetric
Bracts	glabrous	pubescent	glabrous, margins sparsely ciliate	pubescent	glabrous, margins sparsely ciliate
Oxalate deposits at sepal tips	numerous orange dots	two paired orange "calli"	two paired orange "calli"	two paired orange "calli"	two paired orange "calli"
Flower color	white	lilac	pink	red or pink	lilac, rose, or white
Flower size	8–11 mm	12–13 mm	6–8 mm	8–21 mm	8–20 mm
Capsule length	8–10 mm	to 4 mm	2.5–5 mm	2–6 mm	4–8.5 mm

but it can be difficult to distinguish flower forms on herbarium sheets. Flowers are generally tristylous, distylous, or homostylous; all of these forms, except homostylous, have whorls of stamens of different lengths (see Denton, 1973). The flowers of *O. salvadorensis* appear to be distylous or semi-homostylous (sensu Denton, 1973, where one but not both of the stamen whorls equals the stigma length), but further observations with more specimens and more complete material are needed.

Based on the scapose habit and scaly bulbs, *Oxalis salvadorensis* belongs in *Oxalis* sect. *Ionoxalis* (Small) Knuth. In the recent monograph of *Oxalis* subg. *Oxalis* (Lourteig, 2000), *O. salvadorensis* would key out as belonging to section *Ionoxalis*, and within that section would key near to *O. cuatrescasasii* Lourteig from western Colombia (couplet "Fol. anchamente obcordados o subtriangulares, enteros"; Lourteig, 2000: 534). In the recently completed treatment of Oxalidaceae for *Flora de Nicaragua* (Sullivan, 2001), where *O. salvadorensis* might be expected to occur, it would key out in couplet 1 with *O. latifolia* and *O. debilis*, also members of section *Ionoxalis* (see Table 1). Denton (1973: 488) proposed a putative phylogenetic scheme of relationships for North American taxa in section *Ionoxalis*, in which *O. salvadorensis* might be placed close to her *O. gregaria*-*O. alpina* (Rose) Knuth group. A great deal more taxonomic and phylogenetic investigation is clearly required in these interesting and relatively poorly collected herbs.

Paratypes. EL SALVADOR. **Ahuachapán:** P.N. El Imposible, San Benito, 700 m, 13°49′N, 89°56′W, 9 July 1993, *E. Sandoval & F. Pérez 1344* (B, F, LAGU, MO), 28 May 1994, *F. Chinchilla & J. M. Chinchilla s.n.* (B), 23 June 1994, *F. Chinchilla s.n.* (MO).

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Conservation and Ecology of *Lilium pyrophilum*, a New Species of Liliaceae from the Sandhills Region of the Carolinas and Virginia, U.S.A.

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ABSTRACT. *Lilium pyrophilum* M. W. Skinner & Sorrie is a new taxon from the Sandhills region of the Atlantic Coastal Plain, where it is known from 16 counties in the Carolinas and adjacent Virginia. It occurs within the longleaf pine ecosystem in sandy, wet to dry ecotonal situations such as streamheads, seeps, swampy streams, and wet, maintained powerlines. *Lilium pyrophilum* is most closely allied to *L. superbum* but is allopatrically distributed and confined to a restricted habitat. Compared to *L. superbum* it blooms later, is smaller, has fewer and smaller flowers with slightly longer tubes, and it has shorter and relatively broader leaves that are ascending and concentrated in fewer whorls toward the bottom of the stem. Frequent fires are essential for habitat maintenance in natural settings, and thus the Latin epithet *pyrophilum* (= fire loving) is used for the new taxon. We suggest the common name Sandhills lily for this rare lily, and urge its fullest protection.

Key words: fire dependence, Liliaceae, *Lilium*, long-leaf pine ecosystem, North Carolina, South Carolina, U.S.A.,Virginia.

For some time botanists in the Sandhills region have known of the existence of an unusual and perhaps undescribed true lily. In their flora of the Carolinas, Radford et al. (1968) mentioned robust *Lilium michauxii* Poiret plants in bogs that resembled *Lilium superbum* L. It is these plants, previously masquerading in herbaria under both those names, that we describe here as *L. pyrophilum*.

Since its recognition as distinctive in the mid 1970s (Russo, 1997), the taxonomic identity of this new lily has been debated. As Radford et al. (1968) suggested, it is similar to the other pendent-flowered lilies in the region, *L. michauxii* and *L superbum*. However, regional botanists recognized that the turk's-cap lily (*L. superbum*) per se does not occur in the lower part of the Piedmont, which is the hilly region between the Appalachian Mountains and the inner Atlantic Coastal Plain of which the Sandhills are a part. The Carolina lily (*L. michauxii*) is quite recognizable by its compact bulb, striking obovate leaves, fragrant flowers, and drier habitat. Speculation therefore centered on a link between the unknown lily and *L. iridollae* M. G. Henry, a rare endemic lily from the Panhandle region of Florida and adjacent Alabama (Henry, 1946). Indeed, natural heritage programs recorded Carolina populations of *L. pyrophilum* as *L. iridollae* (e.g., North Carolina Natural Heritage Program, 1999), and early status reports commissioned because of *L. pyrophilum*'s rarity assumed the Carolina Sandhills lily populations represented a significant range extension for *L. iridollae*. This suggestion was well founded because both overall morphology and the baygall (*Magnolia*, *Ilex*), *Sarracenia* bog, and streamhead habitats of these two species are closely similar. Others (Moretz & Smith, 1995) suggested that the unknown lily had been previously described from Mississippi as *L. gazarubrum* M. K. Roane & J. N. Henry (1980). However, we have examined lilies from very near the type locality of *L. gazarubrum* in Choctaw County, Mississippi, and have also seen the type, and like Adams (1981), we conclude that *L. gazarubrum* can be accommodated within *L. superbum*. Extended field and herbarium study and unpublished morphometric analysis ultimately led us to determine that the lily described here is distinctive and new.

Lilium pyrophilum M. W. Skinner & Sorrie, sp. nov. TYPE: U.S.A. North Carolina: Moore Co., Highway 73 near Pinehurst, 149 m, 4 Aug. 1995 (fl), *M. W. Skinner 272* (holotype, GH; isotype, MO). Figures 1, 2.

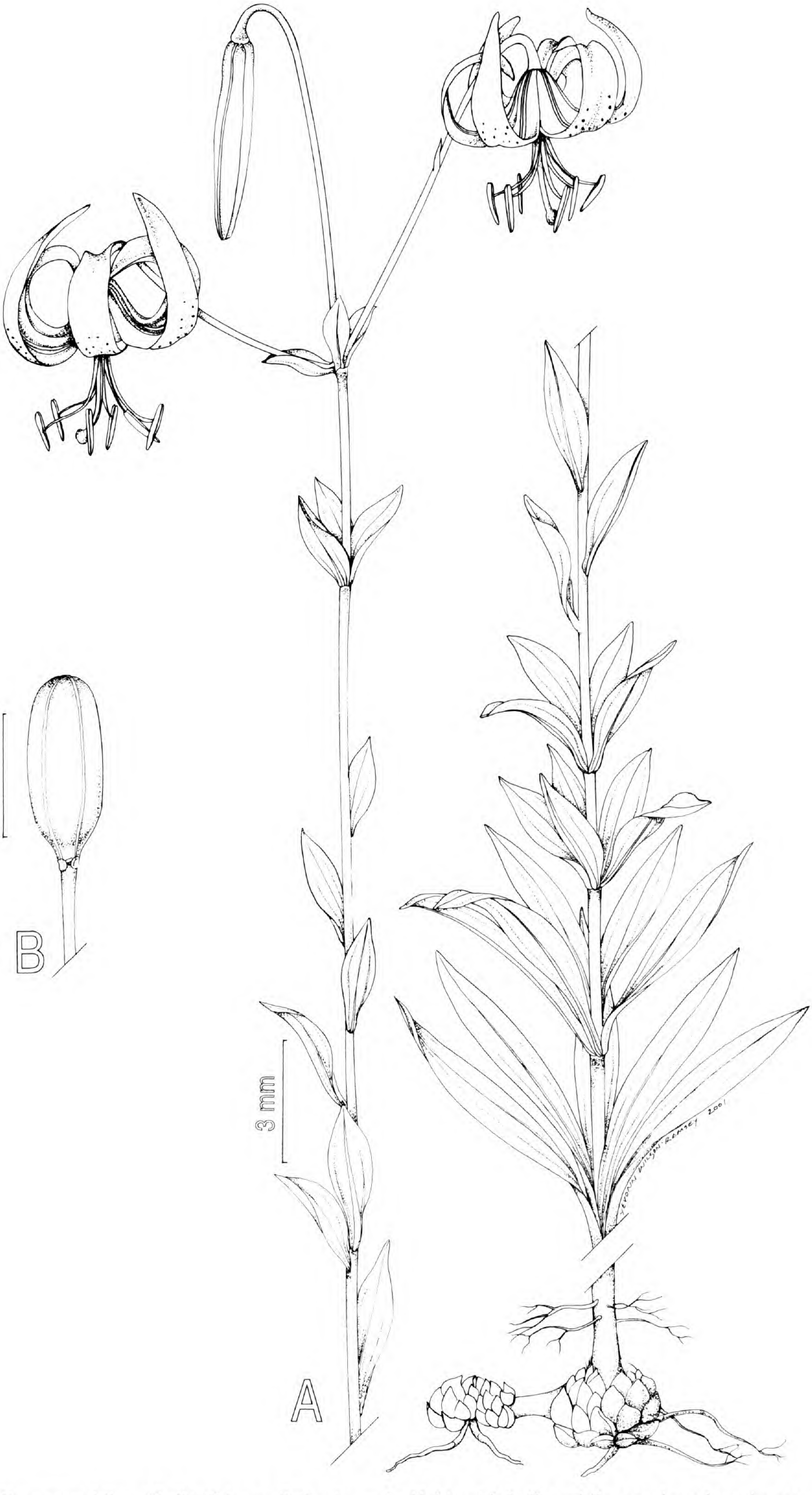

Figure 1. *Lilium pyrophilum* M. W. Skinner & Sorrie. —A. Habit with bulb and flowers, based on the type collection (*M. W. Skinner 272*) from Moore County, North Carolina. —B. Capsule before opening, from a B. A. Sorrie photograph taken at the type locality.

Figure 2. *Lilium pyrophilum*, photographs A–D by M. W. Skinner, E by B. A. Sorrie. —A. Habit of the type specimen (*M. W. Skinner 272*). —B. Habit. —C. Rhizome, the next year's bulb at left (*M. W. Skinner 267*). —D. Flower. —E. Fruiting stalk from the type locality. A, E from Moore County, North Carolina, B–D from Ft. Jackson, Richland County, South Carolina.

Haec species *Lilio superbo* L. arcte affinis, sed ab eo anthesi serotina, habitu multo minore, foliis brevioribus atque tubo florali longiore distinguitur; locos perculationis ortusque rivulorum saepe incensos habitat.

Bulb a slowly growing scaly rhizome, horizontal and elongate, 2.4–2.8 × 5.2–8.6 cm, 0.3–0.5 times taller than long, lacking scales between the 2–3 bulb units that represent annual growth, the young end sometimes dichotomously branched at 120° from main axis; scales (modified leaves) numerous, fleshy and starchy, unsegmented, longest 1.1–1.9 cm, white; roots on each bulb mostly contractile and thus thick (to 5 mm) and often concentrically wrinkled, a few thinner and fibrous. *Stems* to 1.6 m, erect, ± glabrous, green, adventitious roots (stem roots) above the bulb sometimes present. *Leaves* numerous, simple, exstipulate and sessile, the lower leaves scarcely ascending or ascending, drooping at tip or not, upper ascending and appressed, (scattered or) in 0–12 ± proximal whorls of 3 or more leaves, 3–11(–15) per whorl; blade narrowly elliptic, 2.3–10.3(–12.2) × 0.8–2.4 cm, 1.6–7.6(–10.3) times longer than broad, apex acute (scarcely acuminate on upper stem), margin entire, usually glabrous, not undulate, green and somewhat lighter below, the major veins 3, these glabrous below. *Inflorescences* terminal, racemose (umbellate in small plants) and open, maturing acropetally, 1–7-flowered; bracts generally 1–2 per flower, often one broadly lanceolate and basal to the pedicel, the other narrowly lanceolate, adaxial, and attached near the middle of the pedicel; pedicels 6.8–16.5 cm. *Flowers* bisexual, pendent, shaped as a "turk's-cap," radial (or slightly vertically bilateral as flower matures), not fragrant; tepals free, reflexed ⅕–¼ along length from base, red-orange or dusky red (magenta or pinkish, pale orange, red) apically to (pale) yellow (yellow-orange) centers to visibly green basally, magenta spots concentrated in proximal ½–⅔, sepals 3, ± lanceolate and narrowed at the base, 6.7–8.9 × 1.1–1.7 cm, glabrous, each with an adaxial nectar-bearing surface basally and with two sharp parallel longitudinal median ridges abaxially, apex usually acute; petals 3 and similar to the sepals, 6.3–8.7 × 1.5–2.2 cm, apex acute, the basal nectaries less extensive than those on the sepals, with two rounded longitudinal median ridges adaxially; stamens 6, free, opposite the perianth parts, quite exserted; filaments parallel at first then widely spreading at 12–28°, 4.5–5.9 cm; usually pale green; anthers versatile, oblong, 1.1–1.8 cm when fresh, magenta (purple), becoming darker; pollen rust-colored, becoming lighter; pistil 1, compound, 3-lobed with 3 chambers, oblong, 3.4–6.4 cm; ovary superior, 1.5–2.8 cm; axile placentae 6; ovules as many as seeds, a few developing without embryos; style 1, round in cross section, initially parallel to flower axis but generally elongating and curving toward periphery, pale green and often spotted purple; stigma 3-lobed. *Capsules* loculicidal, the valves 3, erect, ± oblong-obovate, with constricted base, not strongly winged, 2.8–4.7 × (1.3–)1.5–1.9 cm, 1.7–2.8 times longer than broad, green maturing brown. *Seeds* many, in 6 ranks, shape a flat 60° wedge, surface verrucose, light brown with darker ovate embryo in center.

Etymology. The epithet is from the Latin for "fire loving," and is employed here because of the very frequent fires that are essential to maintain proper habitats for *L. pyrophilum.* Because the species is restricted to the Sandhills of the Carolinas and adjacent Virginia we propose the vernacular name of Sandhills lily.

Phenology. Flowers in summer (late July–mid August); capsules mature in late October.

Distribution. The known range of *Lilium pyrophilum* extends from southeastern Virginia to south-central South Carolina, wholly within the Atlantic Coastal Plain. The great majority of populations occur within the Sandhills region, an area of rolling topography dissected by abundant blackwater streams. Although this physiographic region extends from the Carolinas to central Alabama, in terms of floristics and phytogeography the core area extends from Johnston County in east-central North Carolina to Richmond County in extreme east-central Georgia (Sorrie & Weakley, 2001). We have documented the lily from ten counties in North Carolina, four in South Carolina, and two in Virginia (Fig. 3), at elevations ranging from 25 to 150 m.

The Sandhills region is a significant area of speciation within the North American coastal plain (Sorrie & Weakley, 2001), and many endemics have been recognized there. The following are distributed exclusively within the core Sandhills region or have the majority of their populations there: *Astragalus michauxii* (Kuntze) F. J. Hermann, *Liatris cokeri* Pyne & Stucky, *Lycopus cokeri* Ahles ex Sorrie, *Physalis lanceolata* Michaux, *Pityopsis pinifolia* (Elliott) Nuttall, *Pyxidanthera barbulata* Michaux var. *brevifolia* (Wells) Ahles, *Stylisma pickeringii* (Torrey ex M. A. Curtis) A. Gray var. *pickeringii*, *Vaccinium crassifolium* Andréanszky subsp. *sempervirens* (Anderson & Rayner) Kirkman & Ballington. *Lycopus cokeri* is a very frequent associate of *Lilium pyrophilum*, whereas *Liatris cokeri*, *Physalis lanceolata*, and *Pityopsis pinifolia* occur on adjacent dry to xeric slopes.

Habitat: the physical setting. The Sandhills re-

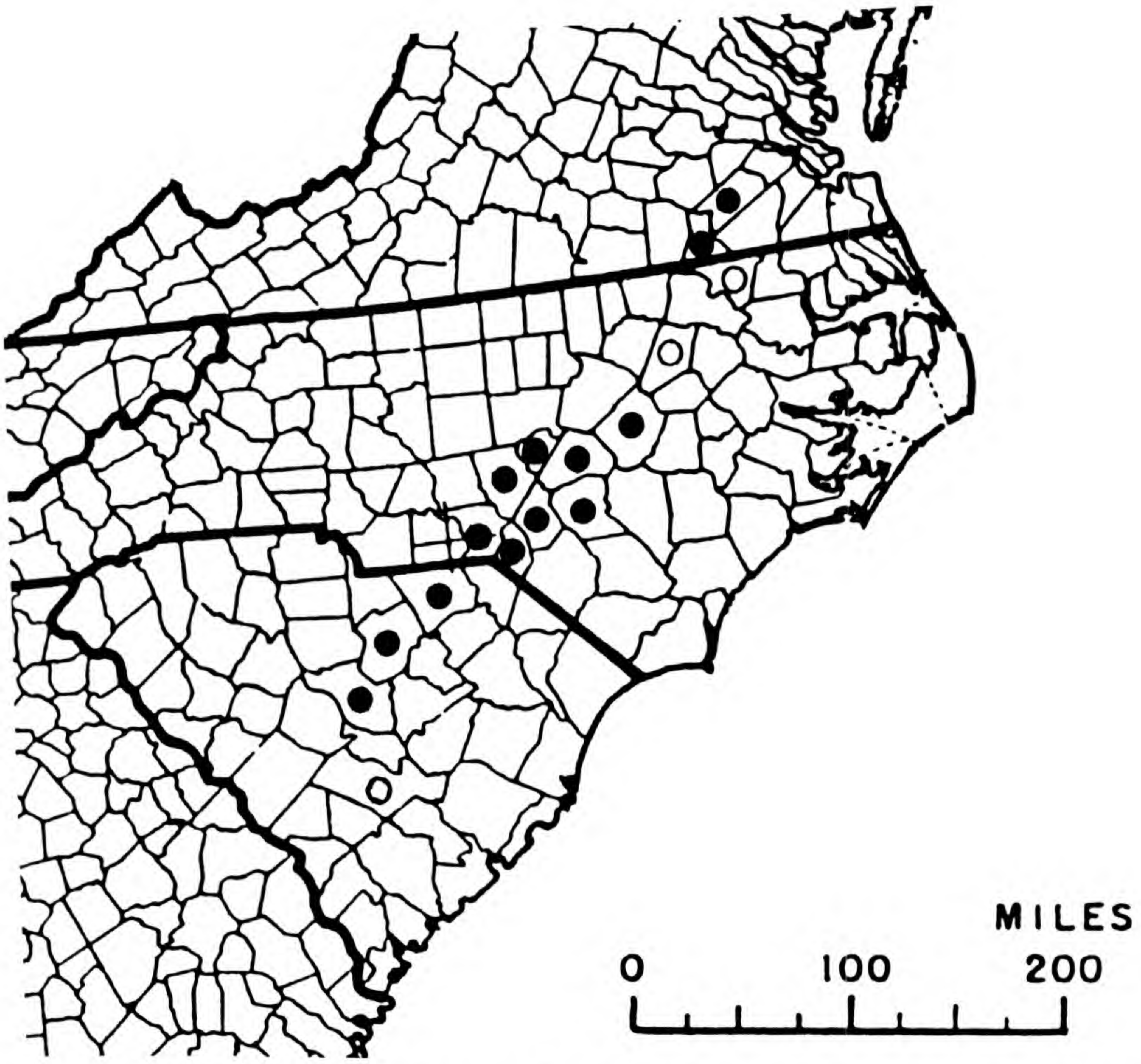

Figure 3. *Lilium pyrophilum* distribution in Virginia, North Carolina, and South Carolina. Solid circles represent counties with extant populations documented since 1990, open circles counties where the species is historical (pre-1990) and presumed extirpated.

gion (also known as the Fall-line Sandhills) constitutes the innermost portion of the coastal plain and abuts the Piedmont physiographic province. The fall-line is a distinct geological boundary separating the younger Cretaceous and Tertiary age sediments to the east and the older Paleozoic formations to the west (Fenneman, 1938). Parent materials of the Sandhills are unconsolidated to partly consolidated sands, gravels, and clays.

Compared with the rest of the coastal plain, topography in the Sandhills is highly varied, with elevations that range from 30 to 180 m above sea level. The term "rolling hills" is apt; although the region is highly dissected, there are few sharp geomorphic features. Rock outcrops are scarce. Drainage creeks are abundant; most lie 10–30 m below the surrounding hilltops and small plateaus, whereas larger streams and rivers lie significantly lower. A number of large rivers traverse the Sandhills from their origins in the Piedmont or mountains. All drainages that originate in the Sandhills are dark tea in color due to high tannin content and are termed blackwater streams.

Upland soils in the Sandhills are acidic well-drained sands and loamy sands; subsoils may be sandy throughout, or have a clayey or loamy layer. Soils of streamheads and creeks are finer loams and loamy sands; those along rivers contain considerable organic matter.

Habitat: plant communities. *Lilium pyrophilum* occurs almost exclusively in ecotonal situations within the longleaf pine (*Pinus palustris* Miller) ecosystem. It inhabits narrow transition zones—usually 2 to 10 m—between dry longleaf pine-oak-wiregrass uplands and wet, wooded creeks and streamheads. Upland communities (usually longleaf pine-oak-wiregrass with scattered low shrubs) quickly give way to a shrub-cane-fern-herb ecotone, in turn replaced by a tree-shrub-sphagnum streamhead with flowing water. Due to the hilly topography of the Sandhills region and myriad drainage creeks, ecotonal habitats once were abundant across the landscape, but widespread fire suppression and conversion of streamheads to fishing ponds, farm impoundments, swimming ponds, and water reservoirs have severely reduced these plant communities.

Ecologists usually ally ecotonal communities of the Sandhills region with the adjacent wetland communities based on the substantial percentage of shared species versus the much smaller percentage of species in common with adjacent uplands (Schafale & Weakley, 1990). Indeed, there is a mix of upland and wetland plants, but Sandhills ecotones support a significant number of species that do not normally occur in either "parent" community. In fact, some of these species such as pine barren reedgrass (*Calamovilfa brevipilis* (Torrey) Scribner) and savanna cowbane (*Oxypolis ternata* (Nuttall) Heller) occur in the Sandhills only in ecotones and related seepage habitats. Phytogeographically, these plants may be considered a subset of those that are characteristic of wet savannas and flatwoods of the outer coastal plain of the Carolinas, particularly the colorful pitcherplants (*Sarracenia*), meadow-beauties (*Rhexia*), seedboxes (*Ludwigia*), milkworts (*Polygala*), orchids, sundews (*Drosera*), and yellow-eyed-grasses (*Xyris*).

Lilium pyrophilum is most closely associated with three distinctive wetland communities, as follows:

1. Streamhead Pocosin. This community occurs along headwaters of creeks and stream branches where seepage water from adjacent ecotones forms definite rivulets. It extends downstream as long as such seepage is important to plants relative to stream flooding. The term "pocosin" is used because the usually dense evergreen shrubs and sparse canopy are reminiscent of true pocosins that develop on peat that accumulates on flatter and younger portions of the coastal plain (Schafale & Weakley, 1990; Sharitz & Gibbons, 1982). Typical shrubs and vines are titi (*Cyrilla racemiflora* L.), fetterbush (*Lyonia lucida* (Lamarck) K. Koch), inkberry (*Ilex glabra* (L.) A. Gray and *I. coriacea* (Pursh) Chapman), highbush blueberry (*Vaccinium formosum* Andréanszky and *V. fuscatum* Aiton), sweet pepperbush (*Clethra alnifolia* L.), evergreen bayberry (*Myrica heterophylla* Rafinesque), redbay (*Persea palustris* (Rafinesque) Sargent), poison sumac (*Toxicodendron vernix* (L.) Kuntze), and blaspheme vine (*Smilax laurifolia* L.). Trees may be sparse or fairly dense, with tuliptree (*Liriodendron tulipifera* L.), pond pine (*Pinus serotina* Michaux), swamp black gum (*Nyssa biflora* Walter), red maple (*Acer rubrum* L.), sweetbay (*Magnolia virginiana* L.), and occasionally Atlantic white cedar (*Chamaecyparis thyoides* (L.) Britton, Sterns & Poggenburg). Sphagnum moss is usually abundant and cane (*Arundinaria tecta* (Walter) Muhlenberg) frequent to common.

Streamhead Pocosin ecotones are normally dominated by low shrubs and cane down-slope and herbs and graminoids up-slope, but complex patterns may be produced depending on soil moisture and disturbance. Woody plants are kept short by recurring fires (or mowing in powerlines). Prominent shrubs are dangleberry (*Gaylussacia frondosa* (L.) Torrey & A. Gray ex Torrey), *Clethra alnifolia*, *Ilex glabra*, and *I. coriacea*, maleberry (*Lyonia ligustrina* (L.) DC.), swamp azalea (*Rhododendron viscosum* (L.) Torrey), blueberries (*Vaccinium crassifolium* and *V. tenellum* Aiton), dwarf witchalder (*Fothergilla gardenii* L.), and honeycups (*Zenobia pulverulenta* (Bartram ex Willdenow) Pollard). Important grasses include *Ctenium aromaticum* (Walter) Wood, *Muhlenbergia expansa* (Poiret) Trinius, *Aristida virgata* Trinius, *A. stricta* Michaux, *Dichanthelium* spp., *Panicum virgatum* L. var. *cubense* Grisebach, *Andropogon glomeratus* (Walter) Britton, Sterns & Poggenburg, *Calamagrostis coarctata* (Torrey) Eaton, and *Calamovilfa brevipilis*. Conspicuous sedges include *Rhynchospora* spp. (up to a dozen taxa), *Carex glaucescens* Elliott, *C. turgescens* Torrey, *Eleocharis tuberculosa* (Michaux) Roemer & Schultes, *E. tortilis* (Link) Schultes, and occasionally *Eriophorum virginicum* L. Other frequent monocots include *Juncus trigonocarpus* Steudel, *Eriocaulon decangulare* L., and *Lachnocaulon anceps* (Walter) Morong. The majority of *Lilium pyrophilum* populations occur in the mid to lower portions of this ecotonal habitat type, and only rarely in the Streamhead Pocosin proper.

1.a. Canebrake Variant. Where burned very frequently, Streamhead Pocosins support fewer trees and shrubs. These are replaced by dense stands of *Arundinaria tecta* called canebrakes. Species diversity is low relative to normal streamhead communities, although ectones remain diverse. Only small populations (1 to 5 plants) of *Lilium pyrophilum* occur in this habitat type.

2. Sandhill Seep. This community occurs on slopes where the clay layer abruptly forces water to the surface, usually where there is a sudden increase in the angle of the slope. Sandhill Seeps occur within the upland pine-oak-wiregrass community as a patch of shrubs, ferns, and cane that form a "rim" across the slope. They may be connected to Streamhead Pocosins and Small Stream Swamps, and may have perennially active seepage or be merely moist. Once numerous in the Sandhills region, high quality examples are now rare due to fire-suppression. *Lilium pyrophilum* appears to be rare in this habitat.

3. Coastal Plain Small Stream Swamp. This community occurs downstream from Streamhead Pocosins where water volume is great enough to cause frequent flooding following rainstorms. It is dominant along the major blackwater streams through the Sandhills region. Canopy dominants are *Nyssa biflora*, loblolly pine (*Pinus taeda* L.), *Acer rubrum*, willow oak (*Quercus phellos* L.), water oak

Table 1. Summary of protection of known *L. pyrophilum* populations.

Ownership	Type of protection	Populations	Individuals
Private	none	3	16
National wildlife refuge	passive	1	2+
Military reservation			
Camp Mackall	passive	2	2
Fort Bragg	passive	21	63
Fort Jackson	passive	1	7
State forest	passive	1	1+
State game land	passive	5	15
Private with utility easement	management agreement	6	89
State park	active	1	7
Private conservation	active	1	3
		42	205+

(*Q. nigra* L.), sweetgum (*Liquidambar styraciflua* L.), and scattered pond cypress (*Taxodium ascendens* Brongniart). Subcanopy trees include American holly (*Ilex opaca* Aiton), *Cyrilla racemiflora*, *Persea palustris*, and *Magnolia virginiana*. Shrubs and vines vary from sparse to dense and include doghobble (*Leucothoe axillaris* (Lamarck) D. Don), blackberry (*Rubus argutus* Link), *Smilax laurifolia*, greenbrier (*Smilax rotundifolia* L.), sawbrier (*Smilax glauca* Walter), poison ivy (*Toxicodendron radicans* (L.) Kuntze), sweetspire (*Itea virginica* L.), and crossvine (*Bignonia capreolata* L.). Herbs are poorly represented, except in light gaps and right along the streambanks. Due to the persistently saturated soils, fire is only a minor component of the ecology of this community. Ecotones to Small Stream Swamps are generally less diverse than those of streamheads due to diminished seepage from adjacent uplands. Only small populations (1 to 5 plants) of *Lilium pyrophilum* occur in these ecotones.

Rarity, management, and conservation. *Lilium pyrophilum* is a very rare plant with clearly defined threats. It is highly vulnerable due to rarity within its limited range and patchy habitat, widespread land conversion to other uses, and modern suppression of fires. Today it survives on properties on which prescribed fire is a management tool or where periodic cutting or mowing takes place, such as in powerline and gasline rights-of-way.

The total number of individual plants documented at the 42 known extant (1990–present) populations is approximately 205; there are 11 populations represented only by historical (pre-1990) collections. The 6 largest extant populations number 42, 25, 15, 12, 11, and 10 individual plants; all others hold fewer than 10 plants each, with most limited to 1 to 3 individuals.

Fortunately, nearly all populations receive protection (Table 1) that varies from active conservation to management agreements to passive conservation. Thirty-nine of 42 extant populations and 189 of 205+ total plants are protected at some level. Although this degree of protection is encouraging despite the small overall population, future prospects remain uncertain. Even if landowners are aware of the lily on their property and wish to foster it, most do not have the resources available to monitor populations nor to conduct specific management protocols. Lilies survive on several properties not as a result of management activities targeted at the plants, but because of the general use of prescribed fire to improve habitat for federally endangered red-cockaded woodpeckers, for improved military troop maneuverability, and for forestry management. On Fort Jackson in South Carolina, exploding ordnance starts the frequent fires that contribute most to habitat maintenance. In utility rights-of-way, lilies survive because periodic cutting to promote human access reduces competition from encroaching woody plants. More sobering is the realization that all four unprotected populations occur on private land in fire-suppressed situations. The general lack of burning within the private sector foretells slim prospects for finding significantly more lilies.

The Sandhills lily currently occupies an extremely narrow range of plant communities, and there is no evidence to suggest that it formerly had wider ecological amplitude. Like its close relative *L. iridollae*, it appears to be a habitat specialist that requires the unusual combination of saturated soils and periodic fire. Within the Sandhills region other rare Carolina endemics such as *Kalmia cuneata* Michaux and the federally endangered *Lysimachia asperulifolia* Poiret also share these requirements. Each inhabits the inner portions of the ecotone where shrubs and/or cane are dominant, rather than laterally where graminoids prevail. Disturbance in the form of periodic fire (or cutting of utility rights-of-way) provides a release from competing shrubs and tree saplings, followed by a brief period of a few years when flowering and fruiting take place.

Although we acknowledge the ecological importance of fire to this new lily, we also realize that frequent fire is not a panacea for all members of the longleaf pine ecosystem. Each has its own limits of fire tolerance with regard to frequency, seasonality, and intensity. Research is needed on the specific effects of fire on *Lilium pyrophilum*. That nearly as many lilies exist in powerlines and gaslines as in areas that burn frequently suggests that mechanical disturbance may be important as well. But what form, if any, did this disturbance take in pre-settlement times? Is it an adequate long-term substitute for fire? To our knowledge no public utility uses fire as a management tool; it should be tried where practicable and compared with traditional cutting. The use of herbicides in rights-of-way is a concern—does it affect the lily? If so, widespread use of herbicides may significantly reduce chances of finding additional populations of the Sandhills lily.

Populations of rare lilies in North America have been decimated in the recent past by collectors and fanciers who hope to appreciate these plants in their home gardens (Skinner & Pavlik, 1994). These misguided efforts usually end in failure due to the highly specific habitat requirements of most geographically restricted lilies. We encourage botanists and plant lovers to appreciate these plants in the field, and caution that removal of plants from most populations would be in violation of existing state or federal laws.

Biologists and land managers continue to find new populations, but overall numbers remain extremely low. Therefore, we recommend that the U.S. Fish and Wildlife Service consider *Lilium pyrophilum* for listing under the federal Endangered Species Act, and urge state protection as well.

Similar species. Lilium pyrophilum is one of a monophyletic group of lilies (Skinner, in press) that also includes *L. superbum* (turk's-cap lily), *L. michauxii* (Carolina lily), and *L. iridollae* (Panhandle lily). This species group is characterized by a generally southern distribution in the United States, green styles, large flowers (sepals 5.7–10.5 cm) with large anthers (1.0–2.6 cm), buds that are triangular in cross section, generally smooth-margined and smooth-veined leaves, sepals with two abaxial longitudinal ridges, and whitish bulbs. The remaining *Lilium* of eastern North America with pendent flowers also represent a well-formed clade marked by a primarily northern distribution, red styles, smaller flowers (sepals 3.2–9.3 cm) with smaller anthers (0.4–1.3 cm), round buds with smooth backs, scarious-margined and scarious-veined leaves that are therefore noticeably rough, and bulbs that are yellow or become so with age. This group includes Gray's lily (*L. grayi* Watson), Canada lily (*L. canadense* L.), and Michigan lily (*L. michiganense* Farwell). A key to *L. pyrophilum* and allies follows:

KEY TO THE *LILIUM* SPECIES OF THE EASTERN UNITED STATES WITH PENDENT FLOWERS, GREEN STYLES, TRIANGULAR BUDS, AND TWIN ABAXIAL SEPAL RIDGES

1. Leaves strongly oblanceolate, noticeably pale beneath, somewhat fleshy; flowers strongly fragrant . . . . *Lilium michauxii*

1′. Leaves elliptic or weakly oblanceolate, scarcely pale beneath, thin; flowers not fragrant.

  2. Rhizomes with 3–4 annual bulbs, 9.6–18.4 cm, scaleless sections between annual bulbs 2.7–5.4 cm; bulb scale leaves or their abscission scars present; leaves subtly oblanceolate; flowers yellow-orange, 1–3; coastal Alabama and western Florida . . *Lilium iridollae*

  2′. Rhizomes with 2(–3) annual bulbs, 5.2–10.2 cm, scaleless sections between annual bulbs 0.3–3.8(–4.6) cm; bulb scale leaves or their abscission scars absent; leaves ± narrowly elliptic; flowers orange or reddish, 1–20 or more; southern and eastern United States.

    3. Plants 1.2–2.8 m; leaves 7.1–26.1 cm, 3.9–18.4 times longer than broad, usually horizontal or drooping, in 6–24 ± evenly distributed whorls of 3 or more; flowers red-orange (red, orange) to yellow (yellow-orange) to green basally, 1–20 or more; Louisiana to Missouri, east to Florida and New Hampshire *Lilium superbum*

    3′. Plants 0.63–1.6 m; leaves 2.3–10.3(–12.2) cm, 1.6–7.6(–10.3) times longer than broad, usually ascending, in 0–12 ± proximal whorls of 3 or more; red-orange or dusky red (magenta or pinkish, pale orange, red) apically to (pale) yellow (yellow-orange) centers to green basally, 1–7; Sandhills of Virginia and North and South Carolina . . . . *Lilium pyrophilum*

Of the four taxa, *L. michauxii* is the most derivative and is easily distinguished by its strongly obovate or oblanceolate leaves that are few in number, darker green above and lighter below, fleshy, and undulate along the margins. Its compact bulb, preference for well-drained sites, and delicately scented flowers with exceedingly wide petals (1.8–2.9

cm) are also distinctive. It is the only pendent lily sympatric with *L. pyrophilum. Lilium iridollae* is narrowly endemic to Escambia, Santa Rosa, Okaloosa, and Walton Counties in the western Florida panhandle and Baldwin, Escambia, and Covington Counties in adjacent Alabama, and it is allopatric to *L. pyrophilum.* Although its habitat within the longleaf pine ecosystem is similar, it is morphologically divergent by virtue of an elongate rhizome that retains 3–4 years' growth, the presence of basal (winter) leaves (otherwise known in North American lilies only in the distantly related pine lily, *L. catesbaei* Walter), subtly oblanceolate stem leaves, and particularly long pedicels (to 23 cm vs. a maximum of 19 in the other three species). Its vibrant and uniformly orange-yellow flowers are usually diagnostic as well.

Lilium superbum is more similar to the Sandhills lily than other congeners. It occurs directly to the north and east of the limited range of *L. pyrophilum* but is absent to the west through the Piedmont; it then reappears along the Appalachian spine. Overlap in blooming times of the two taxa is moderate (Table 2); thus reproductive isolation is achieved geographically and to some degree phenologically. As its name suggests, *L. superbum* is taller and more robust than the other lilies within its general range, including *L. pyrophilum* (Table 2). It bears more and larger flowers, has longer and relatively narrower leaves, and has more whorls of 5 or more leaves (Table 2), and these are rather evenly spaced along the stem. *Lilium pyrophilum* typically has the leaf whorls concentrated toward the bottom of the stem, and the leaves are strongly ascending, which is often characteristic of lilies that occur in very high light environments. Of subtle importance is the shape of the floral tube, which is slightly longer and more tubular in *L. pyrophilum* than in *L. superbum* (Table 2). This *may* be related to pollinator effectiveness (Skinner, 1988), as the Sandhills lily is pollinated at least partially by hummingbirds whereas *L. superbum* is almost entirely swallowtail butterfly-pollinated, notwithstanding infrequent visits from hummingbirds. This longer, thinner tube sometimes obscures the noticeable "green star" that is formed by the six areas of nectary tissue in the widely flaring *L. superbum*; instead *L. pyrophilum* often displays a green triangle formed only by the sepal nectaries.

The rhizomes of *L. pyrophilum* and *L. superbum* are closely similar, though the latter tends to grow from a larger bulb as befits its greater stature. *Lilium superbum* also has a tendency toward longer scales that are two-segmented rather than entire, and a more marked tendency toward clonal growth that is a result of repeated dichotomous branching within the rhizomes.

Phytogeography and theories of origin. We propose three alternatives for the origin of the new taxon. The authors do not necessarily agree on the likelihood of each, but we feel that carefully chosen molecular evidence might be conclusive.

1. As a peripherally isolated derivative of *L. superbum* or its ancestor. This theory acknowledges the phenotypic similarity between these two species and their current lack of sympatry.

2. Hybrid origin. Throughout its limited range *L. pyrophilum* co-occurs with *L. michauxii*, but it overlaps scarcely if at all with *L. superbum* in the coastal plain of southeastern Virginia. It is conceivable that *L. pyrophilum* arose through past contact between these other two species and has evolved its own suite of morphological, biological, and ecological characteristics. Today, *L. superbum* and *L. michauxii* are sympatric over a large area of mountains and piedmont from Virginia to Alabama. Though they rarely produce hybrids (Adams, 1982), the possibility of hybrid origin cannot be excluded as physical conditions and plant genotypes are fluid. Hybrids between *L. michauxii* and *L. pyrophilum* are known from disturbed habitats associated with utility rights-of-way, and are best recognized by the fine tepal spots and broad petals of the former species. Whether they occur in more natural settings is uncertain.

3. Common ancestry with *L. iridollae.* Eleven vascular plant species occur in the Sandhills region of the Carolinas as disjuncts from the Gulf region where *L. iridollae* grows (Sorrie et al., 1997; Sorrie & Weakley, 2001), and a number of others share essentially the same pattern of disjunction. Some of these species occur in the same streamhead habitats as *L. pyrophilum*, including *Carex turgescens* Torrey, *Eriocaulon texense* Körnicke, *Rhynchospora leptocarpa* (Chapman ex Britton) Small, *R. macra* (C. B. Clarke) Small, *R. oligantha* A. Gray, *Xyris chapmanii* Bridges & Orzell, and *X. scabrifolia* Harper. It may be significant that these same species also co-occur with *Lilium iridollae* in the Gulf Coastal Plain, and it suggests that the historical events that introduced these grasslike species to the Sandhills may also have brought a common ancestor of *L. iridollae* and *L. pyrophilum* into that region.

The specimens cited below (herbarium acronyms are listed in full in the Acknowledgments) represent seven extant (1990–present) populations, each in a distinct county (the Lee Co., North Carolina, historical collection from 1961 has recently been verified to represent an extant population), and

Table 2. Major differences between *L. pyrophilum* and *L. superbum*. Measurements are means, (ranges), and [sample sizes]; p values indicate the probability that the samples are from the same statistical population, and are from independent sample T-tests performed using Statistica (1999). Fire frequencies are from Frost (1998).

	L. pyrophilum	*L. superbum*
Distribution	Sandhills of SC, NC, and VA	Coast and mountains from NH to NC, MO, LA, and FL
Habitat	streamhead pocosins, sandhill seeps, swampy streams, wet utility lines; fires extremely frequent (every 1–3 years)	rich, moist woods, roadsides, streamsides; fires vary (every 1–100 years)
Blooming period	peak in early Aug. (late July to mid Aug.)	peak in mid–late July (July to early Aug.)
Pollinators	ruby-throated hummingbirds (*Archilochus colubris* Linnaeus) and palamedes swallowtails (*Papilio palamedes* Drury), probably other swallowtails including spicebush (*P. troilus* Linnaeus); relative importance of bird and butterfly pollinators unknown	large swallowtails, esp. spicebush (*P. troilus*), also tiger (*P. glaucus* Linnaeus) and pipevine (*Battus philenor* Linnaeus)
Plant height (cm) $p \ll 0.001$	103.4 (63–160) [27]	174.4 (118–280) [31]
Rhizome height $p = 0.02$	26.0 (23.9–28.1) [4]	33.4 (23.5–43.9) [17]
Rhizome longest scale (mm) $p = 0.09$ (not significant)	15.5 (11–18.9) [4]	21.8 (11.8–39.3) [17]
Leaf arrangement	usually whorled, whorls often clustered toward bottom of plant, lower leaves scarcely ascending or ascending, drooping at tip or not, upper ascending and appressed to stem	always whorled, whorls evenly spaced on stem, leaves horizontal and drooping at tips, upper leaves often ascending in sun
Leaf shape	narrowly (to broadly) elliptic	(very) narrowly elliptic (to scarcely oblanceolate)
Leaves per plant $p \ll 0.001$	51.0 (29–102) [27]	96.5 (40–186) [31]
Whorls per plant of 5 or more leaves $p \ll 0.001$	3.9 (0–10) [27]	8.4 (3–14) [31]
Leaf length (mm) $p \ll 0.001$	62.2 [23–103(–122)] [206]	138.8 (71–261) [205]
Leaf length/width ratio $p \ll 0.001$	4.1 [1.6–7.6(–10.3)] [206]	9.9 (3.9–18.4) [205]
Flower color	muted orange-red or yellow-orange with red dusting on tips (variable and sometimes reddish pink, red-orange, magenta, dusky red, or salmon), grading to (pale) yellow (yellow-orange) centers to green at base; maroon spots often large	(pale) red-orange (pale red, red, orange, yellow scarcely suffused with red) grading to yellow (yellow-orange) to green at base; magenta (maroon) spots only in yellow and often large
Flowers per plant $p \ll 0.001$	1.7 (1–7) [57]	3.7 (0–22) [299]
Sepal length (mm) $p = 0.014$	78.1 (67–89) [25]	83.5 (68–105) [37]
Floral tube length (mm) $p \ll 0.001$	17.9 (13.1–24.3) [25]	13.0 (8.9–16.5) [37]
Capsule length (mm) $p = 0.001$	38.9 (28.2–47.0) [21]	45.3 (28.8–61.5) [23]

eleven historical populations (collected prior to 1990). Most of these historical populations have been surveyed but habitat is generally degraded, and we assume the plant is extirpated at each location. Four counties—Nash and Northampton in North Carolina and Kershaw and Orangeburg in South Carolina—are represented only by historical specimens collected before 1990. There are current sight records (North Carolina Natural Heritage Program and South Carolina Heritage Trust databases, 1999) from 35 additional populations that add 4 additional Carolina counties to the total with extant populations, as well as a sight record from 1 additional county of Virginia, Sussex County (B. Van Eerden, pers. comm.). Thus *L. pyrophilum* is currently known from 42 populations in 12 counties, and historically at 11 populations in these and 4 additional counties.

Paratypes. U.S.A. **North Carolina:** Cumberland Co., 6.8 mi. S of Fayetteville on NC 87, 7 Aug. 1957, *H. E. Ahles 33525* (GA, NCU); Harnett Co., wet soil by route 53, 1 mi. S of Pineview, 1 Aug. 1927, *H. R. Totten s.n.* (NCU); Fort Bragg Military Reservation, Northern Training Area, seep and pocosin complex, 6 Aug. 1993, *B. A. Sorrie 7512 with B. Van Eerden & T. Hippensteel* (NCU), 3 Aug. 1995, *M. W. Skinner 270* (GH); Hoke Co., pocosin border 3.9 mi. W of Montrose, 9 Aug. 1957, *H. E. Ahles 33802* (NCU); Johnston Co., streamhead under powerline, 20 July 1999, *P. McMillan 3900-a with E. Hajnos* (CLEMS); Lee Co., wet seepage along railroad, 2 mi. S of Lemon Springs, 29 July 1961, *A. E. Radford 44148* (NCU); Moore Co., open shrub bog, Hog Island, SR 2026, 31 July 1974, *J. H. Carter III 1003* (wwh); seepage areas in powerline near Pinehurst, 9 Aug. 1992, *B. A. Sorrie 6746* (bas), 7 Aug. 1993, *B. A. Sorrie 7513* (NCU); Nash Co., recently burned dry pocosin on US 64, 2 ½ mi. SW of Nashville, 22 July 1949, *W. B. Fox & R. K. Godfrey 2734* (NCSC); Northampton Co., low undrained roadside 3 mi. N of Jackson, 2 Aug. 1958, *J. W. Hardin 910* (NCSC); Richmond Co., peat sedge bog near US 1, 5 mi. N of Rockingham, 24 July 1956, *A. E. Radford 14323* (NCU); seepage bog in powerline near Sandhills Game Land, 27 July 1997, *B. A. Sorrie 9367.5* (bas), 4 Aug. 2000, *B. A. Sorrie 10584* (NCU); Richmond/Scotland Co., near Pine Lake, 30 July 1933, *F. Smith s.n.* (DUKE). **South Carolina:** Chesterfield Co., peat sedge bog 8 mi. E of Patrick, 11 Aug. 1956, *A. E. Radford 15809* (NCU); Kershaw Co., powerline crossing of a cleared pond pine pocosin, dirt road off US 1, 3 Sep. 1982, *D. A. Rayner 1496* (USCH); Orangeburg Co., boggy woodland border 3 mi. NE of Orangeburg on SC 33, 19 July 1957, *H. E. Ahles 31685* (NCU); Richland Co., Fort Jackson Army Installation, South Impact Area, 15 Apr. 1992, *J. B. Nelson 12269* (USCH), 1 Aug. 1995, *M. W. Skinner 267* (GH). **Virginia:** Greenville Co., W of Jarratt in powerline, diverse seepage wetland, 8 Aug. 1991, *T. J. Rawinski 11471* (VPI).

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New Combinations within North American *Schoenoplectus smithii* and *S. purshianus* (sect. *Actaeogeton*, Cyperaceae) and Comparison with Eastern Asian Allies

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ABSTRACT. The new combinations *Schoenoplectus purshianus* (Fernald) M. T. Strong var. *williamsii* (Fernald) S. G. Smith, *S. smithii* (A. Gray) Soják var. *setosus* (Fernald) S. G. Smith, and *S. smithii* var. *levisetus* (Fassett) S. G. Smith are made. Diagnostic features, mainly from spikelet dimensions, perianth bristles, and achenes, are provided that distinguish the eastern North American *S. smithii* and *S. purshianus*, and the eastern Asian and Pacific island *S. hotarui* (Ohwi) Holub, *S. juncoides* (Roxburgh) Palla, and *S. komarovii* (Roshevitz) Soják, all five of which have been confused with each other. A description of *Schoenoplectus* sect. *Actaeogeton* (Reichenbach) J. Raynal is provided based mostly on North American and eastern Asian species.

Key words: Asia, Cyperaceae, North America, *Schoenoplectus*, *Schoenoplectus* sect. *Actaeogeton*.

This paper derives from the senior author's work on his treatment of *Schoenoplectus* (Reichenbach) Palla for the upcoming volume 23, Cyperaceae, of the *Flora of North America* (FNA), during which he studied numerous herbarium specimens from about 52 herbaria (Smith, 1995), as well as from the junior author's ongoing work toward a monograph of *Schoenoplectus*, during which he studied numerous herbarium specimens from the herbaria listed in the acknowledgments.

Scirpus L. s.l. has been segregated worldwide in recent years based on embryo as well as vegetative and reproductive characters (Bruhl, 1995; Goetghebeur & Simpson, 1991; Hayasaka & Ohashi, 2000; Smith & Hayasaka, 2001; Smith & Yatskievych, 1996; Wilson, 1981). Nine segregate genera will be recognized for the upcoming *Flora of North America*: *Amphiscirpus*, *Blysmus*, *Bolboschoenus*, *Isolepis*, *Oxycaryum*, *Schoenoplectus*, *Scirpus*, *Trichophorum*, and *Websteria*. The largest of these in North America is *Schoenoplectus* with about 70 species worldwide and 17 in North America.

Schoenoplectus is diverse morphologically and has been divided into several infrageneric taxa (Oteng-Yeboah, 1974; Raynal, 1976; Smith & Hayasaka, 2001). Smith and Hayasaka (2001) recognized and provided a key to four sections within *Schoenoplectus*: sect. *Schoenoplectus*, sect. *Actaeogeton* (Reichenbach) J. Raynal, sect. *Malacogeton* (Ohwi) S. G. Smith & Hayasaka, and sect. *Supini* (Chermezon) J. Raynal.

Upon their transfer from *Scirpus* to *Schoenoplectus*, the infraspecific taxa of the two native North American species of *Schoenoplectus* sect. *Actaeogeton*, *S. purshianus* (Fernald) M. T. Strong and *S. smithii* (A. Gray) Soják, require new combinations. These species also have been confused with each other as well as with three species of eastern Asia and adjacent western Pacific islands (Koyama, 1958, 1962). In addition, the section *Actaeogeton* has never been clearly delineated. This paper addresses these nomenclatorial and taxonomic problems.

1. **Schoenoplectus purshianus** (Fernald) M. T. Strong, Novon 3: 202. 1993. *Scirpus purshianus* Fernald, Rhodora 44: 479. 1942. *Scirpus debilis* Pursh, Fl. Amer. Sept. 1: 55. 1814, non *Scirpus debilis* Lamarck, Illustr. 1: 141. 1791. *Scirpus erectus* Poiret var. *debilis* Camus, Fl. Gen. Indo-Chine 7: 136. 1912. TYPE: U.S.A. Pennsylvania: Muhlenberg Herbarium, "No. 65" and "m. 33" (lectotype, designated by Strong (1993: 203), PH, Herb. Muhl. sheet 345–74, photograph seen; isolectotype, PH, Herb. Muhl. sheet 345–75, photograph seen).

Muhlenberg first published the name *Scirpus de-*

bilis without a description in his 1813 catalog, and Pursh apparently appropriated Muhlenberg's earlier name. The lectotype and duplicate sheet may have been seen by Pursh (Merrill & Hu, 1949), or the specimens may even have been collected by Pursh (C. E. Smith, 1962: 458). A. E. Schuyler and J. Macklin at PH have kindly provided us with photographs of the types and closely examined the specimens. On the lectotype sheet, "Scirpus debilis lupulinus Sm." is written on the label; "345–74" is at the bottom of the sheet. The annotation directly on the sheet reads "Scirpus purshianus Fern. Type of Scirpus debilis Pursh, AE Schuyler 1976"; this sheet bears 15 inflorescence-bearing culms, 3 of which are attached together at their bases, and 12 are without bases. A second sheet bears labels and annotations similar to those on the lectotype with "345–75" written at the bottom of the sheet, and the annotation on the sheet reads "Scirpus purshianus Fern. TYPE MATERIAL of Scirpus debilis Pursh, Fl. Am. Sept. 1: 55. 1813[1814]. AES 1976." It bears 14 culms with inflorescences, and is evidently part of the same collection as the lectotype. All culms on both sheets are very similar, and several bear achenes with attached bristles, which are typical of *Schoenoplectus purshianus* (A. E. Schuyler & J. Macklin, pers. comm. 2001).

1a. Schoenoplectus purshianus var. **purshianus**

Perianth bristles 6, stout, tapered distally, about equaling achene, densely spinulose. Reported habitats: shores of inland ponds and ditches. Distributed throughout the range of the species in northeastern North America from Quebec to Georgia westward to Minnesota, eastern Missouri, and northern Louisiana.

1b. Schoenoplectus purshianus var. **williamsii** (Fernald) S. G. Smith, comb. nov. Basionym: *Scirpus debilis* Pursh var. *williamsii* Fernald, Rhodora 3: 252. 1901. *Scirpus smithii* A. Gray var. *williamsii* (Fernald) Beetle, Amer. J. Bot. 29: 655. Oct. 1942. *Scirpus purshianus* Fernald f. *williamsii* (Fernald) Fernald, Rhodora 44: 479. Dec. 1942. *Scirpus juncoides* Roxburgh var. *williamsii* (Fernald) T. Koyama, Canad. J. Bot. 40: 914. 1962. *Schoenoplectus smithii* (A. Gray) Soják subsp. *williamsii* (Fernald) Soják, Cas. Nár. Mus. Odd. Prir. 148: 194. 1980. TYPE: U.S.A. Massachusetts: sandy shore of Massapoag Lake, Sharon, 7 Sep. 1901, Plantae Exsiccatae Grayanae 26, *E. F. Williams & M. L. Fernald s.n.* (holotype, GH; isotypes, BRIT, CAS, GH, ILL, MO, NEBC, SAPS, UC, WTU).

The names *Scirpus smithii* A. Gray var. *williamsii* (Fernald) Beetle and *Scirpus juncoides* Roxburgh var. *williamsii* (Fernald) T. Koyama were misapplied by their authors to the entire species *S. purshianus*. Koyama (1963: 457) stated that his new combination *Scirpus juncoides* Roxburgh var. *digynus* (Böckler) T. Koyama has priority over *Scirpus debilis* var. *williamsii*. As Koyama referred to his 1962 paper, he apparently intended his new varietal combination to apply to the whole species *S. purshianus*. Böckler's type of the basionym *Scirpus supinus* L. [var.] *digynus* Böckler needs to be examined to determine the specific and varietal identity of *Scirpus juncoides* var. *digynus* (Böckler) T. Koyama.

Perianth bristles absent. Reported habitats: shores of lakes, reportedly with substantial water-level fluctuations. This variety is known only from the type locality in eastern Massachusetts, several counties in southwestern Michigan, one county in adjacent Indiana, and two counties in Wisconsin.

2. Schoenoplectus smithii (A. Gray) Soják, Cas. Nár. Mus. Odd. Prir. 141: 62. 1972, not *Schoenoplectus smithii* (A. Gray) J. Raynal, Adansonia, n.s., 16(4): 530. 1977. *Scirpus smithii* A. Gray, Manual ed. 5: 563. 1867. TYPE: U.S.A. New Jersey: in tidal mud on the N.J. shore of the Delaware below Red Bank opposite the River Schuylkill, July 1865, *C. E. Smith s.n.* (holotype, GH; isotype, PH).

2a. Schoenoplectus smithii var. **smithii**

Perianth bristles absent or rudimentary. Reported habitats: fresh-water tidal shores of rivers and inland shores with large fluctuations in water level. This variety is known from Quebec (St. Laurence River near Quebec City) to New Jersey westward to Minnesota.

2b. Schoenoplectus smithii var. **setosus** (Fernald) S. G. Smith, comb. nov. Basionym: *Scirpus smithii* A. Gray var. *setosus* Fernald, Rhodora 3: 252. 1901. *Scirpus smithii* A. Gray f. *setosus* (Fernald) Fernald, Rhodora 44: 479. 1942. TYPE: U.S.A. Illinois: Augusta, 1845, *S. B. Mead s.n.* (holotype, GH; isotypes, GH, NY, PH).

Perianth bristles 4 to 6, equaling or slightly exceeding achene, densely spinulose. Chromosome number $n = 19$ (Schuyler, 1972). Reported habitats: wet places with little fluctuation in water level such as mires and shores of small lakes or ponds. This variety is known from Quebec (near Quebec

City) to Delaware and western North Carolina westward to Wisconsin and Minnesota. In Michigan, Wisconsin, and Minnesota it is much more common than *S. smithii* var. *smithii.*

2c. Schoenoplectus smithii var. **levisetus** (Fassett) S. G. Smith, comb. nov. Basionym: *Scirpus smithii* A. Gray var. *levisetus* Fassett, Rhodora 19: 42. 1921. *Scirpus smithii* A. Gray f. *levisetus* (Fassett) Fernald, Rhodora 44: 479. 1942. TYPE: U.S.A. Maine: tidal flats of the Cathance River at Bowdoinham and at its mouth in Merrymeeting Bay, 25 Aug.–2 Sep. 1920, *N. C. Fassett s.n.* (holotype, GH; isotype, NY).

Perianth bristles 1 to 3 (4), mostly much shorter than achene, mostly without spinules. Chromosome number $n = 19$ (Schuyler, 1972). Habitat: restricted to fresh-water (or slightly brackish?) tidal muddy or rocky shores of rivers. This variety is very locally distributed but sometimes locally common (Schuyler, 1972). Smith has seen specimens from New Brunswick (Northumberland Co.), Quebec (Portneuf Co., near Quebec City), Connecticut (New Haven), Massachusetts (Middleton Co.), Maine (Penobscott and Sagadahoc Cos.), and Virginia (Fairfax Co.). It is known to be extirpated from Virginia (Strong, 1994).

Koyama (1962: 919) treated the eastern Asian *Schoenoplectus komarovii* (Roshevitz) Soják as *Scirpus smithii* var. *leiocarpus* (Komarov) T. Koyama, = *Schoenoplectus smithii* subsp. *leiocarpus* (Komarov) Soják, basionym *Scirpus supinus* L. var. *leiocarpus* Komarov (other synonyms and type given by Koyama, 1958, 1962). However, our herbarium observations and published descriptions (Koyama, 1958, 1962; Ohwi, 1965) indicate that, pending a revision of the *S. juncoides* complex, *S. smithii* var. *leiocarpus* should be treated as the distinct species *S. komarovii* following Ohwi (1965). Although *S. komarovii* is similar to *S. smithii* var. *setosus* in most characters, including those of perianth bristles and achene shape and surface, it differs from *S. smithii* in its smaller achenes and its frequently compound inflorescences (Table 1).

While Smith has not detected morphological differences between the varieties other than those of the perianth bristles as given above, in his opinion these five infraspecific taxa should be treated as varieties rather than forms because the perianth bristle differences appear to be correlated with habitat differences, and thus these taxa can be interpreted as ecotypic varieties and may be valuable ecological indicators. Also, form status implies that the morphological differences are completely trivial.

Schoenoplectus smithii var. *setosus*, *S. smithii* var. *levisetus*, and *S. purshianus* var. *williamsii* were first described with no mention of ecological differences except for *S. smithii* var. *levisetus*, for which Fassett (1921) found the fresh-water tidal habitat remarkable. When Fernald (1942: 483) reduced the varieties to forms he merely stated: ". . . their differences are in the presence or absence of perianth-bristles, or in the case of *S. smithii*, forma *levisetus*, the lack of retrorse barbs on the bristles." However, Schuyler (1972: 398–399) stated: "In both *S. purshianus* and *S. smithii* the presence or absence of barbed bristles appears to be correlated with the stability of the habitat. For example in eastern New York, New Jersey, eastern Pennsylvania and Delaware, *S. smithii* f. *smithii* is almost completely restricted to the specialized conditions of fresh inter-tidal zones of the Hudson, Raritan and Delaware Rivers while in the same area f. *setosus* occurs in and around lakes, ponds and quagmires. . . . Thus it appears that plants of *S. smithii* which lack barbed bristles are better adapted to the periodic fluctuations in water levels which are characteristic of the estuarine environment than are those which have barbed bristles. . . . *S. smithii* f. *levisetus* is common along the estuaries of the Kennebec River in Maine and the St. Lawrence River in Quebec." Ferren and Schuyler (1980) and Strong (1994) essentially repeated these statements for *S. smithii* var. *smithii* and *S. smithii* var. *setosus* and provided more detailed ecological information for *S. smithii* var. *smithii.*

The few data Smith have seen on herbarium labels support these reported habitat differences. For *S. smithii* var. *smithii*, in addition to coastal estuaries, reported habitats include protected beaches of the very large Lakes Huron, Erie, Cayuga (New York), Oneida (New York) and Champlain. In contrast, reported habitats for *S. smithii* var. *setosus* are "bog" pools and peaty quagmires, marsh edges, sandy or muddy lake and river shores, marshy shore of drying shallow seepage lake, recently scraped road through wet meadow near lake shore, floating muck in lake in center of bog, mill pond, and muck of small drying-up alkaline lake.

Schoenoplectus purshianus and *S. smithii* have been widely confused. Many specimens are misidentified, and some authors have treated *S. purshianus* and *S. smithii* as conspecific (Beetle, 1942; Gleason, 1963; Gleason & Cronquist, 1963; Voss, 1972). Most published distributions are therefore erroneous, and the distributions given here are based almost entirely on specimens that the senior

Table 1. Morphological comparison of *Schoenoplectus purshianus*, *Schoenoplectus smithii*, and their eastern Asian allies.

	Species				
	S. purshianus	*S. smithii*	*S. juncoides*	*S. hotarui*	*S. komarovii*
Involucral bract	erect or often divergent	erect, rarely divergent	erect, sometimes divergent	erect	erect
Inflorescence	single head	single head	single head	single head	single head, or often compound with peduncles 1–5 mm long
Spikelet dimensions	5–12 × 3–4 mm	5–12 × 3–4 mm	6–20 × 4–6 mm	6–15 × 4–6 mm	5–10 × 3–4 mm
Perianth bristles	present, rarely absent, distinctly broader proximally	present or often absent, slender for whole length	present, slender for whole length	present, slender for whole length	present, slender for whole length
Stigma number	2 or a few 3	2 or a few 3	2 or a few 3	3 or a few 2	2
Achene					
Cross-section shape	biconvex, sometimes plano-convex or a few obscurely trigonous, abaxial angle broadly rounded, obscure	biconvex or a few trigonous, abaxial angle narrow, distinct	biconvex	trigonous, abaxial angle narrow, distinct	plano-convex, sometimes biconvex
Outline	mostly obpyriform, mostly widest at the middle	mostly cuneate, mostly widest above the middle	mostly cuneate, mostly widest above the middle	mostly obpyriform, mostly widest at the middle	mostly cuneate, mostly widest above the middle
Base	abruptly contracted, with a distinct neck-like constriction, base 0.3–0.4 mm wide	evenly tapered, rarely with a neck-like constriction, base 0.25–0.3 mm wide	evenly tapered, rarely with a neck-like constriction, base 0.3–0.5 mm wide	abruptly contracted, with a distinct neck-like constriction, base 0.4–0.5 mm wide	evenly tapered, rarely with a neck-like constriction, base 0.2–0.3 mm wide
Surface	clearly rugulose at 10–20×, not longitudinally striate	clearly to obscurely rugulose at 10–20×, finely longitudinally striate at 30×	obscurely rugulose at 10–20×, obscurely longitudinally striate at 30×	clearly rugulose at 10–20×, obscurely longitudinally striate at 30×	obscurely rugulose or nearly smooth at 10–20×, finely longitudinally striate at 30×
Dimensions	1.6–2.2 × 1.2–1.5 mm	1.5–2 × 1.2–1.5 mm	2–2.4 × 1.5–1.9 mm	1.8–3 × 1.5–2.2 mm	1.2–1.6 × 0.8–1.1 mm
Habit	annual	annual	perennial	annual	annual
Distribution	eastern North America	eastern North America	eastern Asia	eastern Asia	eastern Asia

author has seen. The taxonomic confusion is due to the subtle nature of the diagnostic characteristics of achenes and perianth bristles as illustrated by Strong (1994), Blondeau et al. (1996), and in the upcoming volume 23 of the *Flora of North America*, and is summarized in Table 1 herein. Confusion is also caused by the presence in both species of plants with or without perianth bristles as well as plants with erect proximal involucral bracts. Plants without bristles may be identified to species using the differences in achene shape and surface sculpturing as given in Table 1.

Our herbarium studies and the literature indicate that *Schoenoplectus purshianus* and *S. smithii* should be treated as distinct species restricted to eastern North America and distinct from their relatives, which are found in eastern Asia and the Pacific islands. Some authors, however, have treated *S. purshianus* and *S. smithii* as conspecific with eastern Asian species of the "*S. juncoides* complex" (Koyama, 1958, 1962, under *Scirpus*), which is comprised of perhaps 10 taxonomically difficult species of eastern Asia and the Pacific islands. The distinguishing characteristics of *S. purshianus* and *S. smithii* and the eastern Asian relatives with which they have been confused are summarized in Table 1.

Delimitation of *Schoenoplectus* sect. *Actaeogeton*

The species of *Schoenoplectus* sect. *Actaeogeton* and section *Supini* were all included in *Scirpus* sect. *Actaeogeton* by Beetle (1942), Fernald (1942), and Koyama (1958, 1962). Raynal (1976) segregated *Schoenoplectus* sect. *Supini* from other sections based on the perianth bristles reduced or absent, and the ability to produce amphicarpic flowers in the basal leaf sheaths. Although species of *Schoenoplectus* sects. *Actaeogeton* and *Supini* are mostly very similar in both vegetative and sexual structures, our studies support their treatment as separate sections based mainly on the ability for amphicarpy and the usual presence of a node above the basal leaves in the latter (Smith & Hayasaka, 2001). All plants of the North American species of these two sections can be distinguished by these characters (Smith & Yatskievych, 1996), but some Old World species of *Schoenoplectus* sect. *Supini*, e.g., *S. supinus* (L.) Palla, lack a cauline leaf.

The following description of *Schoenoplectus* sect. *Actaeogeton* is based on about 300 specimens of the North American species and about 500 specimens of eastern Asian species as well as the descriptions and illustrations in Koyama (1958, 1962) and Ohwi (1965). The achene SEM micrographs provided by Oh and Ham (1998) show that the epidermal surface sculpturing of *S. hotarui* (Ohwi) Holub, *S. lineolatus* (Franchet & Savatier) T. Koyama, *S. triangulatus* (Roxburgh) Soják, and *S. wallichii* (Nees) T. Koyama, all of which we include in section *Actaeogeton* (Smith & Hayasaka, 2001), are very similar to each other, sharing longitudinally oriented, linear epidermal cells.

Schoenoplectus (Reichenbach) Palla sect. **Actaeogeton** (Reichenbach) J. Raynal, Adansonia 16: 130. 1976. *Scirpus* L. sect. *Actaeogeton* Reichenbach, Fl. Germ. Excurs.: 78. 1830. *Schoenoplectus* subg. *Actaeogeton* (Reichenbach) Oteng-Yeboah, Notes Roy. Bot. Gard. Edinburgh 33: 315. 1974. TYPE: *Schoenoplectus mucronatus* (L.) Palla.

Annuals or perennials, culms densely tufted, ca. 5–200 cm; rhizomes present or apparently absent, very short, hidden among culm bases and roots, or rhizomes long and horizontally creeping and culms single (in *S. lineolatus*). Culms cylindric or trigonous, ca. 1–200 cm long × 1–8 mm thick. Leaves all basal, ½ of to rarely ca. equaling culm, ca. 2 leaves well developed; ventral band hyaline or membranous; ligules minute; blades from a mere mucro to ca. 8 cm long × 0.5–1 mm wide, cross section C-shaped or trigonous. Inflorescence of a single spikelet or usually capitate; spikelets 2 to 20; involucral bracts 1 to 2, the proximal erect to divergent, channeled-subcylindric or trigonous, usually greatly exceeding the inflorescence. Floral scales elliptic to ovate; membranous with thicker midrib, often faintly many-nerved; margins ciliolate; apices entire, mucronate. Perianth present or absent, of 6 (or fewer) bristles that are retrorsely to spreading spinulose or rarely smooth. Styles bifid or trifid. Achenes dark brown to blackish when ripe, obovoid, lenticular to trigonous, abruptly short-beaked, prominently to obscurely rugose or nearly smooth at 10 to 20×. Reported chromosome numbers n = 19, 20, 21, 22, 30, 36, 37.

Habitats and distribution. Fresh-water wetlands, often emergent; worldwide, with the main center of diversity in eastern Asia.

This description is tentative pending further study of species, especially from Asia and Africa, where a taxonomic revision is needed. Fourteen species that we include in *Schoenoplectus* sect. *Actaeogeton* from North America and eastern Asia are listed in Smith and Hayasaka (2001), but it is possible that more species would be included after further study. Although *S. lineolatus* has long, horizontally creeping rhizomes in sharp contrast to the short, hidden rhizomes of all of the other species we include in *Schoenoplectus* sect. *Actaeogeton*, *S. lineolatus* closely resembles the other species in its leaves, floral scales, achene surfaces, and pericarp internal structure (Hayasaka, unpublished data). In addition, hybrids between *S. lineolatus* and both *S. hotarui* and *S. triangulatus* have been reported from Japan (Koyama, 1958; Hayasaka & Ohashi, 2000).

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Neomitranthes obtusa (Myrtaceae), a New Species from Espírito Santo, Brazil

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ABSTRACT. *Neomitranthes obtusa* (Myrtaceae), a treelet from restinga forests in Espírito Santo, southeastern Brazil, is described, illustrated, and compared with the apparently related *Neomitranthes glomerata*, from which it is distinguished by its obtuse leaves, inconspicuous venation, fewer secondary veins, and smaller petioles.

RESUMEN. *Neomitranthes obtusa* (Myrtaceae), un arbolito de las restingas de Espírito Santo, en el sudeste de Brasil, es descrita, ilustrada y comparada con la especie aparentemente afin *Neomitranthes glomerata*, de la cual se distingue por las hojas obtusas, la venación inconspicua, el número menor de nervios secundarios y los peciolos más cortos.

Key words: Brazil, Myrtaceae, *Neomitranthes*.

Neomitranthes was erected by Legrand (Legrand & Klein, 1977) in order to accommodate three southern Brazilian species formerly described under *Mitranthes*. The main distinction between these two genera lies in the embryo morphology: *Mitranthes* presents well-developed cotyledons and hypocotyl, which are characteristic of subtribe Myrciinae in Myrtaceae; in *Neomitranthes* the cotyledons are well developed but the hypocotyl is absent or inconspicuous, characteristic of subtribe Eugeniinae. Since then, although the independence of *Neomitranthes* is clear, its generic boundaries are far from confidently established. The genus is identified chiefly by its axillary flowers borne in racemes or dichasia that open through a calyptra. Ovaries of *Neomitranthes* have 2 locules with 2 to 6 ovules per locule, and its embryos reveal 2 distinct plano-convex cotyledons occasionally with a small hypocotyl; the wall of the locules in some species is internally pilose, a puzzling character occasionally found in other Eugeniinae such as *Eugenia* and *Hexachlamys*. All these characters except the hairy locules overlap those present in other more widespread Eugeniinae such as *Plinia* and *Siphoneugena* (Landrum & Kawasaki, 1997; Proença, 1990). *Neomitranthes* is ultimately distinguished from *Plinia* by its calyptrate calyx and the ovary with generally more than 2 ovules per locule, and from *Siphoneugena* by the persistence of a calyx tube with the staminal ring in the inner surface after anthesis.

The taxonomic value of the opening of the calyx has been severely challenged (Landrum, 1984) and can be considered at best a very weak generic character; the persistence or not of a calyx tube as a useful character has not yet been properly assessed. This situation points to an impasse in establishing definite generic boundaries; it is plausible that future studies may relegate *Neomitranthes* to synonymy either under *Plinia* or *Siphoneugena*—if not merge these three genera into one inclusive genus, in this case *Plinia*.

The number of species in *Neomitranthes* is unknown. Landrum and Kawasaki (1997) estimated fewer than 5 species, a number surely too conservative, and Mattos, in a series of papers (Mattos, 1981, 1989, 1990, 1997), attained a list of 19 species, an excessive number since some of these species are surely synonyms or are better placed in other genera (e.g., *N. maria-aemiliae* (D. Legrand) Mattos is better treated as *Myrceugenia ovalifolia* (O. Berg) Landrum and *N. hatschbachii* (D. Legrand) Mattos as *Myrceugenia gertii* Landrum; see Landrum, 1984). The species of *Neomitranthes* occur mainly in coastal forest formations from northeastern to southern Brazil, from the states of Bahia to Rio Grande do Sul.

Neomitranthes obtusa Sobral & Zambom, sp. nov. TYPE: Brazil. Espírito Santo: Guarapari, Parque Estadual Paulo César Vinha, 28 July 1998, *O. Zambom & A. Assis 338* (holotype, VIES; isotype, MBM). Figure 1.

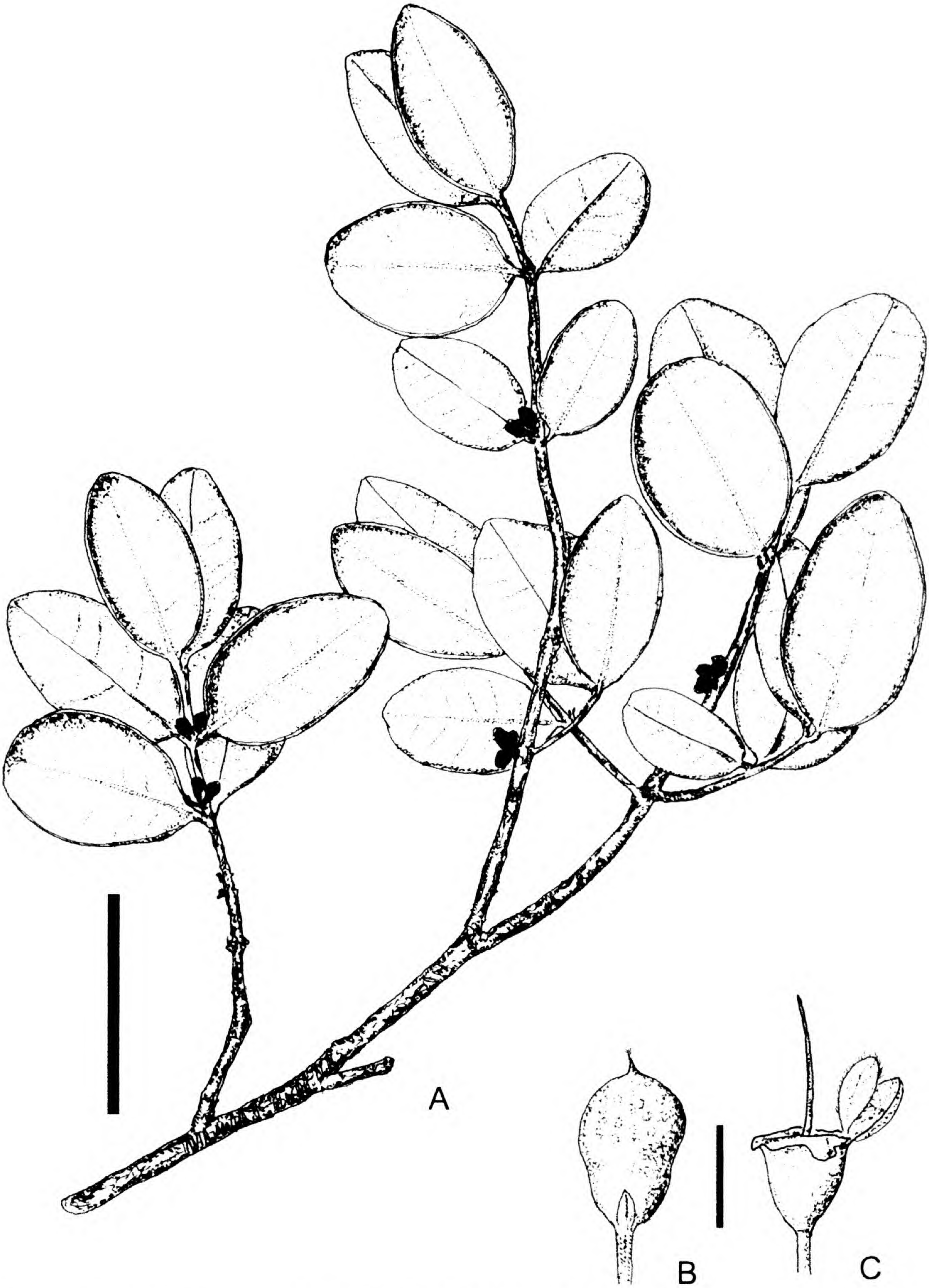

Figure 1. *Neomitranthes obtusa.* —A. Flowering branch (*Zambom & Assis 338*; drawn from isotype at MBM). —B. Closed bud (*Zambom & Assis 339*). —C. Open flower, with stamens detached and petal attached to the larger calyx lobe (*Zambom & Assis 338*). Scale bars A: 50 mm; B, C: 2 mm. Illustration by M. Sobral.

Species *N. glomeratae* proxima, a qua foliis crassis, obtusis, margine forte revoluta, nervis lateralis usque 16, inconspicuis, petiolis brevioribusque recedit.

Treelet 3–4 m high. Plants glabrous. Bark smooth, exfoliating. Leaves elliptic to elliptic-oblong, concolorous to slightly discolorous, chartaceous to coriaceous, (45)65–90 × 30–50 mm, the length/width ratio 1.5–2.5:1, sometimes slightly unequal in the same pair; apex obtuse or rounded; base obtuse or rounded, rarely the very base somewhat acute; central vein strongly convex at the adaxial surface but scarcely convex, plane, or even slightly sulcate abaxially; secondary nerves 8 to 16 pairs, scarcely evident and occasionally convex adaxially, hardly or not at all visible abaxially; marginal vein 1.2–2 mm from the margin, the margin itself strongly revolute; petioles 1.3–2 × 0.5–0.7 mm. Inflorescences axillary or ramiflorous racemes, 1.5–2 × 1 mm, 4- to 6-florous, the flowers whitish at anthesis; bracts rounded-ovate, ciliate, 0.6–0.8 × 0.6–0.7 mm; pedicels 1.3–2 × 0.6–0.7 mm; bracteoles ovate, ciliate, occasionally carinate, deciduous at anthesis, equaling the bracts; buds globose to obovate, 3–5 × 2.5–3.5 mm, apiculate, the apiculum up to 5 mm long and eventually with a tuft of hairs up to 0.1 mm long at the tip; calyx completely fused, tearing irregularly at anthesis and occasionally forming one larger, ± rounded lobe up to 2 mm diam. ("calyptra"); calyx tube 2–3 mm deep; petals absent or 1, generally adnate to the larger calyx lobe, rounded or elliptic, 1.5–3 × 1–2 mm, slightly ciliate; stamens white or creamy, about 80, up to 4 mm long; anthers globose, 0.3–0.4 × 0.3 mm; style up to 7 mm long; ovary 2(3)-locular with 1 or 2 centrally attached ovules per locule. Fruits globose, 1- or 2-seeded, 10–12 mm diam., crowned by the calyx tube, vinaceous when ripe. Seeds with testa easily detachable; embryos reniform, up to 8 × 5 mm, with 2 distinct and sometimes very unequal plano-convex cotyledons and occasionally a hypocotyl 2–2.5 × 1 mm.

Phenology. Flowers collected in June and July; fruits collected in September.

Distribution. The new species has been collected only in the municipality of Guarapari, in the state of Espírito Santo.

Ecology. Neomitranthes obtusa is a treelet of restinga formations (coastal forests growing on sandy soils).

Etymology. The specific epithet refers to the plant's obtuse leaves. Elsewhere in the genus, acuminate or rostrate leaves are more commonly found.

Neomitranthes obtusa is apparently related to *N. glomerata* (D. Legrand) D. Legrand, a species from southern Brazilian coastal forests ranging from São Paulo to Santa Catarina, from which it can be distinguished by the following characters:

1. Leaves with apex obtuse, margins strongly revolute; secondary nerves 8 to 16 pairs, scarcely visible on both faces, generally less evident abaxially; texture chartaceous or occasionally coriaceous; petioles up to 2 mm long; ovary with inner walls of locules glabrous; restingas of Espírito Santo . . . . *Neomitranthes obtusa*

1'. Leaves with apex acuminate or attenuate, margins scarcely or not at all revolute; secondary nerves 20 to 25 pairs, visible on both sides, generally visible abaxially; texture at most chartaceous; petioles 5–10 mm long; ovary with inner walls of locules occasionally pilose; tall coastal forests (mata atlântica) of São Paulo to Santa Catarina . . . . *Neomitranthes glomerata*

Paratypes. BRAZIL. **Espírito Santo:** Guarapari, Parque Estadual Paulo César Vinha, 30 July 1996, *Gomes 2192* (ICN, VIES), 9 June 1998, *Assis 500* (ICN, VIES), 28 July 1998, *Zambom & Assis 339* (MO, VIES), 9 Sep. 1999, *Assis 723* (ICN, VIES).

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Swartzia mexicana (Fabaceae, Swartzieae), a New Species from Oaxaca, Mexico

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ABSTRACT. *Swartzia mexicana*, a new legume species from the State of Oaxaca, Mexico, is described and illustrated. It is presently known only from the districts of Ixtlán and Tuxtepec. The new species belongs to section *Swartzia*, subsection *Swartzia*, and is assigned to series *Tounateae*. Within that series, it is closely related to *S. sumorum* by the leaflets not prominently reticulate, the style uncinate, and the stigma truncate, as well as by the legume elliptic in shape. A key to distinguish the new species from *S. sumorum* and *S. wurdackii* is provided.

RESUMEN. Se describe e ilustra *Swartzia mexicana*, una especie de leguminosas nueva para la ciencia, del estado de Oaxaca, México. Hasta ahora se conoce sólo de los distritos de Ixtlán y Tuxtepec. La especie nueva corresponde a la sect. *Swartzia*, subsect. *Swartzia* y se incluye en la serie *Tounateae*. Dentro de esa serie, se relaciona estrechamente con *S. sumorum* por los foliolos sin nervación reticulada prominente, el estilo uncinado y el estigma truncado, así como por la legumbre de forma elíptica. Se presenta una clave para distinguir a la especie nueva de *S. sumorum* y de *S. wurdackii*.

Key words: Fabaceae, Mesoamerica, Mexico, Oaxaca, series *Tounateae*, *Swartzia*.

Swartzia is a neotropical genus of about 155 species, most of them found in South America. Only two species are known to occur elsewhere, in tropical Africa, according to Cowan (1981). Species of the genus vary from small trees or shrubs (1.5–)3–18 m high, such as *S. invenusta* Barneby and *S. alato-sericea* Barneby, to large trees up to 35–40 m high, such as *S. gigantea* R. S. Cowan and *S. polyphylla* DC. Some slender trees, such as *S. palustris* Barneby, have occasionally sarmentose branches, but the only species with a clambering habit is *S. froesii* R. S. Cowan. The genus is a common component of lowland forests, especially along rivers and in swampy forests, but in the Andean area it can be found from sea level up to 2100 m elevation, as S. *amplifolia* Harms var. *colombiana* R. S. Cowan (Cowan, 1968; Barneby, 1991, 1996).

In Mexico, *Swartzia* is found from Nayarit to Chiapas along the Pacific slope, and it extends eastward to Veracruz, Tabasco, and the Yucatán Peninsula. *Swartzia* habitats include tropical rainforests, semideciduous and deciduous forests, as well as cloud forests. Besides *Swartzia mexicana*, three other species of the genus are known to occur in Mexico: *S. cubensis* (Britton & Wilson) P. C. Standley (Chiapas, Tabasco, Campeche, Yucatán, and Quintana Roo), *S. myrtifolia* J. E. Smith (Veracruz, Oaxaca, Chiapas, Tabasco), and *S. simplex* (Swartz) Sprengel (Nayarit, Jalisco, Michoacán, Guerrero, Veracruz, Oaxaca, and Chiapas). In the State of Oaxaca, the latter two are allopatric to the new species; they are found along the Pacific slope in the districts of Jamiltepec, Pochutla, and Juchitán, growing mainly in lowland forests, 200 to 780 m.s.m., although *S. simplex* has been collected up to 1660 m elevation in the District of Pochutla.

Swartzia cubensis also belongs to series *Tounatae*; it is distinguished from *S. mexicana* by its marginate to winged leaf rachis, shorter inflorescences, and yellow to orange, long stipitate, subglobose or ovate, rostrate fruits. *Swartzia myrtifolia* and *S. simplex* are members of series *Possira*. They are distinguished from the new species by their petaliferous flowers, by the narrowly margined or winged petiole and leaf rachis, and by the subglobose or oblong fruits, very similar to those of *S. cubensis*.

Mesoamerica is a more diverse region: about 9 to 12 species of *Swartzia* have been found from northern Oaxaca and the Isthmus of Tehuantepec,

Figure 1. *Swartzia mexicana* M. Sousa & R. Grether. —A. Branch with leaves and inflorescences. —B. Close-up of stipules. —C. A group of inflorescences in bud. —D. Floral bud and bract. —E. Flower. —F. Stamens. —G. Gynoecium

and in Tabasco, Chiapas, and the Yucatán Peninsula in Mexico, to Panama. The new species is described from the northwestern phytogeographic limit of the Mesoamerican region, as part of the ongoing Flora Mesoamericana project coordinated by the Missouri Botanical Garden, the Instituto de Biología, Universidad Nacional Autónoma de México, and The Natural History Museum (London) (Davidse et al., 1994).

Swartzia mexicana M. Sousa & R. Grether, sp. nov. TYPE: Mexico. Oaxaca: Distrito de Ixtlán, Municipio de Ixtlán de Juárez, 12 km NE de Vista Hermosa, carretera de Ixtlán a Valle Nacional, 17 Apr. 1982, *R. Cedillo-Trigos 1234* & *R. Torres-Colín* (holotype, MEXU; isotypes, BM, MEXU, MO, UAMIZ). Figures 1–3.

Arbor 20–40 m alta; stipulae 1–2.5 mm longae, 0.4–1 mm latae, axis foliaris (petiolus cum rachis) 8–18(–20) cm longus; foliola (5–)7, lanceolato-oblonga, raro elliptica, utrinque glabra, apice acuminata; racemi cauliflori (7–)9–16(–20) cm longi, bracteae 0.6–0.9 mm longae; pediceli 3–7 mm longi, alabastra ad 6 × 5 mm; legumen oblique ellipticum, base atenuata, verrucosum, brunneum, semine uno, elliptico.

Trees 20–40 m high, the bark striate to rugose, grayish brown, with prominent lenticels; branchlets strigulose, rufous, glabrescent. Leaf buds strigose, rufous; young leaves purple, strigulose; mature leaves green, glabrous; stipules 1–2.5 × 0.4–1 mm, subulate to deltoid, strigose to strigulose, deciduous; petioles (1–)2.5–5 cm long, terete to flattened or slightly sulcate on the upper surface, glabrous; rachis (3.5–)5.5–13(–15) cm long, flattened to sulcate on the upper surface, very sparsely strigulose to glabrous, not stipellate; leaflets (5 to)7, the petiolules 3–5 mm, sulcate, glabrous, the blades of the lowermost pair (3.5–)4.5–10 × (2–)2.5–4.5(–5.5) cm, the other pairs (6–)7–14.5(–16) × (2.5–)3–5(–5.5) cm, lanceolate-oblong, rarely elliptic, glabrous on both surfaces, venation tenuous, the main vein prominent on the lower surface, very sparsely strigulose at the base, glabrescent, the base cuneate, the margins entire, thickened, sometimes very slightly revolute, the apex acuminate. Inflorescences racemose, (7–)9–16(–20) cm long, strigose, rufous, cauliflorous, the young racemes growing on very compressed brachyblasts, and disposed in groups of (3 to)6 to 9(to 12), rarely axillary, and solitary; peduncle (0.3–)0.5–1.5(–2) cm long, the peduncle and the floriferous axis strigulose, rufous; bracts 0.6–0.9 × 0.4–0.6 mm, deltoid, strigose, rufous, caducous; bracteoles lacking; pedicels 3–7 mm long, strigose, rufous; floral buds 3.5–6 × 3–5 mm, almost globose, strigulose, rufous, the apex shortly apiculate. Flowers apetalous, calyx 5–5.5 mm long, strigulose, with 4(or 5) irregular lobes, free or shortly fused at the base, green, persistent; corolla lacking; stamens numerous (29 or 30), the longer filaments 6.5–8 mm, free to base, the smaller ones 4–5 mm, white, exceptionally fused in groups of 2 or 3 at the base (Fig. 1F), glabrous, anthers 1.5–2 × 0.8–1.2 mm, oblong to elliptic, nearly basifixed; gynoecium glabrous, ovary stipitate, 4–6 mm long, including the gynophore, the latter 2 mm long, sparsely strigulose at the base, with 4 or 5 campylotropous ovules, obliquely disposed, style 1.5–2 mm, arcuate, glabrous, stigma truncate to obliquely truncate. Legume 4.5–5 × 2–2.3 cm, obliquely elliptic, the base attenuate, the valves 2–5 mm thick, ligneous, verrucose, dark brown, 1-seeded, the apex obliquely obtuse. Seed 3.2 × 1.7 × 1.4 cm, elliptic, the testa chartaceous, rugose, brown, brilliant, the aril probably red, thin.

Common names. "Jarrito silvestre," "palo de jarrito de monte."

Distribution and habitat. As far as we know, the new species is endemic to northern Oaxaca. It occurs in cloud forest with Lauraceae and *Rheedia*, premontane wet forest, and montane tropical rainforest, at elevations of 725–1300 m.

Phenology. It has been collected in flower during March and April, and the fruits have been found in May.

The new species belongs to section *Swartzia*, subsection *Swartzia*, and is assigned to series *Tounateae*, which is characterized by the floral buds usually 5 mm or less in diameter, as well as by the lack of a petal and bracteoles.

Swartzia mexicana is closely related to *S. sumorum* A. R. Molina. Both species share the leaflets not prominently reticulate, the style uncinate, and the stigma truncate, as well as the legume elliptic in shape. It is distinguished from *S. sumorum* by the narrower leaflets, the larger stipules and floral buds, the larger number of leaflets, as well as the longer racemes and pedicels (see key). The new species is also related to *S. wurdackii* R. S. Cowan by the leaf rachis lacking wings or stipels, and the gynoecium glabrous; the latter can be distinguished by the longer stipules, the leaflets with prominent

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with campylotropous ovules. —H. Legume. —I. Seed. (A–G, *R. Cedillo-Trigos 1234* & *R. Torres-Colín*; H, I, *P. Osorio-Hernández 142*).

Figure 2. *Swartzia mexicana* M. Sousa & R. Grether. Close-up of racemes, floral buds, and flowers (photographed from *R. Cedillo-Trigos 1234 & R. Torres-Colín*).

reticulate venation, and the shorter racemes (see key).

Series *Tounateae* comprises 22 species, including *Swartzia mexicana.* Other species of this group with leaf rachis lacking wings or stipels but having a densely pubescent gynoecium are *Swartzia amazonica* Moore occurring in Brazil, *S. bannia* Sandwith known from Suriname and Guyana, and *S. caribaea* Grisebach from the West Indies.

The new species can be distinguished by adding it to Cowan's key to species of series *Tounateae* (1968: 23–24) in his treatment for *Flora Neotropica*, at couplet 11 (p. 23), in the following way:

11. Gynoecium glabrous or sparsely strigose basally.
    12. Stipules 5 mm long; leaflets with prominent reticulate venation; racemes 5–6.5 cm long; Venezuela . . . . *S. wurdackii*
    12. Stipules 0.4–2.5 mm long; leaflets with one prominent vein and tenuous, pinnate venation on the lower surface; racemes (7–)8–16(–20) cm long.
        13. Stipules 0.4–0.5 mm long; leaflets (3 to)5; racemes 8–10 cm long; floral buds

Figure 3. *Swartzia mexicana* M. Sousa & R. Grether. Close-up of open fruit and seed (photographed from *P. Osorio-Hernández 142*).

3 × 3 mm; pedicels 1–1.5 mm long; 2, rarely 1, globose seeds, 1–1.5 cm diam.; Nicaragua . . . . *S. sumorum*
13. Stipules 1–2.5 mm long; leaflets 7(less often, to 5); racemes (7–)9–16(–20) cm long; floral buds 3.5–6 × 3–5 mm; pedicels 3–7 mm long; 1 elliptic seed, 3.2 × 1.7 × 1.4 cm; Mexico . . . *S. mexicana*

Paratypes. MEXICO. **Oaxaca**: Distrito de Ixtlán, Mun. Comaltepec along trail that descends from Hwy. 175 at 1280 m elevation (Puerto Antonio) to settlement of Cuaje, 2–6 Dec. 1994, *B. Boyle & S. Acosta 3960* (MEXU, MO, OAX), *B. Boyle & S. Acosta 4011* (MEXU, MO); Puerto Antonio, 25 Mar. 1989, *R. López-Luna 0438* (MEXU); Distrito de Tuxtepec, Mun. San Felipe Usila, Monte Pan, 3.1 km en línea recta al SE (135°) de Santa Cruz Tepetotutla, 11 Apr. 1994, *P. Osorio-Hernández 37* (MEXU), 7 May 1994, *P. Osorio-Hernández 142* (MEXU), *P. Osorio-Hernández 152* (MEXU); 5.1 km en línea recta al SE (154°) de Santa Cruz Tepetotutla, 29 Mar. 1995, *A. Rincón-Gutiérrez 607, C. Gallardo & E. Pérez-García* (MEXU).

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Rubiacearum Americanarum Magna Hama Pars VI: New Species of and Morphological Notes on *Psychotria* subg. *Psychotria* (Psychotrieae) from Mesoamerica and Western South America

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ABSTRACT. Eight new Neotropical species of *Psychotria* subg. *Psychotria* are described and illustrated here: *P. cerrocoloradensis* of western Panama and *P. matagalpensis* of northern Nicaragua have both previously been confused with *P. sylvivaga* Standley and *P. chiriquina* Standley; *P. cornejoi* of western Ecuador has been previously confused with *P. trivialis* Rusby; *P. jefensis* of Costa Rica and Panama and *P. orosioides* of Costa Rica have both been previously confused with *P. orosiana* Standley; *P. lorenciana* of southern Mexico and Guatemala has been variously confused with *P. grandis* Swartz, *P. flava* Oersted ex Standley, and *P. costivenia* Grisebach; and *P. romolerouxiana* of Amazonian Ecuador and Peru and *P. sacciformis* of lowland Colombia, Ecuador, and Peru have both previously been confused with *P. borjensis* Kunth. The interpretations of stipule morphology and the arrangement of the flowers on the higher-order inflorescence axes as taxonomically informative characters have varied among previous authors and are re-evaluated here.

Key words: Neotropics, *Psychotria*, Rubiaceae.

Psychotria L. (Psychotrieae) in its broad sense comprises approximately 1000 species of shrubs and small trees (or much less often herbs, climbers, or epiphytes) found throughout the tropics. This genus is characterized by its usually woody habit; its relatively small, entomophilous, usually white or cream-colored flowers that are typically distylous; its valvate corolla lobe aestivation; its inferior ovary with usually two locules, each with one basal ovule; and its drupaceous fruits with usually two planoconvex pyrenes. Recently, several studies employing morphological and molecular characters have indicated that Neotropical *Psychotria* as it is currently circumscribed is systematically more complex than has usually been appreciated (Taylor, 1996; Nepokroeff et al., 1999; Andersson & Rova, 1999; Piesschaert, 2001). These studies have distinguished within traditional *Psychotria* several lineages that are not all closely related. The species discussed and described below all belong to *Psychotria* subg. *Psychotria*; all of these studies have considered this a monophyletic group (Steyermark, 1972; Hamilton, 1989; Taylor, 1996; Nepokroeff et al., 1999; Andersson & Rova, 1999; Piesschaert, 2001).

Neotropical *Psychotria* subg. *Psychotria* is characterized by the distinctive color of its dried specimens, which usually are strongly tinged with brown, red-brown, red-gray, gray, or gray-green; its stipules of widely varied form but that are usually quickly caducous exposing a ring of well-developed infrastipular colleters (i.e., glandular trichomes), which are up to 3 mm long and typically persistent on the stem as a chestnut-brown fringe; its white flowers that are relatively short, with tubes 1–8 mm long, and pubescent in the throat and/or at the point of stamen insertion; and its orange to red fruits that bear two planoconvex, usually longitudinally ridged pyrenes. The pyrenes are characterized by an alcohol-soluble reddish pigment and a lack of preformed germination slits, and both of these characters are shared with paleotropical species of *Psychotria* subg. *Psychotria* (Petit, 1964; Nepokroeff et al., 1999; Piesschaert, 2001). In contrast, the other two large Neotropical groups within *Psychotria* s.l., section *Notopleura* [= *Notopleura* (Bentham & Hooker f.) Bremekamp; Taylor, 2001b] and subgenus *Heteropsychotria* Steyermark, have dried specimens with a usually green or brown-green color, stipules of various forms but that are usually persistent and without colleters or with these caducous or drying clear, fruits that may be orange or red at maturity but are more often white, blue, or purple, and pyrenes two to five per fruit and widely varied in form but lacking alcohol-soluble red pigments and bearing preformed germination slits.

Below I re-evaluate some morphological characters that have and also have not been emphasized by previous authors to distinguish among species of *Psychotria* subg. *Psychotria*, and describe several new species.

RECONSIDERATION OF SOME MORPHOLOGICAL CHARACTERS

Hamilton (1989) monographed 61 species of *Psychotria* subg. *Psychotria* found from Mexico through Panama, and contributed significantly to the knowledge of the Neotropical species of this group in several aspects. He presented the first careful consideration of morphological characters with taxonomic significance in this group, and for the most part his work is extremely useful. He relied strongly on details of inflorescence arrangement, leaf venation patterns, and specimen drying colors to separate species and delimit species groups, with much success. However, the use of these characters is problematic at times. For example, in some species there is wide variation in the pattern of leaf venation, as Hamilton noted in his descriptions (e.g., *P. panamensis* Standley). Also, the specimen drying color may depend on preparation of the material, for example, treatment of it with alcohol, as much as on the biology of the plant, and specimens of subgenus *Heteropsychotria* occasionally show the same drying colors for either of these reasons. And, Hamilton's characterization of inflorescence arrangement is based on fully developed inflorescences, so plants with poorly developed or broken inflorescences may be difficult to identify.

In the years since the publication of Hamilton's treatment, numerous additional good collections of these plants have been made, contributing much new morphological and floristic information. Study of *Psychotria* subg. *Psychotria* for the upcoming *Flora Mesoamericana* treatment incorporated these specimens and found that some of the characters Hamilton used, in particular flower arrangement, are more variable and therefore less informative than has been assumed while others, in particular stipule morphology, are more informative than has been recognized.

Much work remains to be done to understand inflorescence structure in *Psychotria*, and a detailed analysis will not be presented here, but some aspects of Hamilton's work require comment in the light of these new collections. In particular, Hamilton (1989) distinguished two general floral arrangements: "flowers sessile in glomerules" in contrast with "flowers pedicellate" in cymules, which he used to separate species and species groups. However, this distinction can be problematic to apply in many species of *Psychotria*. The flowers of these species are arranged in generally dichasial cymules that bear one sessile or subsessile terminal flower subtended by one or two developed higher-order axes, which in turn produce another terminal flower or group of flowers and frequently also a still higher-order set of axes that in turn produce another flower or cymule. The individual flowers may be borne separately along the axes, or in some species are consistently arranged in glomerulate groups of two to several flowers. In this latter case the glomerulate arrangement recognized by Hamilton is usually clear. In the former case, the terminal flower as well as the flowers produced on the higher-order axes are sometimes clearly pedicellate, so their arrangement is clear. However, in many species the terminal flowers are subsessile and the arrangement is ambiguous for the flowers at the ends of the higher-order axes, because they are separated along these axes and the structures that support them can be, and variously have been, considered pedicels or higher-order axes. Hamilton (1989) distinguished several species groups based on whether the flowers are pedicellate or sessile, but he did not clarify his definition of these higher-order axes and seems himself to have called them pedicels in some species groups but axes in others. The position of the flowers produced on these higher-order axes has also been variously described because sometimes the higher-order axes elongate as the fruits develop, so the flowers at anthesis are subsessile in glomerules while the fruits are clearly separated on the tardily developing axes, or pedicels.

Below and in the upcoming *Flora Mesoamericana* treatment, the term "sessile" is applied to flowers that are attached directly (i.e., without a pedicel) to developed higher-order axes at anthesis and have the floral bracts borne directly at the base of the hypanthium (i.e., ovary portion; Fig. 2L). Pedicels can be distinguished from higher-order axes by the location of floral bracts at their bases or in their lower portions but not next to the flower (Figs. 2H, 3D).

Another complicating factor in the interpretation of "sessile" vs. "pedicellate" flowers in this group is the presence in some species of a stipe on the fruit (e.g., *Psychotria panamensis*) even though the flowers are sessile at anthesis. These structures have been called pedicels by most previous authors but are interpreted here instead as a stipitate prolongation of the fruit base, because the elongation begins with and parallels fruit development; because this structure elongates distally leaving the floral bracts at its base; and because the zone of fruit dehiscence is located at the base of this structure rather than at its connection to the fruit base.

Hamilton described and very nicely illustrated (1989: fig. 2) the variety of stipule forms found in this group, and for most species he described the stipules accurately according to his classification. He commented (1989: 68) that "Stipules can provide valuable information as to interspecific relationships but prove almost worthless as a source of key characters, since in this subgenus they are usually caducous, or deciduous," and did not emphasize stipule form in the keys or descriptions. However, stipule morphology actually appears to be highly consistent within a species, highly informative taxonomically, and usually evident on herbarium specimens (and always evident on living plants). Below and in the upcoming *Flora Mesoamericana* treatment, stipule morphology is strongly emphasized in the characterization of species.

Hamilton (1989) classified stipules as "sheathing" when there was any degree of union across the intrapetiolar portions of the stipules, from very short fusion at the bases to complete fusion into a single continuous structure, and whether or not the united portion breaks apart easily when the leaves expand (e.g., *P. carthagenensis* Jacquin) or remains permanently fused (e.g., *P. panamensis*). Below and in the upcoming *Flora Mesoamericana* treatment, a distinction is made among his various forms of "sheathing" stipules to recognize the following types:

- stipules that are interpetiolar and also shortly and/or weakly united in the intrapetiolar portion and quickly separate along this intrapetiolar line (e.g., *P. carthagenensis*; Hamilton 1989: fig. 2a, e), here called "interpetiolar and shortly intrapetiolar";
- stipules that are fused around the stem into a tube that is open at the top, and fall off as a tube that is complete or sometimes split open on one side (e.g., *P. chagrensis* Standley; Hamilton 1989: fig. 2g), here called "tubular";
- and stipules that are completely fused into a conical cap that falls off as a single unit (e.g., *P. trichotoma* M. Martens & Galeotti; Hamilton 1989: fig. 2d), here called "calyptrate."

Hamilton (1989) used the term "biaristate" rather generally for any stipules with two aristas or narrow lobes in some part, combining under this term both the condition with the lobes solitary on each interpetiolar side for a total of two at each node and the condition with two lobes on each interpetiolar side for a total of four at each node (e.g., Hamilton, 1989: figs. 2e and 2g, both described in the respective species descriptions as "biaristate"). Below and in the upcoming *Flora Mesoamericana* treatment, the varied stipule forms in *Psychotria* subg. *Psychotria* are all considered to be derived from two interpetiolar, bilobed stipules, so the number of aristas or lobes is counted with respect to each *interpetiolar* portion. Thus, stipules with two aristas at each node (Hamilton, 1989: fig. 2g) are here considered different from those with four aristas at each node (Hamilton, 1989: fig. 2e). No single Neotropical species of *Psychotria* subg. *Psychotria* has yet been seen with both of these stipule forms.

NEW SPECIES

Psychotria cerrocoloradensis Dwyer ex C. M. Taylor, sp. nov. TYPE: Panama. Chiriquí: Cerro Colorado, on road, 31.6 km from Río San Félix bridge, 1690 m, 15 July 1976, *G. A. Sullivan 332* (holotype, MO-2616700). Figure 1A, B.

Haec species a *Psychotria amplifronde* pedunculo longiore, a *P. rufiramea* inflorescentia ampliore atque a *P. sylvivaga* bracteis floralibus pedicellis et limbo calycino longioribus distinguitur.

Shrubs to 1.5 m tall; stems densely lanuginose-hirtellous to glabrescent. *Leaves* elliptic, 10–22 × 3–10 cm, chartaceous, at apex acuminate, at base cuneate to obtuse or truncate, above glabrous, below densely strigillose to sericeous on veins and glabrous to sparsely puberulous on lamina; secondary veins 10 to 16 pairs, united in a somewhat looping submarginal vein, abaxially without domatia in axils, adaxially venation plane or sometimes a little impressed, abaxially costa prominent and secondary and tertiary venation prominulous; petioles 1.4–3.5 cm long; *stipules* caducous, interpetiolar and shortly intrapetiolar, lanceolate, 13–17 mm long, at apex acute and shortly bidentate with the teeth to 3 mm long and ligulate to triangular, abaxially densely lanuginose to strigillose except glabrescent toward margins. *Inflorescences* terminal, strigillose to lanuginose, peduncle 3.5–7.5 cm long, branched portion 6–14 × 7–20 cm, pyramidal; secondary axes 2 per node, branched; bracts puberulous, 1.5–8 mm long, narrowly triangular, floral bracts 1.5–3 mm long, ovate to lanceolate; pedicels 0–0.5 mm long; *flowers* sessile to subsessile in dichasial to umbelliform cymules of 3 to 7; hypanthium 0.8–1 mm long, turbinate, glabrous; calyx limb 1.8–2 mm long, glabrous, lobed for ¼–½, lobes triangular, ciliolate; corolla tubular-funnelform, white, externally glabrous, internally glabrous except densely pilosulous at stamen insertion, tube ca. 3.5 mm long, lobes 5, ca. 1.5 mm long, triangular; anthers ca. 1 mm long, included; stigmas ca. 0.8 mm long, exserted. *Infructescences* similar in shape and size to inflorescences; immature *fruits* ellipsoid to obovoid.

Habitat, distribution, and phenology. In wet montane forest, 1630–1700 m, western Panama; collected in flower in July and August.

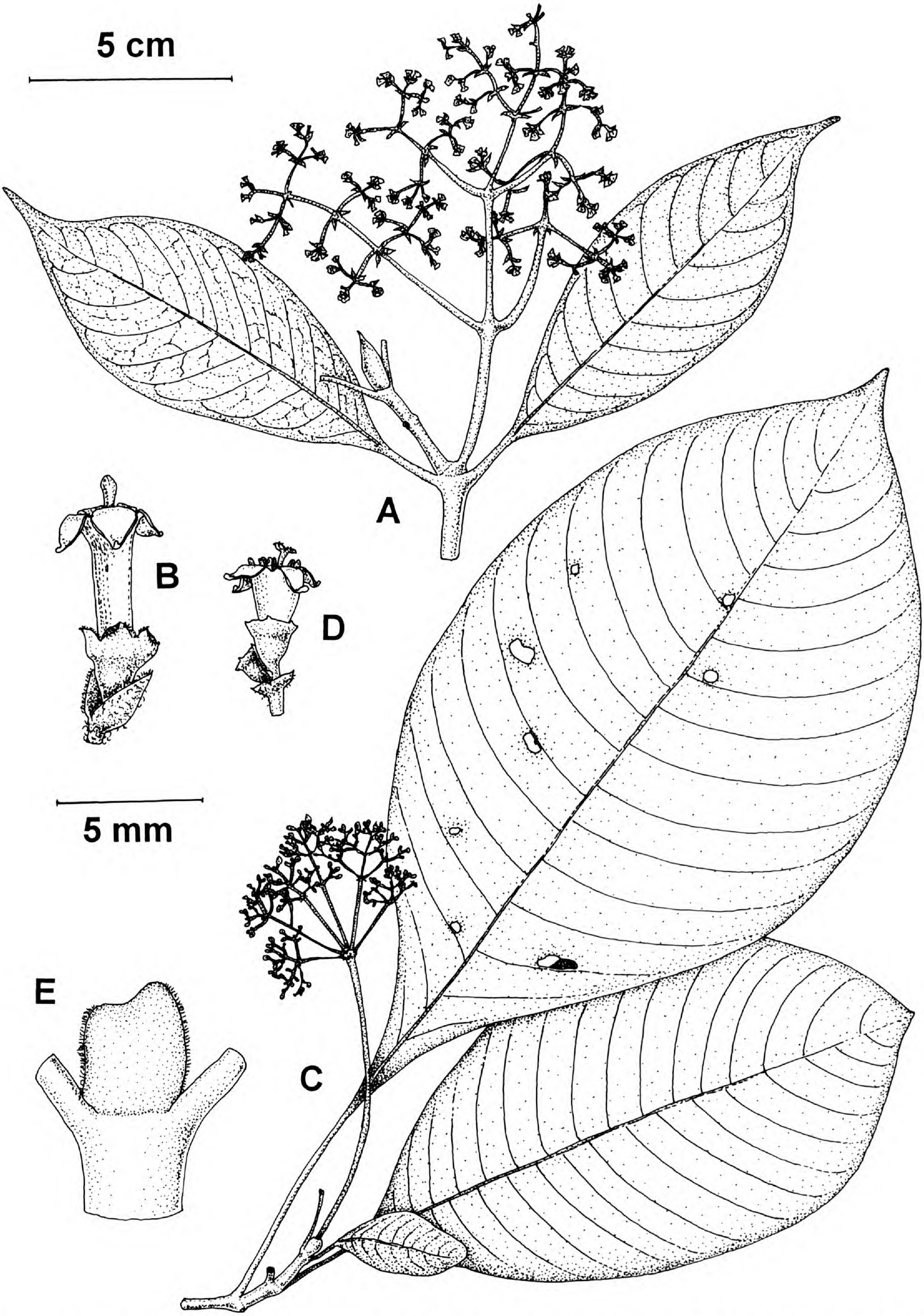

Figure 1. A, B. *Psychotria cerrocoloradensis* C. M. Taylor. —A. Flowering stem. —B. Flower at anthesis. C–E. *Psychotria lorenciana* C. M. Taylor. —C. Flowering stem. —D. Flower at anthesis. —E. Stipule. A, based on *Croat 69148*; B, based on *Sullivan 332*; C, E, based on *Contreras 10014*; D, based on *Lundell & Contreras 19332*. A, C to 5-cm scale; B, D, E to 5-mm scale.

John Dwyer originally recognized this species as new and proposed this epithet, which refers to the collection locality of the Panamanian specimens. *Psychotria cerrocoloradensis* is similar to *P. amplifrons* Standley, which differs by its shorter peduncles 0.3–2 cm long; to *P. rufiramea* Standley, which differs by its smaller inflorescences with the branched portion 1.5–4 × 2–4 cm; and to *Psychotria sylvivaga,* which differs by its shorter floral bracts 0.5–1.5 mm long, longer pedicels 0.5–2 mm long, and shorter calyx limbs 1.2–1.5 mm long. The flowers seen are all similar to the long-styled form of distylous *Psychotria* species in the arrangement of their anthers and stigmas.

Paratypes. PANAMA. **Bocas del Toro:** Cerro Colorado, 6.5 mi. W of Chamé, steep forested slopes N of road, 8°35′N, 81°50′W, *Croat 69148* (MO). **Bocas del Toro/Chiriquí Border:** Cerro Colorado, 11.2 km along ridge road from main road to Escopeta, *Folsom 4888* (MO). **Chiriquí:** Cerro Colorado, along mining road 31.6 km beyond bridge over Río San Félix (10.6 km beyond turnoff to Escopeta), *Croat 37158* (MO).

Psychotria cornejoi C. M. Taylor, sp. nov. TYPE: Ecuador. Guayas: 3 km E of Olón (5 km N of Manglarolto, on the beach), 75–190 m, 20 Dec. 1961, *C. H. Dodson & L. B. Thien 1669* (holotype, MO-3849660). Figure 2A–D.

Haec species a congeneris stipulis interpetiolaribus uniaristatis ac plerumque dense hirtellis atque foliorum sat parvorum supra medium latiorum nervis secundariis camptodromis distinguitur.

Shrubs and small trees to 6 m tall; stems glabrous. *Leaves* elliptic to usually obovate or oblanceolate, 2.5–11.5 × 1.5–5 cm, papyraceous, at apex acute to a little acuminate, at base cuneate to acute and attenuate, adaxially glabrous, abaxially glabrous except sometimes hirtellous on costa and occasionally also secondary veins; secondary veins 4 to 6 pairs, not looping to interconnect, abaxially without or often with pit domatia in axils of 2 or 3 apical pairs of secondary veins, domatia sacciform, 0.5–1.5 mm long, a little elongated, generally appressed to blade, adaxially costa prominulous and remaining venation plane, abaxially costa and secondary veins prominulous and remaining venation plane; petioles 1.5–20 mm long; *stipules* caducous, interpetiolar, lanceolate to triangular, 3–4 mm long (excluding aristas), glabrous to densely hirtellous and often becoming glabrescent, acute to obtuse and 1-aristate, aristas 0.8–3 mm long, puberulous to hirtellous. *Inflorescences* terminal, glabrous, peduncles 0.2–6 cm long, branched portion 2.5–9 × 3–10 cm, pyramidal, secondary axes 2 per node, branched; bracts 0.3–1.5 mm long, elliptic to triangular or linear, ciliolate; pedicels 1–2 mm long; *flowers* pedicellate in umbelliform cymules of 2 to 5; hypanthium turbinate to cylindrical, ca. 0.8 mm long, glabrous; calyx limb 0.5–0.8 mm long, glabrous, entire to denticulate; corolla funnelform, white, externally glabrous, barbate in throat, tube 1.5–2 mm long, lobes 5, 1.5–2 mm long, narrowly triangular; anthers ca. 1.2 mm long, exserted; stigmas ca. 1 mm long, partially exserted. *Fruits* ellipsoid, ca. 5 × 4 mm, apparently red; pyrenes 2, planoconvex, dorsally with ca. 5 rounded longitudinal ridges.

Habitat, distribution, and phenology. In premontane dry forest and seasonal cloud forest at 50–1155 m, central western Ecuador; collected in flower in January, March, September, November, and December, in fruit July through September and in November.

This species is distinguished by its combination of interpetiolar stipules that are aristate and usually densely hirtellous, its relatively small leaves that are broadest above the middle, its secondary leaf veins not looping to interconnect, and its elongated sacciform domatia. In form these domatia are unusual in this genus but somewhat similar to those of *Psychotria sacciformis* of Amazonian Ecuador and Peru; they are discussed further under that species, below. The flowers seen are generally similar to the short-styled form of distylous *Psychotria* species in the arrangement of their anthers and stigmas, except the stigmas appear to be partially exserted. The specific epithet honors Xavier Cornejo, an Ecuadorian botanist who is exploring extensively in the western part of the country and documenting its flora, including this new species.

Paratypes. ECUADOR. Without location, "Coast plain," *Rimbach 99* (F). **El Oro:** Hacienda Daucay, 3°29′S, 79°45′W, *Cornejo & Bonifaz 2537* (MO); Hacienda Buenaventura, 12 km W of Piñas on road to Machala, 3°48′S, 79°46′W, *Kessler 2588* (MO); trail between Portovelo and Zaruma, *Steyermark 53984* (F). **Guayas:** Cordillera Chongón-Colonche, Bosque Protector Loma Alta, 1°48′S, 80°47′W, *Cornejo & Bonifaz 5242* (MO); Cerro de Caña, Cordillera de Colonche, *Valverde 1014* (MO). **Los Ríos:** near Quevedo, Cantón Vinces, *Méxia 6602A* (F). **Manabí:** San Sebastián, Parque Nacional Machalilla, 1°35′S, 80°42′W, *Cornejo & Bonifaz 1235* (MO), 1°36′S, 80°42′W, *Gentry et al. 72502* (MO); Cerro Montecristi, *Dodson & Thien 1720* (MO), *Gilmartin 326* (MO); cantón Montecristi, Cerro Montecristi, carretera Manta–Jipijapa, entrada por Montecristi o El Chorrillo, 1°02′S, 80°41′W, *Núñez et al. 391* (MO); cantón Pedernales, Cerro Pata de Pájaro a 10 km al E de Pedernales, a 5 km del rancho de la familia Arroyo, 00°01′N, 79°57′W, *Vargas 1289* (MO).

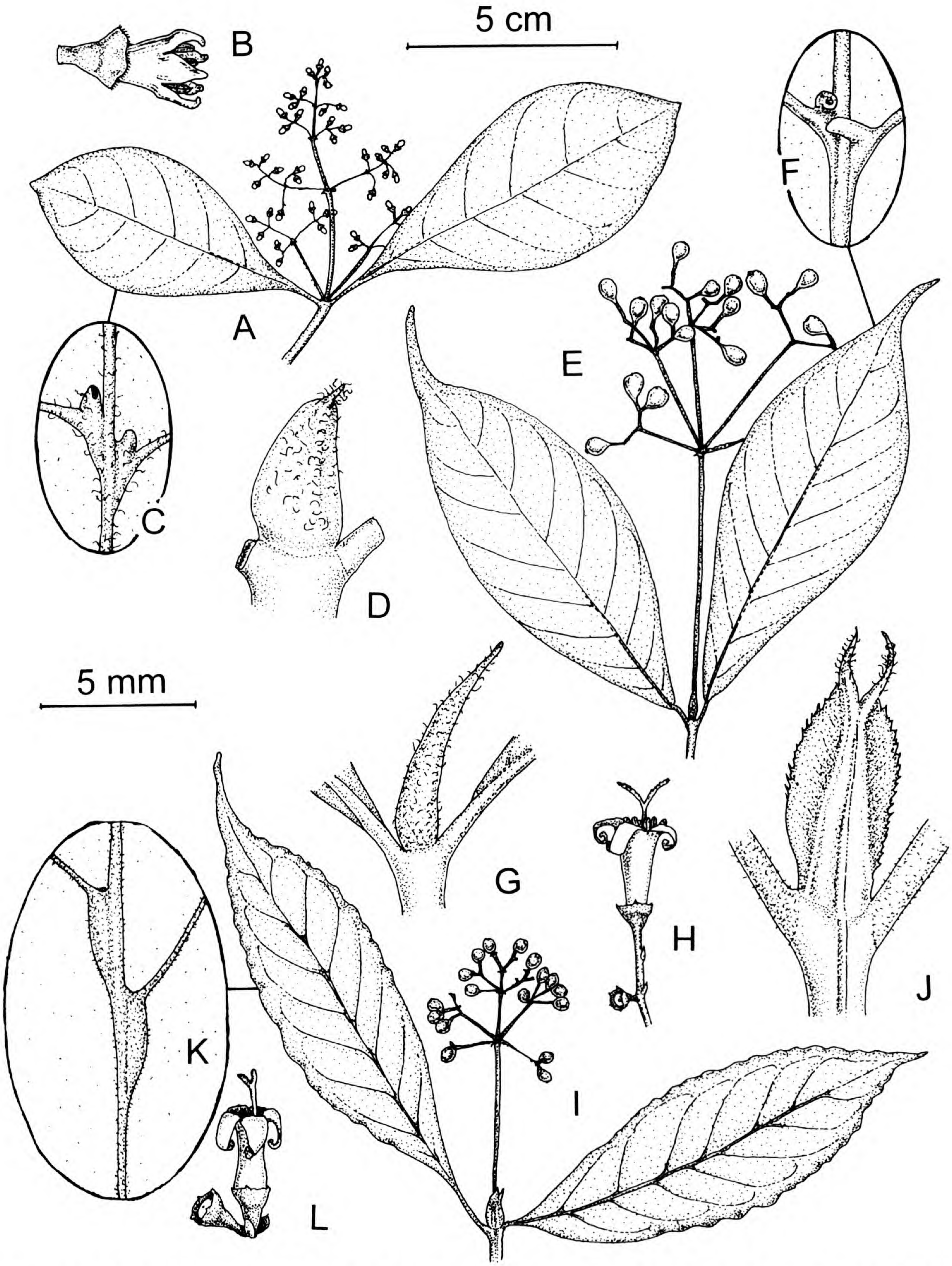

Figure 2. A–D. *Psychotria cornejoi* C. M. Taylor. —A. Flowering branch. —B. Flower bud, partially opened. —C. Detail of abaxial leaf surface, showing two domatia situated in the abaxial axils of two secondary veins with the costa. —D. Stipule. E–H. *Psychotria sacciformis* C. M. Taylor. —E. Fruiting stem. —F. Detail of abaxial leaf surface, showing two domatia situated in the abaxial axils of the secondary veins with the costa. —G. Stipule. —H. Detail of cymule with flower at anthesis. I–L. *Psychotria romolerouxiana* C. M. Taylor. —I. Fruiting stem. —J. Stipule. —K. Detail of abaxial leaf surface, showing two domatia situated in the abaxial axils of two secondary veins with the costa. —L. Detail of cymule with flower at anthesis. A, based on *Gentry et al. 72502*; B, C, D, based on *Dodson & Thien 1669*; E, based on *Alvarez et al. 36*; F, H, G, based on *Romoleroux et al. 2575*; I, based on *Croat 19475*; J–L, based on *Romoleroux & Foster 1684*. A, E, I, to 5-cm scale; all others to 5-mm scale.

Psychotria jefensis Dwyer ex C. M. Taylor, sp. nov. TYPE: Costa Rica. Puntarenas: cantón de Osa, Fila Costeña, Fila Cruces, cabeceras del Río Piedras Blancas, Cerro Anguciana, faldas al O, 8°49′N, 83°11′W, 1000–1400 m, 8 Dec. 1988, *B. Hammel, R. Aguilar & M. Grayum 19214* (holotype, INB; isotype, MO-5169726). Figure 3F, G.

Haec species a *Psychotria orosiana* et *P. laselvensi* lobulis stipularibus hirtellis, foliis domatiis foveolatis carentibus atque limbo calycino longiore distinguitur.

Small trees to 4 m tall; stems glabrous. *Leaves* narrowly elliptic-oblong, 6.5–19.5 × 2–4.5 cm, papyraceous to chartaceous, at apex acute to somewhat acuminate, at base acute to cuneate, adaxially and abaxially glabrous; secondary veins 10 to 21 pairs, looping at least loosely to interconnect, abaxially without domatia, adaxially costa plane to thickened and remaining venation plane, abaxially costa prominulous, secondary veins thickened, and remaining venation plane; petioles 5–8 mm long, glabrous; *stipules* caducous, interpetiolar, lanceolate, ca. 6 mm long, glabrous, acute and 1-aristate, aristas ca. 3 mm long, hirtellous. *Inflorescences* not seen. *Infructescences* terminal, glabrous, peduncle 1.5–6.5 cm long, branched portion 4–9 × 6–10 cm, pyramidal; secondary axes 2 per node, branched; bracts 0.5–2 mm long, deltoid, glabrous, deciduous; pedicels 1–3 mm long; *fruits* pedicellate in umbelliform cymules of 3 to 8, subglobose, 4 × 4–4.5 mm, glabrous, with persistent calyx limb 1–1.2 mm long, shallowly lobed, glabrous; pyrenes 2, planoconvex, dorsally with 4 to 5 rounded longitudinal ribs.

Habitat, distribution, and phenology. In wet forest at 650–900 m, Osa Peninsula of Costa Rica and central to eastern Panama; collected in fruit in April and December.

This new species is similar to *Psychotria orosiana* and *P. laselvensis* C. W. Hamilton, both of which can be distinguished from this new species by their glabrous to puberulous stipule lobes, leaves usually with foveolate domatia in the abaxial vein axils, and shorter calyx limbs 0.2–0.8 mm long. Although flowers have not been seen, the fruiting collections show adequate morphological features to distinguish this species. John Dwyer originally recognized this species as new and proposed this epithet, which refers to the collection locality of one of the Panamanian specimens.

Paratypes. PANAMA. **Panamá:** vicinity of Cerro Jefe, Altos de Pacora, *Antonio 3228* (MO). **San Blas:** Cerro Brewster, headwaters of Río Cangandí, 9°18′N, 79°16′W, *de Nevers et al. 5489* (MO).

Psychotria lorenciana C. M. Taylor, sp. nov. TYPE: Guatemala. Izabal: El Estor, bordering Río Sarco, El Milagro Ranch, 22 May 1975, *C. L. Lundell & E. Contreras 19332* (holotype, MO-3763295; isotype, F). Figure 1C–E.

Haec species a *Psychotria grandi, P. costivenia* et *P. flava* fructu subgloboso in diam. 4–5 mm atque inflorescentiae rotundato-corymbiformis axibus secundariis imis insigniter bene evolutis distinguitur.

Shrubs or small trees to 15 m tall; stems glabrous. *Leaves* elliptic to oblanceolate or obovate, 15–25 × 5.5–11 cm, papyraceous, glabrous above and below or sometimes below puberulous on costa and less often also on secondary veins, at apex obtuse to deltoid, at base cuneate to acute; secondary veins 14 to 19 pairs, sometimes looping to interconnect at least in distal portion of blade, abaxially without domatia, adaxially venation plane or costa sometimes prominulous, abaxially costa prominent, secondary veins prominulous and lesser venation plane; petioles 1.5–5 cm long; *stipules* interpetiolar, caducous, 5–12 mm long, ovate to elliptic, glabrous except margins ciliolate, rounded to usually emarginate or sometimes 1-aristate with aristas to 2 mm long and inserted at or below apex. *Inflorescences* terminal, glabrous, paniculate, peduncles 4–14 cm long, branched portion 4–17 × 5–26 cm, rounded-corymbiform, secondary axes 2 per node or often 4 and subequal, extensively branched with first internode usually well developed; bracts 0.5–5 mm long, triangular to rounded; pedicels to 1 mm long; *flowers* distylous, mixed sessile and pedicellate in dichasial cymules of 2 to 11; hypanthium turbinate, ca. 0.8 mm long, glabrous; calyx limb truncate to denticulate, ca. 0.5 mm long, glabrous; corolla tubular-infundibuliform, white, externally glabrous, barbate in throat, tube 2–2.5 mm long, lobes 5, deltoid to narrowly triangular, 1.2–2 mm long, acute, smooth abaxially; anthers ca. 1 mm long, included; stigmas ca. 0.5 mm long, exserted. *Fruits* subglobose, 4–5 mm diam., color unknown; pyrenes 2, planoconvex, dorsally slightly ridged to smooth.

Habitat, distribution, and phenology. In wet forests of southern Mexico and Guatemala at 120–800 m, collected in flower in March and May through July, in fruit in February, March, and May.

This new species has previously been confused with the sympatric species *Psychotria grandis, P. costivenia*, and *P. flava*, by both Standley and Williams (1972) and Hamilton (1989). *Psychotria lorenciana* is distinguished from these three species by its subglobose fruits 4–5 mm in diameter and its different inflorescence arrangement, with the secondary axes two at each node or often four, in either case with the secondary axes all ascending and with their basalmost internodes all generally as well developed as the comparable internode of the primary axis. In contrast, these other species have subglobose to usually ellipsoid fruits 5–13 × 4–9 mm and corymbiform to usually pyramidal inflorescences with the secondary axes two at each node or usually four or six, with all of the secondary axes less well developed than the primary axis and when four or six, then also markedly unequal in pairs. The flowers seen are all similar to the long-styled form of distylous *Psychotria* species in the arrangement of their anthers and stigmas. It is a pleasure to dedicate this species to David H. Lorence, a long-time and distinguished student of the Mexican and Mesoamerican Rubiaceae.

Paratypes. GUATEMALA. **Alta Verapaz:** 9 mi. uproad to Oxec along gravel road which turns N off Highway 7E between Tucúru and El Estor ca. 6 km NE of Panzós, *Croat 41672* (MO); between Finca Cubilgüitz and Hacienda Yaxcabanal, *Steyermark 44833* (F), *Steyermark 44837* (F). **Huehuetenango:** around Ixcan at Patcushís, Sierra de los Cuchumatanes, *Steyermark 49197* (F). **Izabal:** Cadenas/Puerto Méndez, bordering Río Dulce, *Contreras 9887* (F); Puerto Méndez/Cadenas, on Río Dulce Road, 19 km, *Contreras 10014* (MO); Puerto Méndez on Río Dulce Road, *Contreras 10309* (F); between Seja/Ciénaga, 5 km from Seja, 200 m E from Río Dulce Road, *Contreras 10204* (F, MO); between Ciénaga/Seja, on Petén/Guatemala Road, *Contreras 10728* (F); El Estor, bordering Lake Izabal, E. in El Zapotillo, *Lundell & Contreras 19299* (F); La Jagua Creek, Murciélago, ca. 10 mi. E of El Estor, Lake Izabal, *Rowland & Snedaker B-5* (F), *Snedaker D-127* (F). **Petén:** La Cumbre, on old Pusila Road, 3 km, top of hill, *Lundell & Contreras 20011* (F). MEXICO. **Chiapas:** mpio. Las Margaritas, western side of Laguna Miramar E of San Quintín, *Breedlove 33160* (MO); mpio. Ocosingo, en el vértice del Río Chixoy, *E. Martínez S. 18941* (F, MO).

Psychotria matagalpensis C. M. Taylor, sp. nov. TYPE: Nicaragua. Matagalpa: ridge between Cerro Bravo and Cerro Picacho, mountains N of Hotel Selva Negra, 13°01′N, 85°55′W, 1490–1550 m, 26 May 1985, *G. Davidse, A. Grijalva & M. Sousa 30484* (holotype, MO-5059845). Figure 3A, B.

Haec species a *Psychotria chiriquina* et *P. sylvivaga* limbo calycino ac corolla brevioribus atque foliis domatiis foveolatis munitis distinguitur.

Shrubs or small trees to 8 m tall; stems glabrous. *Leaves* elliptic, 4–10.5 × 1–3 cm, papyraceous, at apex acute to acuminate, at base acute, abaxially and adaxially glabrous; secondary veins 4 to 5 pairs, not looping to interconnect, abaxially with 2 to 4 pairs of veins bearing well developed, glabrous to occasionally pilosulous, foveolate domatia, adaxially venation plane, abaxially costa and secondary veins thickened and remaining venation plane; petioles 1–2.5 cm long, glabrous; *stipules* caducous, interpetiolar and shortly also intrapetiolar, elliptic to obovate, 4–18 mm long, obtuse to acute and sometimes shortly bidentate, glabrous, margins ciliolate and often membranaceous. *Inflorescences* terminal, glabrous, sessile or subsessile and appearing fasciculate, 3–5 × 3–5 cm, broadly pyramidal to corymbiform-rounded; secondary axes 2 per node, branched, with basalmost pair generally equally well developed as primary axis; bracts 0.2–0.5 mm long; pedicels 1–3 mm long; *flowers* pedicellate in umbelliform cymules of 3 to 7; hypanthium 0.8–1 mm long, glabrous, turbinate; calyx limb 0.6–1 mm long, glabrous, subtruncate to broadly and shallowly dentate; corolla salverform, white, externally glabrous, internally densely pilosulous at stamen insertion, tube ca. 3 mm long, lobes 5, ca. 2 mm long, triangular to narrowly so; anthers ca. 0.8 mm long, exserted; stigmas ca. 0.8 mm long, exserted. *Infructescences* similar in size and shape to inflorescences; fruits ellipsoid to ellipsoid-obovoid, 6–7 × 4.5–5 mm, red; pyrenes 2, planoconvex, dorsally with 4 to 5 rounded longitudinal ribs.

Habitat, distribution, and phenology. In wet montane, cloud, and dwarf forest with boreal elements at 920–1700 m, central-western Nicaragua; collected in flower May through August, in fruit January through May and August through December.

This new species is similar to *Psychotria chiriquina* of Costa Rica and Panama, with which it was confused by Hamilton (1989) and Taylor (2001a); *P. chiriquina* differs from this new species by its longer calyx limbs 1–1.6 mm long, its longer corolla tubes 4–7 mm long, and its leaves without domatia in the abaxial vein axils or with only a tuft of pubescence here. The specific epithet refers to the region from which this new species is known. The flowers seen are all similar to the short-styled form of distylous *Psychotria* species in the arrangement of their anthers and stigmas. This new species is also similar to *P. sylvivaga*, also of Costa Rica and Panama, which differs from *P. matagalpensis* by its longer calyx limbs 1.2–1.5 mm long, its longer corolla tubes 4–5 mm long, and its leaves without domatia in the abaxial vein axils or with only a tuft of pubescence here.

Paratypes. NICARAGUA. **Jinotega:** la entrada a "Aranjuez", 13°01′–02′N, 85°55′–56′W, *Araquistain 3645* (MO); carretera Matagalpa–Jinotega, entre el Km 133–134, a 10 km al SE de la ciudad de Jinotega, 13°01′30″N, 85°55′W, *Grijalva & Araquistain 175* (MO); Kilambé, "Paricutín", 4 km al SE del Cerro Kilambé, 13°35′N, 85°40′W, *Moreno 7459* (MO); Cerro Kilambé,

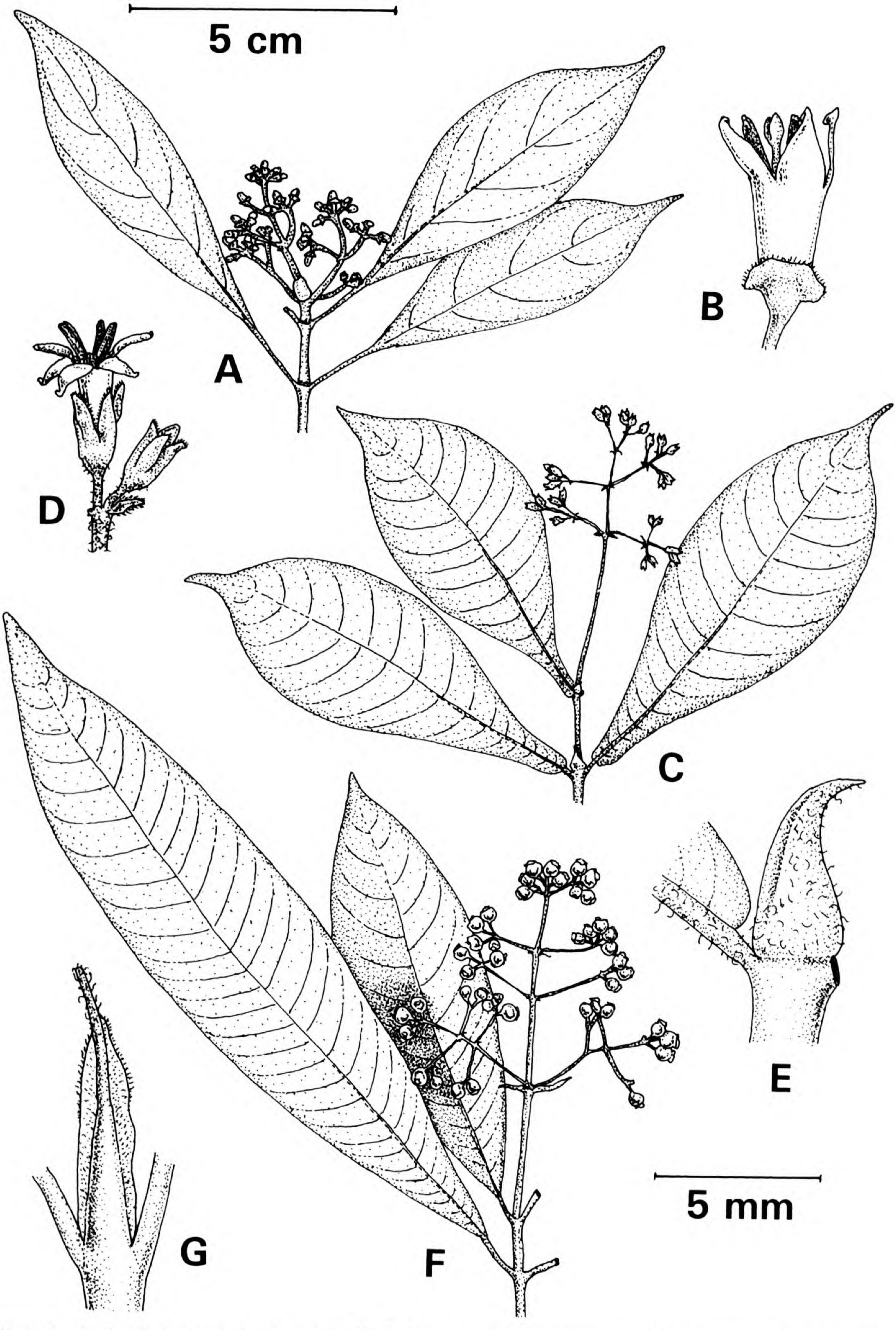

Figure 3. A, B. *Psychotria matagalpensis* C. M. Taylor. —A. Flowering branch. —B. Mature flower bud, partially opened. C–E. *Psychotria orosioides* C. M. Taylor. —C. Flowering branch. —D. Detail of cymule with flower at anthesis.

faldas E del Pico Piedra Pelona, 13°34′N, 85°40′W, *Moreno 7752* (MO), *Moreno 7759* (MO); Montaña Cuspire, 13°17′N, 86°09′W, *Moreno 8036* (MO); along Hwy. 3 ca. 1.9 km NW of Aranjuez road entrance, 13°02′N, 85°56′W, *Stevens 5625* (BM, MO), *Stevens 9178* (BM, MO); Macizos de Peñas Blancas, along trail between finca of Socorro Mejía and finca of Luis Manzanares, 13°16′–17′N, 85°40′–41′W, *Stevens 11317* (MO); along Hwy. 3 ca. 1 km NW of La Fundadora entrance, unnamed peak ca. 500 m W of hwy., 13°01′N, 85°56′W, *Stevens & Henrich 20445* (MO), *Stevens & Miller 22461* (BM, MO). **Madriz:** Cerro Pataste, *Neill 129* (MO); Cerro Volcán Somoto (Volcán Tepesomoto), 13°26′N, 86°35′W, *Moreno 2870* (MO), 13°25′N, 86°34′W, *Moreno 20073* (MO). **Matagalpa:** Finca Los Alpes, 9 km NE de Matagalpa, 12°57′N, 85°21′W, *D. Castro 2536B* (MO); El Porvenir, Cordillera Central of Nicaragua, *A. Molina R. 20516* (F); Cordillera Central of Nicaragua, vicinity El Porvenir 4 km E of Santa María de Ostuma, *A. Molina R. 22920* (F, MO); El Picacho, E of Santa María de Ostuma, Cordillera Dariense, *A. Molina R. & A. R. Molina 30521* (F); Cerro El Picacho, N del Hotel Selva Negra, 13°00′N, 85°55′W, *Moreno 21678* (MO), *Nee 27621* (MO), *Nee 27633* (MO); Cordillera Dariense, Hacienda Santa María de Ostuma, 10 km N of Matagalpa, *Neill 2304* (BM, MO), *Neill 3167* (BM, MO), *Tomlin 24* (MO), *Tomlin 60* (BM, MO), *Tomlin 126* (MO), *Tomlin 145* (MO), *Tomlin 157* (MO); Macizos de Peñas Blancas, SE side, drainage of Quebrada El Quebradón, slopes N and W of Hacienda San Martín, 13°14′–15′N, 85°38′–39′W, *Stevens et al. 21145B* (MO); NW slope of Cerro El Picacho, 13°00′N, 85°55′W, *Stevens 22157* (MO); "Disparate de Potter," Santa María de Ostuma, Cordillera Central of Nicaragua, *L. O. Williams & T. P. Williams 25051* (F), *Williams et al. 27594* (BM, F), *Williams et al. 29176* (F); Santa María de Ostuma, Cordillera Central de Nicaragua between Matagalpa and Jinotega, *Williams et al. 23342* (F); Finca Santa María de Ostuma, Cordillera Central of Nicaragua, *L. O. Williams & A. Molina R. 42652* (BM, F).

Psychotria orosioides C. M. Taylor, sp. nov. TYPE: Costa Rica. Alajuela: Reserva Forestal de Arenal, Quebrada San Gerardo, Río Caño Negro, Finca de los Mejías, 10°22′N, 84°48′W, 1200 m, 17 Feb. 1990, *E. Bello 1894* (holotype, CR; isotype, MO-4362126). Figure 3C–E.

Haec species a *Psychotria orosiana* limbo calycino longiore distinguitur.

Shrubs to 2 m; stems hirtellous to glabrescent or glabrous, somewhat flattened. *Leaves* oblanceolate, 8–17 × 3–6 cm, papyraceous, adaxially glabrous, abaxially glabrous except hirtellous on costa and sometimes also secondary veins, at apex acuminate, at base narrowed then abruptly truncate to rounded; secondary veins 10 to 13 pairs, united in a continuous, slightly looping submarginal vein, abaxially with domatia, adaxially and abaxially costa prominulous, secondary veins thickened, and remaining venation plane; petioles 0.5–2 mm long, hirtellous to glabrous; *stipules* caducous, interpetiolar and shortly intrapetiolar, hirtellous, ovate to lanceolate, 5–8 mm long, interpetiolarly 2-aristate, aristas 0.5–2 mm long, hirtellous. *Inflorescences* terminal, puberulous to pilosulous, peduncles 4–10 cm long, branched portion 2–5.5 × 3–10 cm, pyramidal to rounded-corymbiform, secondary axes 2 or 4 per node, branched; bracts 0.5–3 mm long, lanceolate to narrowly triangular; pedicels 0.5–1 mm long; *flowers* pedicellate in umbelliform to dichasial cymules of 3 to 7; hypanthium ca. 0.5 mm long, puberulous to hirtellous, cupuliform to turbinate; calyx limb 1.2–2 mm long, puberulous, lobed for 1/2–2/3, lobes sometimes rather unequal in length on a single flower, narrowly triangular, acute to acuminate, entire to ciliolate; corolla tubular to funnelform, apparently white, externally glabrous, internally densely pilosulous at stamen insertion, tube 2.5–3 mm long, lobes 5, ca. 1.2 mm long, triangular, thickened to shortly hooked at adaxial apex; anthers in short-styled form ca. 1.2 mm long, partially exserted, in long-styled form not seen; stigmas in short-styled form ca. 0.5 mm long and included, in long-styled form ca. 0.8 mm long and exserted. *Fruits* ellipsoid to subglobose, 4–5 × 4–5 mm, red; pyrenes 2, planoconvex, dorsally with 4 to 5 rounded longitudinal ridges.

Habitat, distribution, and phenology. In understory of wet lower montane forest at 900–1400 m in northwestern Costa Rica; collected in flower in February, June, and July, in fruit in April and May.

This new species is similar in overall aspect to *Psychotria orosiana*, which has been collected in the same region and can be distinguished by its shorter calyx limb 0.5–0.8 mm long. The specific epithet refers to the similarity between these species.

Paratypes. COSTA RICA. **Alajuela:** Reserva Biológica Monteverde, Río Peñas Blancas, Altos de Quebrada Portal, 10°17′N, 84°43′W, *Bello 902* (MO); Reserva Biológica Monteverde, Río Peñas Blancas, parcela de Alemán, 10°18′N, 84°45′W, *Bello 962* (MO); Bosque Eterno de los Niños, valley of Río Agua Gata, Atlantic slope, 13 km NE of Monteverde, 10°23′N, 84°42′W, *Haber & Zuchowski 10550* (MO). **Guanacaste:** Río Chiquito de Tilarán, Río Negro valley, Atlantic slope, 10°22′N, 84°52′W, *Haber ex Bello 5879* (MO).

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—E. Stipule and adjacent leaf base. F, G. *Psychotria jefensis* C. M. Taylor. —F. Fruiting branch. —G. Stipule. A, based on *Neill 2304*; B, based on *Davidse et al. 30484*; C, based on *Bello 962*; D, E, based on *Bello 1894*; F, G, based on *Hammel et al. 19214*. A, C, F, to 5-cm scale; all others to 5-mm scale.

Psychotria romolerouxiana C. M. Taylor, sp. nov. TYPE: Ecuador. Napo: Estación Científica Yasuní, parcela de 50 ha, Placa #50094, 00°38′S, 76°30′W, 200–300 m, 10 June [without year; 1995], *K. Romoleroux & R. Foster 1684* (holotype, QCA; isotype, MO-4933514). Figure 2G, I, J, K.

Haec species a *Psychotria borjensi* domatiis foveolatis bene evolutis atque stipulis bilobis longioribus distinguitur.

Shrubs to 2.5 m; stems puberulous to glabrescent. *Leaves* elliptic to narrowly elliptic or oblanceolate, 4.5–20 × 0.9–7 cm, at apex slenderly acuminate, at base acute to sometimes abruptly and shortly obtuse, adaxially glabrous, abaxially glabrous on lamina and densely spreading-puberulous on costa and secondary veins, margins undulate at least when dry; secondary veins 6 to 10 pairs, looping broadly to interconnect with 1 to 2 secondary loops, abaxially 2 to 5 secondary veins near apex usually with domatia in axils, domatia foveolate, 2–5 mm long, with swollen portion fused to costa, adaxially venation plane or costa prominulous, abaxially costa prominulous, secondary veins thickened to prominulous, and higher-order venation plane; petioles 2–6 mm long, sometimes slightly winged; *stipules* persistent on 2 to 5 most distal nodes, interpetiolar and shortly intrapetiolar, obovate to elliptic, 6.5–14 mm long, glabrous except sometimes hirtellous to puberulous in a central line and/or with margins ciliolate to ciliate, at apex bidentate with teeth narrowly triangular, 1–4 mm long, acute to acuminate. *Inflorescences* terminal, puberulous, peduncles 2–4 cm long, branched portion 1–4 × 1.2–8 cm, ovoid to broadly pyramidal or subglobose, secondary axes 4 or 6 per node, shorter and reflexed in pairs, branched one time or terminating in a glomerule; bracts reduced or to 0.8 mm long, triangular; *flowers* sessile in glomerules of 2 to 3, these glomerules often arranged on short dichasial axes; hypanthium ca. 0.5 mm long, cylindrical to turbinate, puberulous; calyx limb ca. 0.5 mm long, denticulate, puberulous; corolla funnelform, white, externally glabrous, internally densely hirtellous at stamen attachment, tube ca. 2.5 mm long, lobes 5, ca. 1.5 mm long, triangular; anthers ca. 1 mm long, included; stigmas 0.8–1 mm long, exserted. *Fruits* ellipsoid, 5–6 × 4.5–5.5 mm, red; pyrenes 2, planoconvex, dorsally with 4 to 5 reduced, rounded to acute, longitudinal ridges.

Habitat, distribution, and phenology. In wet "tierra firme" forest and seasonally inundated "várzea" forest at 100–300 m, Amazonian Colombia to Peru; collected in flower in April, June through August, October, and November, in fruit January through March and May through December.

This new species keys out to *Psychotria borjensis* in several flora treatments (e.g., Steyermark, 1972, 1974), and has been combined with this species in recent works (Taylor & Pool, 1993; Taylor, 1997, 1999). However, *P. borjensis* is apparently allopatric in the northeastern Amazon basin and differs from this new species by the combination of its leaves abaxially without domatia or with only a few flat foveolate domatia up to 1 mm long and its acute triangular stipules 5–8 mm long. This new species is also similar to *P. sacciformis*; see the discussion under the description of this latter species below. The flowers seen are all similar to the long-styled form of distylous *Psychotria* species in the arrangement of the anthers and stigmas. The specific epithet honors Katya Romoleroux, an Ecuadorian botanist who is studying the Ecuadorian flora.

Paratypes. COLOMBIA. **Amazonas:** Parque Nacional Natural Amacayacu, Centro Administrativo Amacayacu INDERENA, a la orilla del Río Amacayacu, 3°47′S, 70°15′W, *Pipoly 15309* (MO); Parque Nacional Natural Amacayacu, Quebrada de Agua Pudre, ca. 1.5 km NE de desembocadura sobre el Río Amacayacu, Muestreo Permanente Estratégica del MO, 3°47′S, 70°15′W, *Pipoly et al. 16005* (MO), *16519* (MO); Parque Nacional Natural Amacayacu, Mata-Matá, en trocha hacia donde el "Abuelo Panduro", 3°47′S, 70°15′W, *Rudas & del Aguila 1383* (MO). ECUADOR. **Napo:** Yasuní Forest reserve, 1–3 km E of Pontifícia Universidad Católica del Ecuador Science Station, by Tiputini River, 00°41′S, 76°24′W, *Acevedo-Rodriguez & Cedeño 7344* (MO), sendero atrás de la casa, *Jaramillo 8514* (F); Estación Científica Yasuní, Río Tiputini, al NO de la confluencia con el Río Tivacuno, 6 km E de la carretera Maxus, Km 44, desvío hacia el pozo, 00°38′S, 76°30′W, *Romoleroux 2230* (F), *Romoleroux & Foster 2134* (F, MO). **Pastaza:** Lorocachi, ca. 5 km SSW of the military camp, 1°38′S, 75°58′W, *Brandbyge & Asanza 31051* (MO); Curaray, SE of the airstrip, 1°22′S, 76°57′W, *Holm-Nielsen et al. 22274* (MO). PERU. **Loreto:** Prov. Maynas, Varadero de Mazán from Río Amazonas to Río Napo, *Croat 19475* (F, MO), *Croat 20762* (MO); Santa María del Ojeal on Río Amazonas, ca. 15 km downriver from Iquitos, *Davidson 5328* (MO); Río Gueppi [sic; Guepí], tributary of Río Putumayo, northernmost tip of Peru on border with Ecuador, trail from Puerto Perú (8 km from mouth of river) toward Río Napo, *Gentry et al. 21946* (F, MO); Quebrada Sucusari, Llachapa camp of Explorama, N side of Río Napo below Mazán, *Gentry et al. 27576* (MO); Yanomono, Explorama Tourist Camp, 25 km NE of Iquitos along Río Amazonas between Indiana and mouth of Río Napo, 3°28′–30′S, 72°48′–50′W, *Gentry et al. 31466* (F, MO), *Gentry et al. 37213* (MO), *Gentry et al. 37987* (MO), *Gentry et al. 39718* (MO), *Gentry et al. 42253* (MO), *Gentry et al. 42438* (MO), *Pipoly et al. 12427* (MO), *Pipoly et al. 12485* (MO), *Vásquez et al. 4699* (MO), *Vásquez et al. 5166* (MO), *Vásquez et al. 14102* (MO), *Vásquez et al. 14142* (MO), Bushmaster Trail, *Webster 23334* (MO); Río Ampiyacu, Pebas and vicinity, near town, 3°10′S, 71°49′W, *Plowman et al. 6538* (F); Cahuide (Río Itaya), *Vásquez & Jaramillo 5635* (F, MO); Iquitos, Allpahuayo, Estación Experimental del Instituto de Investigaciones de la Amazonía Peruana (IIAP), *Vásquez & Jaramillo 14477* (MO); Nanay, Monte real [sic], *Woytkowski 5154* (MO); Prov. Requena: Sinchicuy, Río Amazonas, 3°35′S, 73°15′W, *Vásquez et al. 7801* (F).

Psychotria sacciformis C. M. Taylor, sp. nov. TYPE: Ecuador. Napo: Estación Científica Yasuní, Río Tiputini, al NO de la confluencia con el Río Tivacuno, 6 km E de la carretera Maxus, Km 44, desvio hacia el pozo, 00°38′S, 76°30′W, 200–300 m, 8 Oct. 1996, *K. Romoleroux, M. Bass, R. Foster & G. Villa 2575* (holotype, QCA; isotypes, F, MO-5094912). Figure 2E, F, G, H.

Haec species a congeneris foliis domatiis foveolatis in saccum clausum 0.5–2.0 mm longum prolongatis munitis distinguitur.

Shrubs or small trees to 4 m; stems glabrous or sometimes hirtellous in a longitudinal interpetiolar line. *Leaves* oblanceolate to elliptic-oblanceolate or elliptic, 6–14 × 1.8–6 cm, papyraceous, adaxially and abaxially glabrous or adaxially hirtellous along costa, at apex acuminate, at base cuneate to obtuse or acute; secondary veins 3 to 9 pairs, united in a looping, weak to well developed submarginal vein, abaxially with domatia in axils, domatia foveolate, 0.5–2 mm long, tubular to sacciform and prolonged, emergent, adaxially venation plane or costa sometimes prominulous, abaxially costa prominent, secondary veins prominulous, and remaining venation plane; petioles 3–6 mm long, glabrous to sparsely hirtellous; *stipules* caducous, interpetiolar and shortly intrapetiolar, narrowly lanceolate to narrowly triangular, 3–12 mm long, glabrous or usually hirtellous at least in a central interpetiolar line, slenderly acuminate. *Inflorescences* terminal, glabrous to puberulous, peduncles 3.5–7.5 cm long, flexuous, branched portion 3.5–6 × 3.5–6 cm, ovoid to rounded-corymbiform, secondary axes 4 per node with 2 shorter and reflexed, branched 1–3 times, with higher-order axes and pedicels spreading to 90°–100°; bracts reduced or to 1 mm long, triangular, glabrous; pedicels 1–2 mm long; *flowers* in umbelliform cymules of 3 to 7; hypanthium ca. 0.5 mm long, turbinate to somewhat cupuliform, glabrous; calyx limb 0.5–0.8 mm long, glabrous, denticulate; corolla tubular, cream to white, externally glabrous, barbate in throat, tube ca. 2.5 mm long, lobes 5, ca. 1.5 mm long, triangular; anthers in both forms ca. 1 mm long, in short-styled form exserted, in long-styled form included to partially exserted; stigmas in short-styled form ca. 0.8 mm long and included, in long-styled form ca. 1 mm long and exserted. *Fruit* ellipsoid to obovoid, 5–5.5 × 4 mm, red to purple, with stipes to 4 mm long; pyrenes 2, planoconvex, dorsally with 4 to 5 rounded longitudinal ridges.

Habitat, distribution, and phenology. In wet forest at 200–750 m in Amazonian Ecuador and Peru; collected in flower in January, July, October, September, and November, in fruit March through May and in September.

This new species is distinguished by its leaves abaxially with foveolate domatia that are prolonged into tubular, emergent sacs 0.5–2 mm long and completely closed or sometimes open tardily at the very top; the specific epithet refers to these structures. These structures are highly unusual among the South American Rubiaceae. Similar domatia are known to me only in *Psychotria cornejoi* of South America (described above), and have been reported from one African species, *Coffea dactylifera* Robbrecht & Stoffelen, where they are also considered unusual (Stoffelen et al., 1999). *Psychotria sacciformis* will key out to *Psychotria borjensis* in several flora treatments (Steyermark, 1972, 1974; Taylor, 1997), and has been confused with this species in other recent works (Taylor & Pool, 1993; Taylor, 1999). However, *P. borjensis* is apparently allopatric in the northeastern Amazon basin, and differs from this new species by the combination of its leaves abaxially without domatia or with only a few flat foveolate domatia up to 1 mm long and its acute stipules. This new species is also similar to *P. romolerouxiana*, described above, which differs in its domatia that are fused along their lengths with the costa and its bidentate stipules.

Paratypes. COLOMBIA. **Antioquia:** mpio. San Luis, Quebrada La Cristalina, 6°N, 74°45′W, *J. G. Ramírez & Cárdenas L. 1923* (JAUM, MO); mpio. de San Luis, corregimiento El Prodigio, vereda Las Confusas, hacienda La Esperanza, margen izquierda del Río El Tigre, *Toro 15* (MEDEL, MO). **Caquetá:** mpio. San Vicente del Caguán, trazado de la carretera entre Neiva y San Vicente, vereda Las Perlas, bajo Río Pato, finca Galicia, en la vega del Río Pato, *Betancur et al. 2266* (HUA, MO). **Chocó:** E side of Serranía del Darién, from Acandí, 8°30′N, 77°20′S, *Juncosa 655* (MO). **Meta:** mpio. La Macarena, 1 hora sobre el Río Guayabero en la desembocadura del Río Losada, 2°20′N, 74°60′W, *Callejas & Marulanda 7074* (HUA, MO). **Putumayo:** mpio. Mocoa, El Afán, *B. R. Ramírez P. 769* (MO, PSO). ECUADOR. **Morona-Santiago:** pozo petrolero “Garza” de TENNECO, 35 km (approx.) al NE de Montalvo, 1°49′S, 76°42′W, *Zak & Espinoza 4767* (MO). **Napo:** Loreto, al N de Galeras, Bloque 19, línea sísmica 22, helipuerto 3, Compañía Triton, 00°47′S, 77°28′W, *Freire & Cerda 220* (MO); vía Payamino-Loreto, 4–6 km del río, 00°26′S, 77°02′W, *Zaruma 733* (MO); cantón Aguarico, Parque Nacional Yasuní, Lagunas de Garza Cocha, 01°01′S, 75°47′W, *Cerón & Gallo 4962* (MO); cantón Archidona, Parque Nacional Sumaco, carretera Hollín-Loreto, comunidad Avila Vieja, 00°38′S, 77°26′W, *Alvarado 485* (MO); Avila Viejo, 00°38′S, 77°25′S, *Kohn & Alvarado 1581* (MO); cantón La Joya de los Sachas, comunidad de Pompeya, lado S del Río Napo, campamento de Maxus, Río Jivino, carretera de Maxus, Km 1–5, 00°25′S, 76°37′W, *Grijalva et al. 217* (MO); cantón Orellana, Parque Nacional Yasuní, carretera y oleoducto de Maxus, Km 40, parcela permanente #10, 00°39′S, 76°26′S, *Aulestia 2715* (MO, QCNE); Parque Nacional Yasuní, carretera y oleoducto de Maxus en construcción, Km 53–54, *Dik 416* (MO); Parque Nacional Yasuní, Tiputini Km 41, parcela 1, *Macía et al. 3074* (MO); Estación Científica Yasuní, Río Tiputini, al NO de la confluencia con el Río Tivacuno, E de la carretera Maxus, Km 44, desvío hacia el pozo Ivacuno, Sendero Dicaron, entre la carretera y la parcela de 50 ha, 00°38′S, 76°30′W, *Romoleroux & Foster 1632* (F, MO, QCA); Estación Científica Yasuní, parcela de 50 ha, Sendero Saino, 00°38′S, 76°30′W, *Romoleroux & Foster 1909* (F, MO, QCA); Estación Científica Yasuní, Río Tiputini, al NO de la confluencia con el Río Tivacuno, 6 km E de la carretera Maxus, Km 44, desvío hacia el pozo Tivacuno, parcela de 50 ha, 00°38′S, 76°30′W, *Romoleroux et al. 2191* (MO, QCA), *2231* (F, QCA), *2271* (F, MO, QCA); Estación Científica Yasuní, Río Tiputini, al NO de la confluencia con el Río Tivacuno, 6 km E de la carretera Maxus, Km 44, desvio hacia el pozo, 00°38′S, 76°30′W, *Romoleroux et al. 2645* (F, MO, QCA); cantón Tena, Reserva Biológica Jatun Sacha, Río Napo, 8 km al E de Misahuallí, 1°04′S, 77°36′W, *Alvarez 25* (MO), *Alvarez et al. 36* (MO), *Cerón 946* (MO), *1222* (MO), *Cerón & Iguago 5548* (MO), *Palacios 4216* (MO); Parque Nacional Yasuní, pozo petrolero Daimi I, CONOCO, 1°02′S, 76°10′W, *Hurtado et al. 42* (MO). **Pastaza:** Lorocachi, zona O del campamento militar, a 3 km del Río Curaray, 1°38′S, 75°58′W, *Jaramillo et al. 30796* (MO).

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Emended Circumscription of *Begonia silletensis* (Begoniaceae) and Description of a New Subspecies from Yunnan, China

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ABSTRACT. The circumscription of *Casparya silletensis* A. DC. (= *Begonia silhetensis* (A. DC.) C. B. Clarke) is emended so as to accurately describe the type material of this species and exclude material of *B. aborensis* S. T. Dunn. *Begonia silletensis* subsp. *mengyangensis*, a taxon endemic to the Xishuangbanna region of Yunnan Province, China, is newly described and illustrated. *Begonia silletensis* subsp. *mengyangensis* differs from subspecies *silletensis* by its larger leaves (14–27 × 20–27 cm vs. 10–17 × 10–15 cm) and unequally ridged fruit. *Begonia silletensis* subsp. *silletensis* is reported new to Burma and Thailand. A key is provided to distinguish the two subspecies.

Key words: *Begonia*, Begoniaceae, China.

Approximately 70 species of *Begonia* L. are found in Yunnan Province, representing about 60% of the total number found in China and 6 of the 18 Asiatic sections (Doorenbos et al., 1998). *Begonia silletensis*, a species previously considered restricted to northeastern India, was discovered in the Xishuangbanna region of Yunnan Province in 1977 during a Kunming Botanic Garden expedition and introduced into cultivation. Examination of the Begoniaceae collections of the Kunming Botanic Garden Herbarium has revealed additional material collected from the same region by an earlier Sino-Soviet expedition in 1957. As these disjunct Chinese populations of *B. silletensis* differ from the northeast Indian populations by having larger leaves and unequally ridged fruit, the Chinese populations are recognized here as a new subspecies. Before we can compare the new subspecies with the typical *B. silletensis*, the description of *B. silletensis* requires emending.

De Candolle (1864) originally described *Begonia silletensis* as a species of the genus *Casparya*. The original circumscription of *Casparya silletensis* A. DC. does not match its type (*Wallich 9107*). De Candolle (1864) described *C. silletensis* as having velutinous petioles, peduncles, outer surfaces of the male perianth segments, and ovaries and hispidulous leaf blades. However, the type collection that he cited along with the description is glabrous throughout. Apart from this discrepancy, De Candolle's description of *C. silletensis* matches the type collection. We therefore suggest that De Candolle based his species on the *Wallich 9107* collection and additional material of a different taxon. As no additional material is cited in his description of *C. silletensis*, the identity of this additional material is not certain. However, it is likely to have been *B. aborensis* S. T. Dunn, as this species is covered with velvety hairs and is closely related to *B. silletensis*. *Begonia aborensis* was not recognized as a distinct species until 1920. In 1879, Clarke synonymized the genus *Casparya* with the genus *Begonia* and arbitrarily changed the spelling of the epithet "*silletensis*" to "*silhetensis*." Clarke (1879) certainly did include material of both *B. silletensis* and *B. aborensis* in his description of *B. silhetensis*. His circumscription of *Begonia silhetensis* (= *B. silletensis*) is based on *Wallich 9107* and two other collections, *Griffith 2569* and *Wallich 3677B*. Our research shows that *Griffith 2569* and *Wallich 3677B* are conspecific with Burkill's collections from the Abor Hills of northeastern India upon which Dunn (1920) based his *Begonia aborensis*. Clarke, in fact, suspected that his description was based on material of more than one species as he stated: "Griffith's No. 2569 (with which Wallich's No. 3677B agrees), differs considerably in hairiness and in size of the flower from Wallich's No. 9107 on which A.DC. founded his *Casparya? silhetensis*: two species are possibly here mixed, but the material is not sufficient to justify a new species" (Clarke, 1879: 636). The circumscription of *Begonia silletensis* is emended here so as to accurately describe the type (*Wallich 9107*) and exclude material that Dunn much later described as *B. aborensis*. Following Clarke (1879), the species is classified in the genus *Begonia*.

Begonia silletensis (A. DC.) C. B. Clarke emend. M. C. Tebbitt. *Casparya silletensis* A. DC., Prod. 15(1): 277. 1864. *Begonia silhetensis* (A. DC.) C. B. Clarke, in J. D. Hooker Fl. Brit. Ind. 2: 636. 1879. TYPE: Sillet Mts., *Wallich 9107* (holotype, G-DC; isotypes, BM, K-WALL).

a. Begonia silletensis subsp. **silletensis**

Dioecious perennial herbs. *Stems* prostrate, ca. 1 cm diam., internodes 1–2 cm, glabrous. *Stipules* persistent, lanceolate, 1.4–2.1 × ca. 0.4 cm, apex acute, margin entire, both surfaces glabrous. *Leaves* few, drooping; *petioles* 22–43 cm, glabrous; *blade* green, glabrous on both surfaces, ovate, 10–17 × 10–15 cm, apex shortly acuminate, base asymmetric, sinus 3–4.5 cm deep, margin undulate, with short serrate teeth, primary veins 7–9, palmate. *Inflorescence* axillary, an erect dichasium in which the primary peduncle branches vary from 0.1 to 5 cm so that the inflorescence is either umbellate or cymose in appearance, flowers fragrant, 1–10; *peduncles* 8–11 cm in both male and female inflorescences; *bracts* deciduous, ovate to elliptic, ca. 1.1 × 0.2 cm, margin entire, both surfaces glabrous. *Pedicels*: those of male flowers 1–2 cm, those of female flowers 4–5 cm. *Male flowers*: *bracteoles* absent; *perianth segments* white, greenish white or pink, 4, outer 2 ovate, oblong or obovate, concave, thick, 4.5–15 × ca. 10 mm, apex blunt, inner 2 ovate-obovate, 3.4–17.5 × 7.5–8 mm, apex rounded; *stamens* 100^+, arranged in a symmetrical dome-shaped mass, *filaments* 1.75–2.5 mm, free to base, attached to a raised receptacle, *anthers* linear, 1.75–2.75 mm, dehiscing via vertical slits along side of anther, connective projecting 0.5 mm, apex rounded. *Female flowers*: *bracteoles* absent, *perianth segments* white or pink, 4, oblong to obovate, apex rounded, outer 2 slightly longer; *ovary* ovoid to ellipsoidal, ca. 1 × 1 cm, circular in cross section, 4-locular, *placentation* axillary, *placentae* bifid, rhomboidal in cross section, ca. 4 × 4 mm, bearing ovules on both surfaces of branches; *styles* deciduous, 4, very broad, base 0.5 cm across, 0.8–1.2 cm long, fused just below half way, and then bifid, band of stigmatic papillae twice spirally twisted. *Infructescences* 1–2-fruited; *fruiting pedicels* ca. 3.5 cm; *fruit* indehiscent, usually cork-like in texture or rarely leathery (in sicco), ovoid to ellipsoidal, 2.3 × 1.5 cm, walls ca. 2.5 mm thick, lacking ridges or wings.

Northeastern India, Burma, and northern Thailand. We report it as new to Burma and Thailand. Wallich proposed the invalidly published name "Begonia gigantea" for this species based on the collection "*Wallich 3677B*" (Wallich, 1831).

Representative specimens. INDIA. **Assam:** Chanduar Forest, *Mann 7/87* (K); Luckimpore, Makum 300 ft., 12.iv.1885, *Clarke 37805* [specimen annotated by C. B. Clarke as "B. sphaerocarpa" nomen nudum] (K); Namchung, 155 ft., Luchimpore, 18.iv.1885, *Clarke 37937A* [specimen annotated by C. B. Clarke as "B. sphaerocarpa" nomen nudum] (K); Cachar, moist shade of Shapose Bomara, Nov. 1873, *Keenan s.n.* (K); Katakhal Forest, *Mann s.n.* (K). BURMA. Nammeen to Namma, Myitkina District, 1000 ft., 7.iii.1910, *Lace 5170* (E). THAILAND. Northern Chiengmai, Trang, ca. 800 m, 11.vi.1960, herb scattered in evergreen forest, by stream, fruits purplish red, angular, *T. Smitinand & H. St. John 6832* (K).

b. Begonia silletensis subsp. **mengyangensis** M. C. Tebbitt & K.-Y. Guan, subsp. nov. TYPE: China. Yunnan: Xishuangbanna, on way from Puurem to Mengyang, bottom of valley in wet area in slope facing N, dense forest, 21 Apr. 1957, *Sino-Soviet Union expedition 9633* (holotype, KUN; isotype, KUN). Figure 1.

A *B. silletensis* subsp. *silletensis* foliis majoribus (ad 27 × 27 cm); fructus globosus interdum carinatus.

Dioecious, perennial herbs, 20–50 cm tall. *Stems* prostrate, 1.5–4.0 cm diam., cortex red as seen in cross section, internodes 2–3 cm, with sparse short hairs. *Stipules* persistent, reddish, not keeled, asymmetrically triangular-lanceolate, 2–2.5 cm long, dorsal surfaces with short hairs. *Petioles* green with white lenticels, red at base, 30–55 cm long, with short white hairs throughout; *blades* shiny green, leathery, glabrous above, paler green, hairy beneath, broadly ovate, 14–27 × 20–27 cm, apex acute, base cordate, slightly asymmetric, sinus 4.5–11 cm deep, leaf bases overlapping, margin undulate, with short serrate teeth, primary veins 8, palmate. *Inflorescence* axillary, an erect dichasium in which the primary peduncle branches are reduced to 1–3 mm long so that the inflorescence appears umbellate, flowers fragrant, ca. 15; *peduncles*: those of male inflorescence 10–15 cm long, with short white hairs, those of female inflorescence ca. 17 cm long, with short white hairs; *bracts* deciduous, narrowly to broadly ovate, 0.8–2 × 0.2–1.2 cm, both surfaces glabrous, margins shortly ciliate. *Pedicels* of male flowers 12–35 mm long. *Male flowers*: *bracteoles* absent; *perianth segments* white, sometimes flushed pink, 4, outer 2 broadly ovate to broadly elliptic, ca. 15 × 10–15 mm, apex obtuse, outer surfaces pubescent, inner two broadly elliptic to broadly obovate, ca. 10 × 12 mm, apex obtuse,

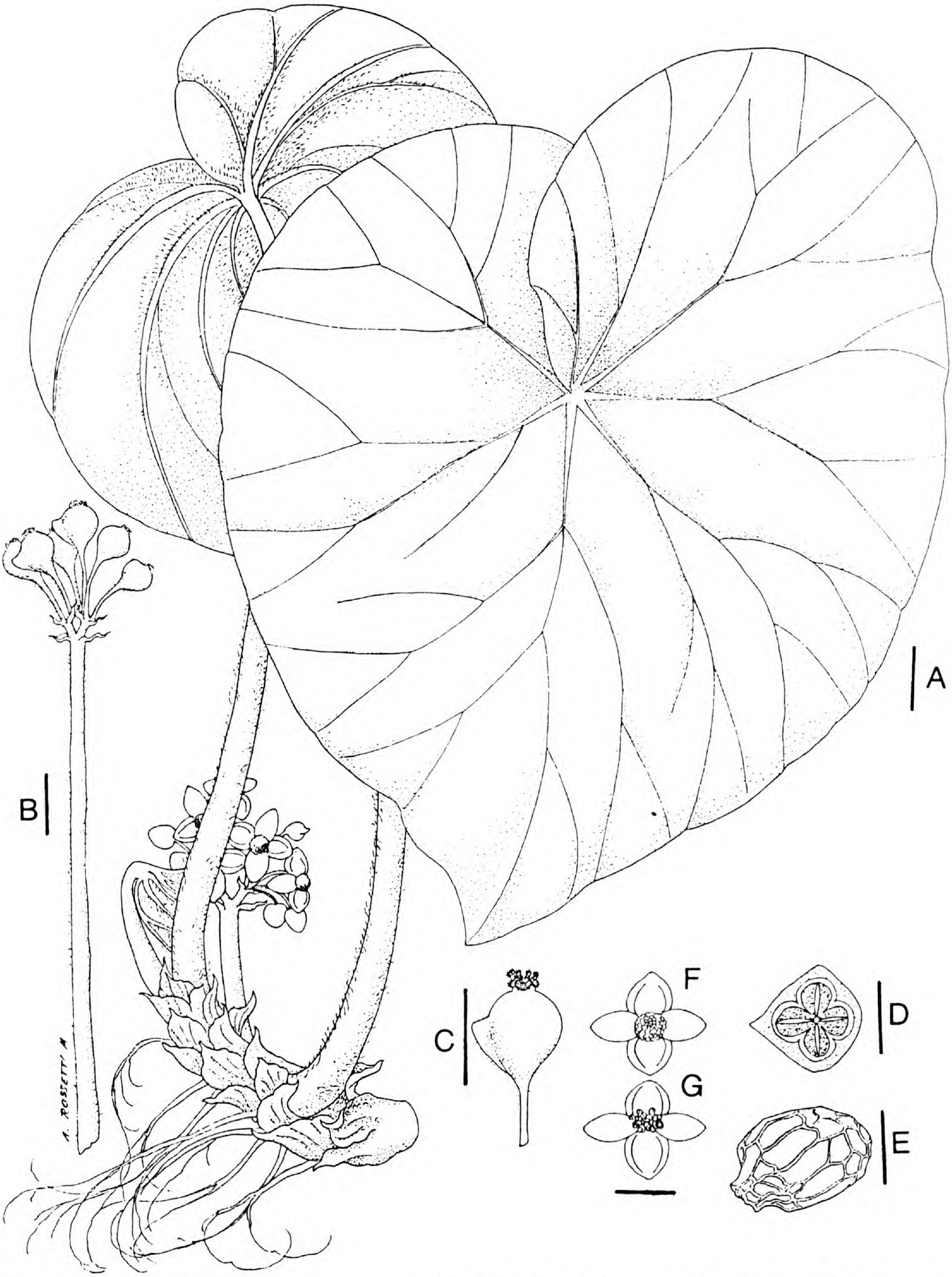

Figure 1. *Begonia silletensis* subsp. *mengyangensis* M. C. Tebbitt & K.-Y. Guan. —A. Male plant. —B. Infructescence. —C. Fruit. —D. Transverse section of mature fruit. —E. Seed. —F. Male flower. —G. Female flower. Scale bars: A = 2.25 cm; B = 2 cm; C, D = 1 cm; E = 150 μm; F, G = 2 cm.

outer surfaces glabrous. *Stamens* ca. 60, arranged in a symmetrical dome-shaped mass, *filaments* free to base, ca. 2 mm long, attached to a raised receptacle, ca. 1 mm high, *anthers* elliptic, ca. 2.2 mm long, dehiscing via vertical slits along side of anther, connective projecting 0.5 mm, apex rounded. *Pedicels* of female flowers 1–2 cm long. *Female flowers*: *bracteoles* absent, *perianth segments* white, sometimes flushed pink, 4–6, outer 2–3 ovate, ca. 15 mm long, apex obtuse, inner 2–3 elliptic to obovate, ca. 12 mm long, apex obtuse; *ovary* ellipsoidal, ca. 1 × 1 cm, 4-locular, *placentation* axillary, *placentae* bifid, bearing ovules on both surfaces of branches; *styles* long persisting but eventually deciduous, 4, fused at base for 1.5–2 mm, bifid, band of stigmatic papillae once spirally twisted. *Infructescence* 4–6-fruited. *Fruiting pedicels* green, erect, to 3 cm long; *fruit* indehiscent, fleshy, ellipsoidal, (0.5–)1–2 cm diam., with short hairs, lacking ridges or wings or with up to 4 blunt unequal, triangular ridges (on same plant), ridges 2–3 × 3–5 mm high. *Seed* ca. 300 μm long.

Begonia silletensis subsp. *mengyangensis* grows among tall herbaceous vegetation in damp, shady areas in primary tropical forest at altitudes between 570 and 1200 m; it has been collected with flowers and fruit in May and April. This taxon has proved amenable to cultivation, both at Kunming Botanic Garden, China, and Glasgow Botanic Gardens, Scotland.

Paratypes. CHINA. **Yunnan:** Xishuangbanna, Cheli liusha he, along riverside wet areas in shady forest, 600–800 m, 30 Apr. 1957, *Sino-Soviet Union expedition 9834* (KUN); Xishuangbanna, Mengla, Mengyang, in valley under dense forest in wet areas, 1200 m, 5 Apr. 1957, *Sino-Soviet Union expedition 5869* (KUN-3 sheets); Mengla, Mengxin he, in valley, alt. 570 m, 19 Mar. 1977, *Xhangjianhou 13666* (KUN). CULTIVATED. Glasgow Botanic Garden National Begonia Collection, 18 Jan. 2000, *L. L. Forrest 99* (E).

KEY TO THE SUBSPECIES OF *BEGONIA SILLETENSIS*

1a. Leaves 10–17 × 10–15 cm; fruit lacking ridges . . . . subsp. *silletensis*
1b. Leaves 14–27 × 20–27 cm; fruit unequally ridged . . . . subsp. *mengyangensis*

Acknowledgments. We thank Adèle Rossetti Morosini who provided the illustration and Kerry Barringer, Laura Forrest, Katherine Gould, James Yeadon, and two anonymous reviewers who provided comments on the manuscript. We also thank David Chamberlain for helping to arrange the fieldwork and Ewan Donaldson and John Stevenson for providing cultivated material. This research was supported by the Biotechnology & Biological Sciences Research Council (grant no. 93701311) and represents a portion of a Ph.D. dissertation submitted by the first author to the University of Glasgow, Scotland.

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Magnolia pugana (Magnoliaceae): Una Nueva Combinación en el Complejo *M. pacifica*

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RESUMEN. Investigación morfológica y ecológica reciente, tanto en la costa norte de Jalisco como en la Zona Centro del mismo Estado, apoyan el reconocimiento de *Magnolia pugana* (H. H. Iltis & A. Vázquez) A. Vázquez & Carvajal a nivel de especie.

ABSTRACT. Recent morphological and ecological investigation in both the northern Jaliscan coast and central Jalisco support the recognition of *Magnolia pugana* (H. H. Iltis & A. Vázquez) A. Vázquez & Carvajal at the species level.

Key words: *Magnolia*, Magnoliaceae, Mexico.

La sección neotropical *Theorhodon* (Spach, 1839; MO-W^3-Tropicos, ⟨http://mobot.mobot.org/W3T/Search/vast.html⟩, 09 julio 2001) (caracterizada por tener hojas siempre verdes, estípulas libres del peciolo, gineceo sésil, tépalos subsimilares y estambres sin conectivo extendido) del género *Magnolia* presenta un patrón marcado de especiación alopátrica (Howard, 1948; Vázquez G., 1990, 1994), con considerable variación entre poblaciones, tal vez relacionado con la distancia geográfica y/o ambiental entre las mismas. De tal suerte que el intrincado relieve y diversidad climática parecen favorecer dicho fenómeno de especiación. En la actualidad esta sección incluye 11 especies publicadas, la mayoría de México (6) y varias más están sin describirse, con escaso material fértil de flores y frutos. Vázquez (1994) y Felger (1971) ilustran respectivamente importantes aspectos de variación tanto morfológica en hojas y frutos como ecológica de lo que podríamos denominar el complejo *Magnolia pacifica* A. Vázquez. Este complejo consiste de tres subespecies alopátricas (Fig. 1): *M. pacifica* subsp. *pacifica*, *M. pacifica* subsp. *tarahumara* y *M. pacifica* subsp. *pugana*, las cuales por falta de suficientes especímenes fértiles procedentes de la Sierra Madre Occidental fueron tratadas en forma conservadora como subespecie por Vázquez G. (1994). La disponibilidad de mayor cantidad de frutos maduros procedentes de poblaciones representativas de la costa norte de Jalisco y del centro de Jalisco, aunado a exploraciones adicionales en hábitats potenciales, permitió reconocer y confirmar una discontinuidad morfológica, geográfica y ecológica entre *Magnolia pacifica* subsp. *pacifica* y *Magnolia pacifica* subsp. *pugana* (Fig. 1), por lo que ésta última se propone como una especie independiente. Tan solo los caracteres del número de carpelos por fruto y número de estambres por flor permiten separarla con claridad.

La clave publicada para taxa del complejo *M. pacifica* (Vázquez G., 1994: 13) quedaría, traducida y corregida, de la siguiente forma:

Pedúnculos generalmente glabros; polifolículos maduros oblongoides, con 25–35 folículos; hojas de angostamente alargadas o lanceoladas a angostamente elípticas, 2.5–8 cm de ancho (Centro y N de Jalisco a S de Zacatecas, "región de barrancas") . . . . *M. pugana*
Pedúnculos pubescentes, al menos en los nodos; polifolículos maduros de angostamente oblongoides a ovoides o subglobosos, con 18–26 folículos; hojas anchamente elípticas a lanceolado elípticas, 3–10 cm de ancho.
– Polifolículos maduros angostamente oblongoides, con 18–25 folículos, estos, cuando maduros y abiertos, con lóculos angostos, más largos que anchos; hojas usualmente anchamente elíptico obovadas, 4–10 cm de ancho (Nayarit, SW Jalisco) . . . *M. pacifica* subsp. *pacifica*
– Polifolículos maduros ovoides a subglobosos, con 21–26 folículos, estos, cuando maduros y abiertos, con lóculos ovados a redondeados (excepto los de la base del polifolículo); hojas elípticas a lanceolado elípticas, 3–7 cm de ancho (SE de Sonora, SW de Chihuahua, NW de Sinaloa, NW de Durango) . . . *M. pacifica* subsp. *tarahumara*

Magnolia pugana (H. H. Iltis & A. Vázquez) A. Vázquez & Carvajal, comb. nov. Basónimo: *Magnolia pacifica* A. Vázquez subsp. *pugana* H. H. Iltis & A. Vázquez, Brittonia 46: 14. 1994. TIPO: México. Jalisco: margen de bosque en pequeño tributario del arroyo San Lorenzo, 35 km al NW de Guadalajara, 8 km NW de Tesistán, Zapopan, 20°50′N, 103°34′W, 1450 m, 18 Mar. 1987, *Iltis, Cházaro B. y R. López V. 29722* (holótipo, WIS; isótipos, IBUG, MEXU, MICH, MO, US). Figura 2.

Árboles de 10–15(20) m de alto, 50–80(150) cm dap, con las primeras ramas de 2–15 m de el piso; ramillas esencialmente glabras, corteza rugosa, de 1–2 cm de grosor, gris oscura a castaño. *Hojas* cor-

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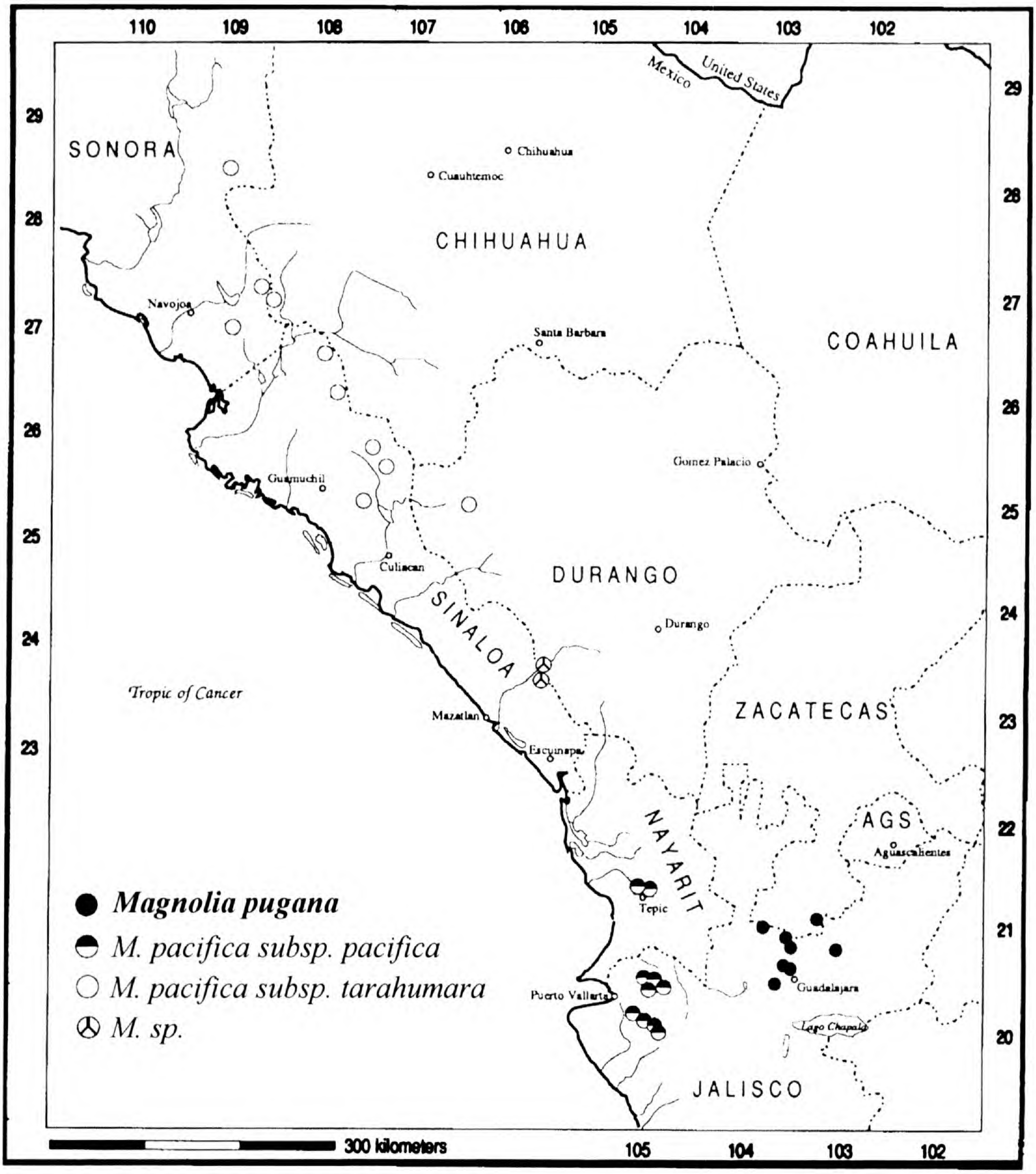

Figura 1. Distribución del complejo *Magnolia pacifica*.

iáceas, angostamente oblongas o lanceoladas a angostamente elípticas, 12–22 × 2.5–8 cm; agudas a obtusas en el ápice, cuneadas en la base; estípulas lineares de 4.5–7 × 3–6(8) cm de ancho, pálido seríceas en el exterior, con nervaduras reticuladas; pecíolos canaliculados, de 1–1.5(3) cm de largo, glabros o rara vez pubescentes. Flores con botones ovoides a oblongoides, protegidos por 2 a 3 brácteas, la superior espatácea de 4–6.5 × 1.5–2 cm; la bráctea inferior (pérula) dehiscente, 1.5–2 × 6–9 mm, densamente pálido-velutina. Flores abiertas 9–15 cm en diámetro, blancas; pedúnculos glabros, 3.5 × 3.5–6 mm de diámetro, consiste de dos entrenudos, 0.5–1.5 mm de largo, el menor de 33 mm de largo; sépalos, 3, obovado-oblongos, cóncavos, 3–7 × 2–3.5 cm, verdosos en el exterior, blancos o color crema en el interior, glabros en ambas caras; pétalos 6 a 7, anchamente obovados, abruptamente atenuados hacia su delgado pecíolo, los exteriores 5–7 × 2.5–5.5 cm, los interiores 3–5.5 × 1–4 cm de ancho, blancos, glabros en ambas caras; estambres 92 a 104, 8–12 × 1–2 mm de ancho,

Cuadro 1. Diferencias entre *Magnolia pugana* y *M. pacifica* sensu stricto.

Características	*M. pugana*	*M. pacifica* sensu stricto
Pedúnculos	esencialmente glabros	pubescentes al menos en los nudos
Polifolículos maduros	oblongoides, con 25–35 folículos	estrechamente oblongoides, con 18–25 folículos
# de estambres	92–100	100–110
Lóculos de folículos	ovales a casi redondos, poco más largos que anchos	angostos, mucho más largos que anchos
Forma de hojas	angostamente oblongas a lanceoladas, a estrechamente elípticas	angostas a ampliamente elípticas o obovadas
Ancho de la hoja	2.5–8 cm	4–10 cm
Hábitat	bosque de galería en barrancas subtropicales	bosque mesófilo de montaña
Especies arbóreas comunes	*Astronium graveolens* Jacquin, *Ficus*, *Nectandra* y *Salix*	*Podocarpus reichei* Buchholz & Gray, *Matudaea trinervia* Lundell, *Pinus jaliscana* Pérez de la Rosa, *Dion edule* var. *sonorense* (De Luca, Sabato & Vázquez Torres) McVaugh & J. A. Perez de La Rosa, *Styrax argenteus* C. Presl, *Persea hintonii* C. K. Allen e *Inga laurina* (Swartz) Willdenow
Geografía	Jalisco: centro y norte; Zacatecas: sur	Jalisco: suroeste; Nayarit: centro

las anteras acuminadas a cuspidadas en el ápice, color crema; gineceo oblongoide-elipsoide, verde, glabro; estilos encorvados, 2–3 mm de largo, verdosos, con papilas estigmáticas inconspicuas. Frutos de tipo polifolículos oblongoides, glabros, con 25–35 folículos, estos, cuando maduros y abiertos, con lóculos ovales casi redondos, un poco más largos que anchos, algunos teñidos de color rojizo. Semillas prismático triangulares, subcilíndricas o rotundo comprimidas de 9–12 × 7–8 mm, con sarcotesta de color rojo escarlata.

Variabilidad. Es muy posible que la obtención de suficientes especímenes con flores y frutos maduros de poblaciones del complejo *M. pacifica* en las estribaciones de toda la Sierra Madre Occidental apoye la moción de que *M. pacifica* subsp. *tarahumara* deba también ser reconocida a nivel de especie. Las poblaciones de las montañas del sur de Durango y Sinaloa son excluidas por ahora ya que podrían, incluso representar una especie distinta, sin embargo todavía no son bien conocidas.

Distribución, hábitat y fenología. México, cercanías de Guadalajara en Zapopan, Jalisco, y hacia el Norte hasta Moyahua, Zacatecas, 1300–1800 m (Fig. 1). En cañadas profundas (barrancas) con remanentes de bosque en arroyos permanentes, con árboles de *Astronium*, *Ficus*, *Clethra*, *Nectandra* y *Salix*; arbustos de *Malvaviscus* y *Randia*; y en ocasiones especies raras como *Psilotum* y *Equisetum*. Florece de marzo a principios de julio, con algunas flores durante la mayor parte del año; los frutos por lo común permanecen unidos y su dehiscencia se presenta en marzo o en abril del siguiente año. Algunos árboles tiran sus frutos en mayo, después de su dehiscencia, mientras que otros los mantienen durante la floración.

Epónimo. La especie en honor a Luz María Villarreal de Puga, eximia profesora y exploradora botánica del Instituto de Botánica de la Universidad de Guadalajara.

Nombres y usos locales. "Almacasusco" (*Rzedowski 9135*), "magnolia" y "manolia" (*Vázquez G. et al. 5019a-c*). A los pétalos de *Magnolia pugana* se les atribuyen propiedades medicinales, y se preparan como tisana para tratar padecimientos cardiacos. Las flores se colectan y utilizan en peregrinaciones de cuaresma para adornar hogares y recintos religiosos y aromatizar el ambiente.

Estado de conservación. *Magnolia pugana* es endémica a la región de barrancas (Rzedowski & Mc Vaugh, 1966) del centro de Jalisco y zonas adyacentes de Zacatecas. Esta especie, por el reducido tamaño de sus poblaciones y por su distribución restringida se encuentra en peligro de extinción. Aunque en el Bosque La Primavera, decretado como Área de Protección Forestal y Refugio de Fauna Silvestre, se ha reportado una población de *M. pugana*, esta no contiene toda la variabilidad genética de la especie. Por eso, se recomienda proteger de manera prioritaria otras poblaciones *in situ* antes de que sean exterminadas por los cambios del uso del suelo, por incendios forestales o bien por aprovechamientos forestales de autoconsumo. También se recomienda su reproduc-

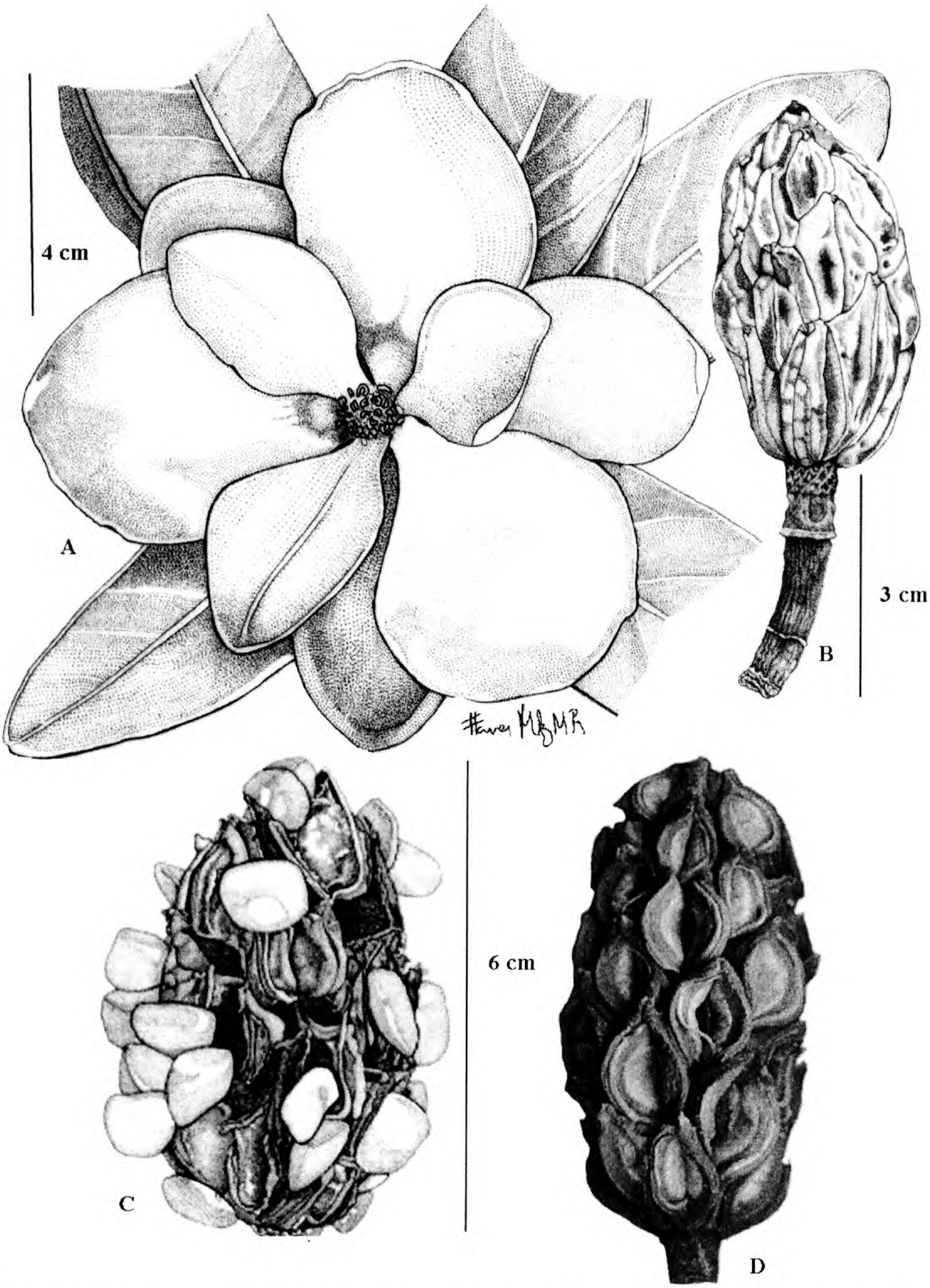

Figura 2. *Magnolia pugana* (H. H. Iltis & A. Vázquez) A. Vázquez & Carvajal. —A. Flor. —B. Fruto inmaduro. —C. Fruto en dehiscencia. —D. Fruto despues de la dehiscencia.

ción y propagación para su uso en zonas urbanas (con base en la experiencia de plantaciones exitosas realizadas en el Centro Universitario de Ciencias Biológicas y Agropecuarias de la Universidad de Guadalajara).

Ejemplares representativos examinados. MÉXICO. **Jalisco:** (1) Zapopan, Arroyo San Lorenzo, 8 km al NW de Tesistán, 1530 m, 30 June 1984, *Saínz-Ch. & Nieves-H. 134* (IBUG, WIS, XAL); 8 km al NW de Tesistán, 20°50′N, 103°34′W, 1450 m, 18 Mar. 1987, *Iltis et al. 29724* (WIS); 1550 m, 12 Oct. 1984, *Saínz-Ch. 205* (IBUG), 14 July 1989, *Vázquez-G. et al. 5019a-c* (WIS), 17 Jan. 1999, *Sánchez-M. s.n.* (IBUG); 1460 m, 6 Jan. 1974, *Villarreal de Puga 6126* (IBUG, MEXU, MICH); 1450 m, W de Santa Lucía, 18 Mar. 1987, *Cházaro-B. et al. 4545* (IBUG); 12 km al NE de Tesistán, camino a San Cristóbal de la Barranca, 1600 m, 12 Aug. 1985, *Soltero-Q. & Contreras 240* (IBUG); La Mesita de Santa Lucía, 1600 m, 15 July 1989, *Ramírez-D. & Camacho 1388* (IBUG); 10 km antes de San Cristóbal de la Barranca, 1560 m, 14 Feb. 1982, *Castro-C. 91* (IBUG); Arroyo Agua Caliente, Baños El Encanto, Arroyo Los Pajaritos, 1350 m, 29 Dec. 1974, *Villarreal de Puga 7102* (IBUG); La Sabana, camino a El Taray, N de Tesistán, 1800 m, 28 June 1986, *Ramírez-D. 332* (IBUG); Reserva Forestal y de la Fauna Bosque La Primavera, 4 June 1974, *Becerra-G. 1540* (IBUG). (2) Amatitán, 17 km de Santa Lucía, brecha de Tesistán a presa Santa Rosa, 1355 m, 1 Mar. 1995, *Silva-V. et al. 1–3* (IBUG); (3) San Cristóbal de la Barranca, Arroyo Milpillas, 1400 m, 13 June 1987, *Ornelas-U. & Flores-M. 855* (IBUG); 9 km al NE de San Cristóbal de la Barranca, carretera a Colotlán, 1300 m, 15 Oct. 1986, *Santana-M. et al. 2561* (IBUG); carretera Tesistán–San Cristóbal de la Barranca, 16 July 1987, 1450 m, 12 July 1987, *Cházaro-B. et al. 4872* (IBUG); 10 km después de el Balneario Los Camachos, 1400 m, 20 Dec. 1980, *Gutiérrez-O. s.n.* (IBUG); El Savial, 3 km al W de la carretera Guadalajara–Ixtlahuacán del Río, 1630 m, 6 May 1984, *Gallegos s.n.* (IBUG). **Zacatecas:** Moyahua, 17 km al S de Moyahua, 1400 m, 25 June 1957, *Rzedowski 9135* (ENCB, MEXU, MICH); Santa Rosa, arroyo Los Aquacastizcos, 21 Oct. 1992, *Enríquez-E. 327* (IBUG).

Agradecimientos. A los curadores de los herbarios ENCB, IBUG, JAL, MEXU, MICH, MO, US, WIS, ZEA por los especímenes facilitados en calidad de préstamo. A Manuel Flores Martínez por la elaboración de la ilustración.

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Taxonomic and Morphological Notes on *Hypoxis angustifolia* (Hypoxidaceae) from Africa, Madagascar, and Mauritius

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ABSTRACT. Four varieties within *H. angustifolia* Lamarck, the most common species of the genus *Hypoxis* L. in Africa, are recognized, based in part on differences of seed testa features between populations in Mauritius, Madagascar, and continental Africa. SEM micrographs of seeds of *H. angustifolia* var. *angustifolia*, variety *luzuloides* (Robyns & Tournay) Wiland, and variety *madagascariensis* Wiland are included, and full descriptions of the above varieties as well as *H. angustifolia* var. *buchananii* Baker are given.

Key words: Africa, Hypoxidaceae, *Hypoxis*, Madagascar, Mauritius.

Hypoxis angustifolia is the most common and widely distributed species of *Hypoxis* (Hypoxidaceae) in Africa and on West Indian Ocean islands (Baker, 1877: 369, 1878a: 265, 1878b: 111, 1896: 180–181, 1898: 378; de Cordemoy, 1895: 188; Durand & Schinz, 1895: 231, 1896: 260; Engler, 1908: 352; Durand & Durand, 1909: 554; Nel, 1914b: 303; De Wildeman, 1921: 33; Bews, 1921: 64; Hutchinson & Dalziel, 1936: 394; Guinea López, 1945: 258; Williams, 1949: 302; Robyns & Tournay, 1955b: 388; Troupin, 1956: 207; Andrews, 1956: 306; Binns, 1968: 53; Hepper, 1968: 172; Morton, 1968: 31; Geerinck, 1971: 5–6; Jacot Guillarmod, 1971: 148; Troupin, 1971: VI.277; Ross, 1972: 132; Wickens, 1976: 160; Marais, 1978; Nordal et al., 1985: 24; Champluvier, 1987: 81; Nordal & Iversen, 1987: 34; Agnew & Agnew, 1994: 313; Thulin, 1995: 31; Zimudzi, 1996: 15; Nordal, 1997: 87). Throughout its range from Guinea-Conakry to Mauritius and to South Africa (for a map with general distribution see Wickens, 1976: 316) this species occurs from sea level to about 2000 m (Nordal et al., 1985, suggested even to 3000 m). It is common in a wide variety of open habitats, including secondary habitats such as road borders, grazed pastures, fields, and plantations.

Hypoxis angustifolia is regarded as a "good" species on the basis of cytological observations: its karyotype is established at the diploid (rarely triploid) level, with no indications of apomixis (Nordal et al., 1985). It is characterized by wide morphological variation but was usually treated as a single species without infraspecific taxa (e.g., Geerinck, 1971). Some authors (Nel, 1914b; Marais, 1978) facing the morphological variation within this species observed that it should probably be divided into microspecies. Until the present, however, only the variety *H. angustifolia* var. *buchananii* Baker had been described from the southeastern African coast.

For this paper a thorough study of morphology of *H. angustifolia* was conducted on specimens from Central Africa, Madagascar, and Mauritius and compared with specimens from other regions of the continent. Characters shared by almost all populations of the species include a membranous tunic, corymbose inflorescences with long pedicels, and two-branched trichomes on the leaves. Field observations in Tanzania show that the plant habit of *H. angustifolia* is highly influenced by its habitat. Plants growing in places exposed to sun and wind, on rocks, especially along disturbed areas like paths, tend to have rather rigid, narrow leaves. Plants occurring on the forest bottom tend to have wider leaves, which are soft in texture. Specimens in numerous herbaria (B, BR, BRLU, DAR, K, MO, NHT, P, POZG, TAN, UPS, WAG) often differ widely in dimensions and sometimes also shapes of tepals, anthers, pistils, and bracts; it seemed possible at first that this morphological variation might be as great within a single population as between widely separated populations.

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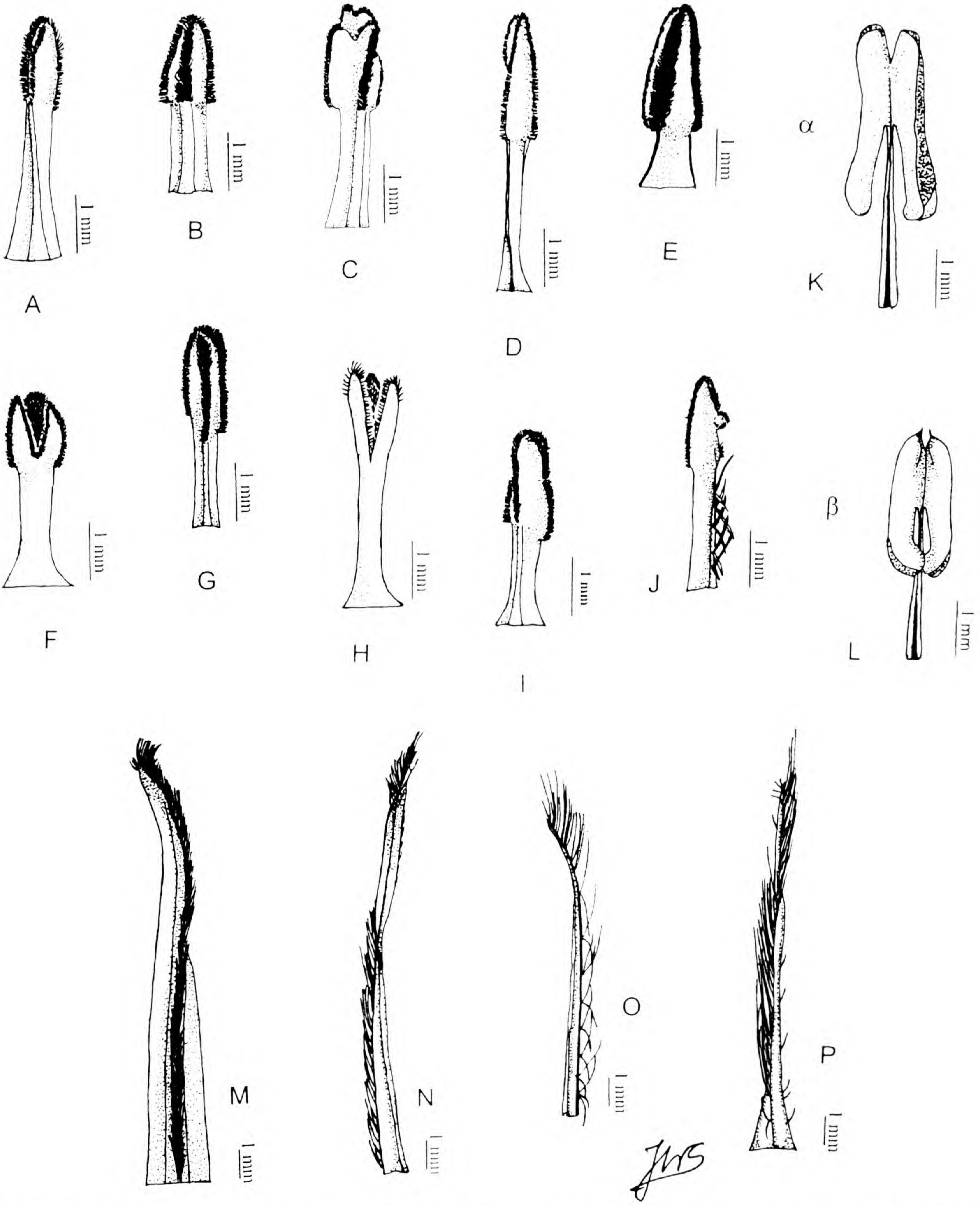

Figure 1. *Hypoxis angustifolia* var. *luzuloides* (Robyns & Tournay) Wiland. —A–I. Morphological forms of style with stigma. —J. Anomalous style and stigma. —K. Stamen, form α. —L. Stamen, form β. —M–P. Bracts. A & N from *Bamps & Malaisse 8052*, BR; B from *Quarre 5056*, BR; C from *Noirfalise 826*, BR; D from *Gillet s.n.*, BR; E from *Troupin 1243*, BR; F from *Lejoly 82/1013*, BRLU; G from *Liben 620*, BR; H from *Van Oosten 120*, BR; I from *Pauwels 6009*, BR; J from *Vanderyst s.n.*, BR; K & O from *Williams 18*, BR; L & M from *Lisowski 86119*, POZG; P from *Lewalle 5486*, BR.

Studies conducted on mature flowers from 51 herbarium sheets of *H. angustifolia* from Central Africa provided the observation that morphologies of style and stigma are the most variable characters in this species. Ten forms of gynoecium were observed, differing in a ratio of stigma to style length and stigma shape (Fig. 1A–I). They can be divided into two groups according to the ratio between style and stigma: the first group, when the style is much longer than the stigma (Fig. 1A, C, D, F, H), and the second group when both are of equal size (Fig. 1B, G, I) or the stigma is longer than the style (Fig. 1E). The style can be trigonal in cross section (Fig. 1A, B, C, D, G, I) or terete (Fig. 1E, F, H), visibly tapering toward the apex (Fig. 1A, C, E) or wider only in the basal part and then of a constant width (Fig. 1D, F, H, I) or equal throughout its length (Fig. 1B, G). It can be massive in shape (Fig. 1B, E, F) or thin and delicate (Fig. 1D, H). The stigma is usually composed of three lobes except in one case where it is divided in four (Fig. 1C). The lobes can be totally fused, and in this case the papillae will be distributed in three stripes (Fig. 1A, B, D, E, G, I). All of these stripes can be of an equal length (Fig. 1A, B, D, E) or unequal (Fig. 1G, I). They might be of uniform width (Fig. 1A, D), tapering toward the stigma's apex (Fig. 1B, E) or tapering toward its base (Fig. 1G, I). Another variable feature is stigma shape. It tends to be more or less pyramidal in shape, tapering toward the apex (Fig. 1B, D, E), ovoid (Fig. 1A), or rather oblong (Fig. 1G, I). Sometimes the stigma consists of three free lobes (Fig. 1F, H) covered with papillae on their edges and adaxially. Lobes can be triangular in shape (Fig. 1F) or oblong (Fig. 1H). In several specimens the stigma was divided in the apical part into 4 obtuse lobes covered with stripes of papillae on margins (Fig. 1C). In one case an anomaly in the gynoecial structure was observed (Fig. 1J): one stripe of papillae on a stigma is much shorter and there is a spherical appendage covered with papillae below it, and 2-branched trichomes grow out of the style. The occurrence of trichomes on the style is extremely rare and may be considered a developmental anomaly. The most common forms of gynoecium are depicted in Figure 1A and 1D. Frequently plants with a different gynoecial type look alike otherwise. No correlation among gynoecial structure, other morphological features, or geographical range was observed. Palynological and molecular studies might provide insights into the origin of this natural infraspecific diversity.

The fact that the ratio of style to stigma length is not constant within *H. angustifolia* negates the taxonomic value of the sections proposed by Nel (1914a, 1914b), who emphasized this character as one of the most important in his subdivision of *Hypoxis*. It was already observed as a common situation in this genus (Nordal et al., 1985). In the description of section *Angustifoliae*, Nel (1914a) implied that species of this group posses a gynoecium with a stigma much shorter than the style, and only exceptionally equal. Although Nel gave *H. dinteri* Nel as an example for this section, the sectional epithet is taken from *H. angustifolia*, a species with a much greater variability in these characters. Nel's observations of variability within *H. angustifolia* were limited to dimensions of leaves.

The morphological variability of the reproductive organs in *H. angustifolia* involves stamens as well. The stamens are biseriate, with the inner cycle usually shorter than the outer, with a difference of about 0.5–1.0 mm, entirely due to the length of filaments. Equally long stamens were observed only in a few plants. Filaments are subulate, with one distinct vein and almost membranous edges. Rarely, they are linear and wider only in the basal part. There are two anther forms named here α and β (Fig. 1K, L). Both are emarginate at the apex, exactly as Nel (1914a, 1914b) observed, and sagittate at the base. Anthers α are usually relatively long in comparison to the filaments and reach 2–3 mm in length (exceptionally 1 mm). Thecae are oblong and obtuse on both ends (Fig. 1K). Raphides are often visible in the outer tissue. Anthers β are usually shorter, 1.2–2.5 mm long (exceptionally 3 mm long). Thecae are obtuse in the basal part. The connective is thickened in the apical part and often prolonged into tiny appendages, a phenomenon that is especially distinct after dehiscence (Fig. 1L). Anthers α are much more common than β and were observed in 60% of studied plants.

There is usually a difference between bracts subtending older and younger flowers in one inflorescence in most species of *Hypoxis*. Upper younger bracts in *H. angustifolia* are usually one-veined and similar to each other. Older bracts are more variable. All bracts are subulate, acute and more or less keeled, covered with trichomes along the midrib abaxially (Figs. 1M–P). The most common bracts are 5–15 mm long, usually less than 1 mm wide; lightly keeled or plane in the middle, flatly hooded at apex, single veined, villous along the midrib, hispid at apex, exceptionally with simple trichomes on edges near apex; sometimes with some raphide cells or red stripes on midrib (Fig. 1N, O). Less common are strongly keeled bracts with two smaller veins parallel to the midrib; 12–17 mm long and 1.5–2.0 mm wide; with appressed trichomes and occasionally with several simple trichomes on edges at apex, very often with raphide cells in tissue (Fig. 1M). The least common are bracts ca. 12.5 mm long and 0.5–1.7 wide, single-veined, pubescent with long (to 4 mm) trichomes, almost glabrous in basal part, sparsely ciliate on margins with short simple trichomes (Fig. 1P).

During the study of Madagascar plants it was observed that in many specimens of *H. angustifolia*, especially *H. angustifolia* var. *madagascariensis*, the apices of the inner tepals are covered with club-shaped one- or few-celled papillae (Fig. 3B). Such papillae sometimes also occur on the tepals of continental plants; however, they are usually not as visible as in Madagascar populations. This feature of inner tepals has so far not been observed in any other species of *Hypoxis*; in other species the inner tepals are usually apically flat and entire, although they are sometimes acute. The outer tepals are always somewhat hooded at the apex and possess a small appendage covered with papillae or short trichomes (see Wiland, 1997).

A sculptured seed testa has often been noted as a shared character in *H. angustifolia* (Nordal et al., 1985; Nordal & Iversen, 1987). It is usually brown in coloration, in some specimens showing a bit of iridescence, that makes it similar to the testa of some American species (Brackett, 1923). SEM micrographs from African populations show ovoid seeds to 2 mm long with a short papillose appendage at the apex, and the testa with pyramidal pointed projections covered with a wrinkled brown cuticle (Fig. 2A, B) (see also Nordal et al., 1985: 19; Nordal & Iversen, 1987: 45). Seeds of *H. angustifolia* var. *buchananii* are black (Y. Singh, pers. comm.), but unfortunately they were not available for a closer examination.

An examination of materials from Madagascar and Mauritius at MO revealed that numerous specimens of *H. angustifolia* possess seeds with a testa sculpture different from that described above. No other authors dealing with Hypoxidaceae from these islands (Baker, 1877; de Cordemoy, 1895; Perrier de la Bâthie, 1950) except Marais (1978) have noted the seed testa sculpture of *H. angustifolia*. Specimens from Mauritius, including the type specimen, have black seeds with colliculate testa and smooth cuticle (Fig. 2C). Semi-spherical papillae are minutely micropapillate on their surface (Fig. 2D). Such seeds were mentioned by Marais (1978) for the plants of Réunion and Mauritius and depicted on the plate in his paper. In plants from Madagascar two kinds of testa sculpture are present. A large proportion of specimens have testa with pyramidal papillae covered with a wrinkled brown cuticle, as is common in continental plants. Some specimens, however, possess black seeds with slightly longitudinally furrowed tuberculate papillae (Fig. 2E, F). The latter sculpture pebbling is different from that observed in Mauritius as well as on the African continent.

Because of the morphological variation of the seed testa sculpture in *H. angustifolia* from Mauritius, Madagascar, and continental Africa, recognition of four varieties is justified. *Hypoxis angustifolia* var. *buchananii* moreover is easily distinguishable because of its larger habit and because it grows in tufts versus the smaller and solitary-growing plants of other varieties. The island taxa are probably descendants of the continental populations. However, *H. angustifolia* was first described from Mauritius, so the type specimen possesses seeds with the least common type of testa sculpture.

Hypoxis angustifolia Lamarck, Encycl. 3: 182. 1789. TYPE: Mauritius. *Commerson s.n.* (holotype, P, computer image seen).

Perennial *herb*, 10–53 cm high; *rhizome* globose, 0.5–1.2 cm diam. (when dry), white inside, surmounted by inconspicuous membranous remains of old leaves, sometimes with some thin fibers; roots white, ± thick. Leaves grouped in a whitish pseudostem, *outer leaves* rarely present, if present not numerous, ovoid and spathe-like in basal part, linear in upper part, acute, to 10 cm long, ca. 0.7 cm wide, pilose along midrib and margins beneath with 2-branched white trichomes; nervation composed of 5 to 13 veins of unequal size; *inner leaves* 3 to 16, grass-like, linear or broadly linear, tapering toward apex, keeled, often recurved along two prominent lateral veins, acute at apex, 7–50 cm long, 0.2–1.0 cm wide, ciliate on margins and midrib beneath or very sparsely pilose on entire surface; trichomes 2(–3)-branched, 1.3–2.5 mm long, golden or white, soft; nervation composed of 5 to 29 veins of unequal size with 2 or 4 lateral veins prominently larger than the others. *Scapes* 1 to 7, 4–20 cm high, 0.5–1.1 mm wide, compressed, winged and glabrous in lower half, ciliate in upper half and pilose only beneath inflorescence; trichomes 2- or 3-branched; *flowers* single or in a lax 2- to 6-flowered corymbose cyme; *bracts* subulate or sword-shaped, acute, often two subtending a solitary flower, sometimes those subtending first two flowers much larger than upper ones, 3–17 mm long, 0.2–1.7 mm wide, keeled, 1-, 3-, or 5-veined, glabrous, villous or sparsely pilose on midrib abaxially, sometimes ciliate on margins; *pedicels* 5.5–35 mm long, pubescent or pilose. *Tepals* 6 (exceptionally 4), yellow, bright yellow, or outer tepals green and inner yellow, sometimes with a red or brownish stripe along midrib; *outer tepals* ovate, acute at apex, 3.5–10.0 mm long, 1.0–3.3 mm wide, adaxially with a clavate appendage below apex, 5- to 7-veined with irregular veins, villous or sparsely pilose abaxially; *inner tepals* ovate, obtuse, 3.5–9.0 mm long, 1.2–4.0 mm wide, 5- to 7-veined with irregular veins,

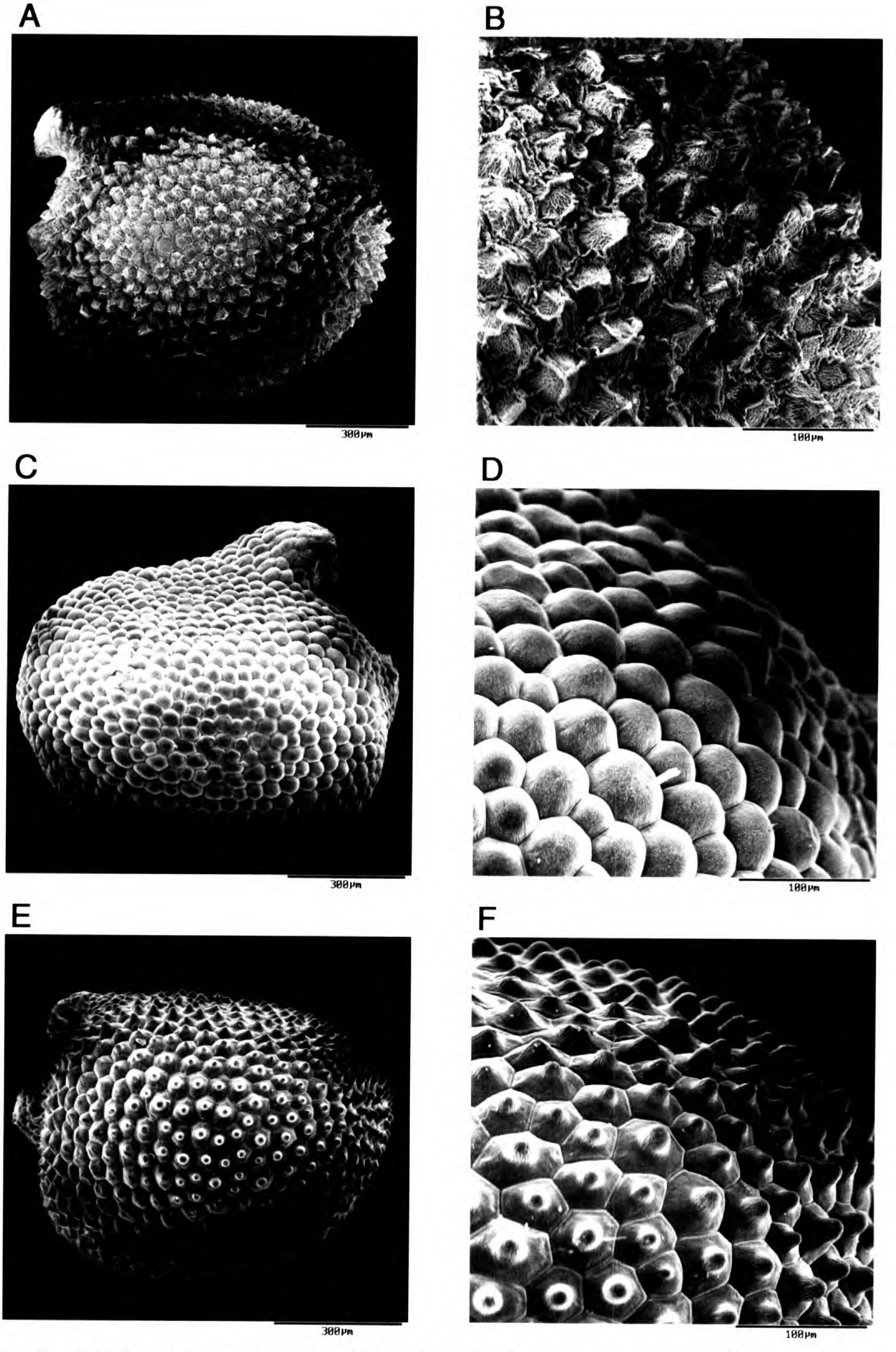

Figure 2. A, B. *Hypoxis angustifolia* var. *luzuloides*.—A. Seed. —B. Seed testa sculpture. C, D. *H. angustifolia* var. *angustifolia*.—C. Seed. —D. Seed testa sculpture. E, F. *H. angustifolia* var. *madagascariensis*.—E. Seed. —F. Seed

glabrous or pilose along midrib abaxially; *stamens* usually unequal, outer longer than inner or rarely equal; *filaments* subulate; outer stamens 2.2–4.0 mm long with filaments 1.3–3.0 mm long; inner stamens 1.7–3.5 mm long with filaments 1–2 mm long; *anthers* linear, deeply sagittate at base, retuse at apex, 1.0–3.2 mm long; *ovary* obconical, 2–5 mm long, 1–3 mm wide, almost glabrous or villous; *style* 0.5–3.0 mm long; *stigma* 0.6–2.5 mm long, both variable in shape. *Capsule* turbinate, 3.5–14.0 mm long, 2.5–4.0 mm diam., glabrous or pubescent, surmounted by persistent perigon, often splitting in three lobes; *seeds* numerous, ovoid, 0.8–2.0 mm long, 0.65–0.80 mm wide, with short papillose appendage at apex, black or brown; for cuticle and testa features, see varietal descriptions.

KEY TO THE VARIETIES OF *HYPOXIS ANGUSTIFOLIA*

1a. Plants growing in tufts; inner leaves 9–10 mm wide, flat, with at least 4 prominent lateral veins . . . . *H. angustifolia* var. *buchananii*
1b. Plants growing solitary; inner leaves 3–8 mm wide, with 2 prominent lateral veins.
  2a. Seeds brown; papillae pyramidal; cuticle wrinkled . . . . . *H. angustifolia* var. *luzuloides*
  2b. Seeds black; papillae semi-spherical or tuberculate; cuticle smooth.
    3a. Papillae semi-spherical . . . . *H. angustifolia* var. *angustifolia*
    3b. Papillae tuberculate . . . . *H. angustifolia* var. *madagascariensis*

Hypoxis angustifolia var. **angustifolia**

Herb to 5–15 cm high; *rhizome* 0.8–1.2 cm diam. (when dry). *Inner leaves* 3 to 10, linear, 7–15 cm long, ca. 0.2 cm wide, ciliate on margins and midrib beneath or very sparsely pilose on entire surface; trichomes golden; nervation composed of 7 to 11 veins with two lateral veins prominently larger than the others. *Scapes* 2 to 7, 4.0–7.5 cm high, 0.5–0.8 mm wide, ciliate in lower half, pilose in upper half; *flowers* single or in a lax 2-flowered cyme; *bracts* subulate, usually two subtending a solitary flower, 3–7 mm long, ca. 0.2 mm wide, 1-veined, villous on midrib abaxially; *pedicels* 7–11 mm long, pubescent. *Tepals* 6, yellow or bright yellow; *outer tepals* 4–5 mm long, ca. 2 mm wide, 5-veined, villous abaxially; *inner tepals* 3.7–4.5 mm long, 1.2–1.4 mm wide, 5-veined, pilose along midrib abaxially; *stamens* unequal; outer stamens 2.4–2.8 mm long with filaments 2.0–2.1 mm long; inner stamens 1.7–2.5 mm long with filaments 1.8–2.0 mm long; *anthers* ca. 1 mm long; *ovary* ca. 2.5 mm long, ca. 2 mm wide, villous; *style* subulate, 1.5–2.0 mm long; *stigma* 0.6–0.7 mm long, composed of three fused lobes. *Capsule* 3.5–4.5 mm long, ca. 3 mm diam., pubescent; *seeds* ca. 1 mm long, ca. 0.8 mm wide, black; testa covered with smooth cuticle; semi-spherical papillae minutely micropapillate on their surface (Fig. 2C, D).

Habitat. Gravelly soil, along path and roadside in sun with grasses; in open, humid places (Marais, 1978); 660–770 m altitude.

Observations. This typical subspecies occurs on Mauritius and probably also on Réunion.

Flowering January and September.

Specimens examined. MAURITIUS. Montane Cocotte nature reserve, *Lorence 2248* (MO); Macambe forest, *Lorence 660* (MO).

Hypoxis angustifolia var. **buchananii** Baker, J. Linn. Soc., Bot. 17: 111. 1878b. TYPE: South Africa. Natal: Nov. 1875, *Buchanan s.n.* (holotype, K).

Herb to 35 cm high; *rhizome* not seen. *Inner leaves* 4 to 6, broadly linear, 16–35 cm long, 0.9–1.0 cm wide, sparsely ciliate on margins and midrib beneath; trichomes golden; nervation composed of 25–29 veins with 4 lateral veins prominently larger than others. *Scapes* 4 to 5, 13.0–19.5 cm high, ca. 1 mm wide, winged and glabrous in lower half, ciliate in upper half, sparsely pilose on the whole surface below inflorescence; *flowers* in a very lax 2- to 3-flowered cyme; *bracts* subulate, 6–9 mm long, ca. 1 mm wide, 1-veined, pilose on midrib abaxially; *pedicels* 20–35 mm long, sparsely pilose. *Tepals* 6, yellow; *outer tepals* ovate, acute at apex, ca. 10 mm long, ca. 3.3 mm wide, with an oblong appendage, 7-veined, sparsely villous abaxially with 2- or 3-branched trichomes; *inner tepals* ca. 9 mm long, ca. 3 mm wide, 7-veined, pilose along midrib abaxially to half of its length; *stamens* unequal; outer stamens ca. 4 mm long with filaments ca. 2.5 mm long; inner stamens ca. 3.5 mm long with filaments 2.0 mm long; *anthers* ca. 3.2 mm long; *ovary* 4.0–4.5 mm long, ca. 1.2 mm wide, villous; *style* ca. 0.5 mm long; *stigma* ca. 2 mm long, pyramidal, obtuse at apex, wider than style, with three wide stripes of papillae. Fruits and seeds not seen.

Observations. On the sheet with the type specimen three plants are present. Two of them corre-

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testa sculpture. A and B from *Lewalle 5486*, MO; C and D from *Lorence 1421*, MO; E and F from *Lowry, Rakotozafy & Nicoll 4208*, MO.

spond to the description above, whereas one has much narrower leaves with fewer veins and belongs to the widespread continental variety. So far, *H. angustifolia* var. *buchananii* was cited from only two other collections: from Inanda *Wood 426, 771* (Baker, 1896: 180–181). Whereas *H. angustifolia* var. *luzuloides* occurs mainly in open places with sunlight, Baker (1896: 180) observed that this is "a large shade grown variety, with longer leaves of very thin texture; pedicels longer, very slender." Pedicels of this taxon are indeed usually longer than in the other varieties; however, this feature overlaps somewhat between *H. angustifolia* var. *buchananii* and *H. angustifolia* var. *luzuloides*. This variety, which occurs on the very edge of the range of *H. angustifolia*, certainly deserves further study.

Specimen examined. REPUBLIC OF SOUTH AFRICA. **Natal:** Umzinto, Rynie Park, *Strey 5974* (BR).

Hypoxis angustifolia var. **luzuloides** (Robyns & Tournay) Wiland, comb. et stat. nov. Basionym: *Hypoxis luzuloides* Robyns & Tournay, Bull. Jard. Bot. État 25: 254. 1955. TYPE: Congo-Kinshasa. Kivu, Tschambi, *G. F. de Witte 1130* (holotype, BR).

Herb 10–53 cm high; *rhizome* 0.8–1.2 cm diam. (when dry). *Inner leaves* 3 to 12, grass-like, linear, tapering toward apex, usually keeled, often recurved along two prominent lateral veins, acute at apex, 10–50 cm long, 0.3–0.8 cm wide, ciliate on margins and midrib beneath or very sparsely pilose on entire surface; trichomes golden or white; nervation composed of 5 to 13(23) veins with 2 thicker than others. *Scapes* 1 to 6, 5–20 cm high, ca. 1 mm wide, ciliate in lower half, pilose in upper half; *flowers* single or in a lax 2- to 6-flowered cyme; *bracts* subulate, 12–17 mm long, (0.5–)1.0–1.7 mm wide, 1- or 3-veined, villous on midrib abaxially, sometimes ciliate on margins; *pedicels* 12–25 mm long, pubescent. *Tepals* 6 (exceptionally 4), yellow, bright yellow, or outer tepals green and inner yellow, sometimes with a red stripe along midrib; *outer tepals* 5–8 mm long, 2–3 mm wide, 5- to 7-veined, villous abaxially; *inner tepals* 4–7 mm long, 3–4 mm wide, 5- to 7-veined, pilose along midrib abaxially to ¾ of its length; *stamens* usually unequal; outer stamens 3–4 mm long with filaments 2.5–3.0 mm long; inner stamens 2–3 mm long with filaments 1.5–2.0 mm long; *anthers* 1.5–3.0 mm long; *ovary* 2–5 mm long, 1–3 mm wide, villous; *style* 1–3 mm long, *stigma* 0.7–2.5 mm long, both variable in shape. *Capsule* 7–14 mm long, ca. 3 mm diam., pubescent; *seeds* ca. 2 mm long, 0.65–0.80 mm wide, brown; papillae pyramidal, testa covered with wrinkled cuticle (Fig. 2A, B).

General distribution. Intertropical and southern Africa, Madagascar, Mascarenes.

Habitat. Miombo; dry forest; bush; various grasslands; wooded grassland in river valleys; river banks; lakeshores, moist depressions; dunes; on base of termite mounds; pastured grassland on rocky soil; granite slabs on slopes; secondary grassland on laterite; fallow fields in grassland, shrubby fallow fields on sand; moist roadsides, roadside ditches, along trails and roads in the forest, disturbed forest, rocky gorge on steep grade; cultivation of manioc; loamy soil, with kaolin, rocky soil. Altitude 0–2800 m.

Observations. Flowering from January to May. Medicinal plant; pulp from the rhizome is useful for healing pustules and infected wounds (Gillet & Pâque, 1910). Its chemical compounds were studied by Sibanda et al. (1990). *Hypoxis luzuloides* Robyns & Tournay (1955a) was described from Central Africa as a separate species in Nel's section *Argenteae* based on the fact that in the type specimen the stigma was longer than the style. This is, however, weak support as discussed above. Various authors included this name in the synonymy of *H. angustifolia* (Geerinck, 1971; Nordal et al., 1985; Zimudzi, 1996; Nordal, 1997; Wiland-Szymańska, 2001). The type specimen of *H. luzuloides* possesses all features common in *H. angustifolia* and seeds with the testa sculpture and wrinkled cuticle typical of continental populations. I have therefore transferred this specific epithet to the varietal rank rather than choosing a new epithet and type specimen.

Selected examined specimens. SIERRA LEONE. *Haswell 37* (K), *Morton SL3532* (K). NIGERIA. **Kaduna:** Igabi Dist., Anara, *Keay 25779* (K). **Plateau:** Jos Plateau, Naraguta, *Lawlor & Hall 101* (K). **Taraba:** Mambila Plateau, *Chapman 66* (K). **Adamawa:** Chappal Hendu, *Chapman 4424* (K). CAMEROON. **North-West:** Bamenoa, Bafut-Ngemba, *Richards 5308* (K). CHAD. **Chari-Baguirmi:** Region du Lac Fitri entre Boullai et Djannaw, *Chevalier 9485* (K). CENTRAL AFRICAN REPUBLIC. **Bamingui-Bangoran:** 8°28′N, 20°53′E, *Fay 3105* (K). SUDAN. **Darfur:** Jabel Marra, *Wickens 1945* (K). ETHIOPIA. *Thulin, Hynde & Tadesse 3369* (UPS). **Amhara:** Blue Nile Gorge, *Gilbert 2162* (K). **Oromiya:** 5 km N of Neghelle, *Vollesen 2640* (K). **Southern:** 11 km S of Dilla, *Friis, Tadesse & Jefford 4274* (K). CONGO-KINSHASA. **Bas-Zaïre:** Lutete, *Hens 221* (BR, K, P). **Kinshasa:** Kimuenza, *Lejoly 82/1013* (BR, BRLU). **Bandundu:** Chutes Tembo, *Breyne 2590* (BR). **Haut-Zaïre:** Abok, *Scops 168* (BR); Nioka, *Lejoly 3338* (BRLU), *Lisowski 48484* (POZG). **Kasai Oriental:** Lomami, *Dandoy 206* (BRLU). **Kivu:** Kikanga, *Bequaert 4211* (BR). **Shaba:** Tshibonde, *Mullenders 2346* (BR); Kapolowe, *Lisowski B-7276* (POZG). RWANDA. Parc National de L'Akagera, *Bouxin*

& *Radoux 434* (BR); Gabiro, *Burgeon 17 & 34* (BR); Kibugabuga, *Liben 620* (BR); Nemba, *Bouxin & Radoux 1415* (BR); Bugesera, *Augier 2898* (BR); Matinza, *Bouxin & Radoux 1008* (BR); Lulama, *Bouxin & Radoux 418* (BR); Mimuli, *Troupin 4230* (BR); Lukionji, *Troupin 6776* (BR); Kakitumba, *Christiaensen 736* (BR). BURUNDI. Route Bubanza–Musigati, *Lewalle 4189* (BR); Bujumbura, *Lewalle 5486* (BR, MO); plaine de la Ruzizi, *Reekmans 2906* (BR, MO), *Lambinon 75/44* (WAG); Bulamata, *Germain 7191* (BR); Rumonge, *Lewalle 5029* (BR). UGANDA. **Bushenyi:** Kasharara, *Rwaburindore 1872* (MO). **Mbarara:** Mbarara, *Purseglove 602* (K); Kilaro, *Rwaburindore 2064* (MO). **Masaka:** 1–2 km E of Kikoma, *Lye 4440* (K, UPS). **Mpigi:** Entebbe, *Brown 293* (K). **Mukono:** Busana, Bugerere, *Eggeling 527* (K). **Inanga:** on lower NW slopes of Bugiri hill, *Wood 702* (K). **Kumi:** Bukedea, *Katende K226* (K). **Moroto:** base of Mt. Debasien, near Mornita, *Eggeling 5798* (K). **Kapchorwa:** NE Mt. Elgon, *Tweedie 1110* (K). **Mbale:** N Bugisu, Muyembe escarpment, *Norman 256* (K). KENYA. **Western:** Kakamega, *Carrall 429* (K). **Nyanza:** Oyugis–Kendu Road, *Hanid & Kiniaruh 651* (MO); Tinderet Forest Res., *Maas Geesteranus 5220* (BR). **Rift Valley:** Kipkarren, *Brodhurst-Hill 173* (K); 8 km S of Nandi Hills, *Davidse 7121* (MO); Menengai, *Maas Geesteranus 4573* (BR). **Central:** Vlei near 14 Falls, Thika–Donyo Sabuk Road, *Verdcourt 1965* (K). **Eastern:** Moyale, *Gillet 12799* (BR, K). **Coast:** Maji ya Chumvi, *Kässner 453* (K); Shimba Hills, Longo Mwagandi area, *Magogo & Glover 311* (MO); Shimba Hills, Pengo Hill, *Bamps 6331* (BR). TANZANIA. **Kagera:** Kabogo, near Shanga, *Tanner 5857* (K). **Mara:** Wogakuria Hill, *Greenway & Turner 12007* (K). **Shinyanga:** Shinyanga, *Bax s.n.* (K). **Arusha:** Essimingori Mountain, *Wiland & Mboya 174* (MO); Mt. Meru, *Bjørnstad 233* (K, DAR); between Magugu & Babati, *Polhill & Paulo 2373* (BR). **Kilimanjaro:** road to Horombo, *McCusker 98* (K); Moshi–Arusha road, *Polhill & Paulo 984* (BR). **Tanga:** 12 km E of Old Korogwe *Eriksson, Kalema & Leliyo 572* (NHT); Machui, Tanga–Pangani road, *Faulkner 1844* (B, BR, K); Mandundu, *Archbold 1007* (DAR). **Dodoma:** Mpwapwa, Kiboriani Mountains, *Hornby & Hornby 2096* (K). **Morogoro:** Uluguru Gebirge, *Schlieben 3245* (B, BR, K, MO); Mgeta, *Wigfield 2313* (DAR). **Pwani:** 59 mi. from Dar es Salaam on main road to Morogoro, *Welch 296* (BR, K); about 15 mi. S of Dar es Saalam, between Kambiji and Mjimwema, *Batty 1347* (MO); Mafia Island, Rufiji, *Wallace 811* (K); Dar es Salaam, *Harris 244 & 1234* (DAR); Kibaha Research Station, *Banda 314* (NHT). **Zanzibar:** Zanzibar Island, *Faulkner 2940* (BR, K); Pemba Island, *Williams 18* (BR, K). **Iringa:** near Isele village, *Wiland & Mboya 73* (MO); Chimala escarpment, *Richards 7513* (K); Kidatu, *Mhoro 424* (DAR). **Lindi:** Nachingwea, *Anderson 947* (NHT). ZAMBIA. *van Rensburg 1317* (P). MOZAMBIQUE. *de Koning 7406* (BR), *Quintas 157* (BR), *Bates 520* (BR), *Pope & Miller 588* (BR). REPUBLIC OF SOUTH AFRICA. *Schlieben 7345* (BR), *Ackock 10832* (BR). MADAGASCAR. **Fianarantsoa:** 10 km W of Ivato, *Croat 29634* (MO, TAN); Ranomafana Res., NE of Fianarantsoa, *Leeuwenberg et al. 14147* (MO, TAN). **Tananarive:** Forest Station of Manjakatiompo, *Croat 28950* (MO, TAN). **Toamasina:** swamp of Torotonsifotsy, *Rakotomalaza, Andrianasolo, Rasolomanana & Andraintsiferana 1340* (MO, TAN); 7 km E of Anjozorobe, *Schatz, Stevens & Lowry 3483* (MO, TAN). **Toliara:** 5 km S of Manambaro, 23 km W of Fort Dauphin, *Miller & Randrianasolo 6218* (MO, TAN). **Tulear:** Chain Anosyennes from Fort Dauphin to Ranamafona, *Croat 31840* (MO).

Hypoxis angustifolia var. **madagascariensis** Wiland, var. nov. TYPE: Madagascar. Toamasina: Ambanizana, Masoala Peninsula, along Androka River S of MBG house, 15°39′30″S, 49°57′30″E, June 1993, *Zjhra & Hutcheon 273* (holotype, MO). Figures 2E, F, 3.

Haec varietas a *H. angustifolia* var. *angustifolia* et *H. angustifolia* var. *luzuloides* seminis testa tuberculato-aculeata differt.

Herb to 10–15 cm high; *rhizome* 0.5–1.2 cm diam. (when dry), surmounted by inconspicuous membranous remains of old leaves to 1 cm high. *Inner leaves* 5 to 16, not grouped in a distinctive pseudostem, linear, tapering toward apex, keeled, acute at apex, 9–38 cm long, 0.2–0.4 cm wide, almost glabrous or sparsely ciliate on margins and midrib beneath; trichomes white; nervation composed of 5 to 15 veins. *Scapes* 1 to 6, 2.5–13.0 cm high, 0.5–1.1 mm wide, elongate with age, ciliate in lower half, sparsely pilose in upper half; *flowers* single or in a lax 2- or 3-flowered cyme (Fig. 3C); *bracts* sword-shaped, with membranous edges, those subtending the first two flowers much larger than the third, often two subtending a solitary flower, the lowest 12–17 mm long, 1.0–1.7 mm wide, 3- or 5-veined, the uppermost 5–7 mm long, sparsely pilose abaxially or glabrous; *pedicels* 5.5–12.0 mm long, glabrous or sparsely pilose. *Tepals* 6 (exceptionally 4), yellow; *outer tepals* 3.5–4.3 mm long, 1.0–1.5 mm wide, 5-veined, sparsely pilose abaxially; *inner tepals* 3.5–4.2 mm long, 1.2–1.6 mm wide, with numerous papillae around apex (Fig. 3B), 5-veined, glabrous; *stamens* equal, ca. 2 mm long with filaments 1.4–1.6 mm long, or unequal with outer stamens ca. 2.2 mm long with filaments 1.3–1.4 mm long, and inner stamens ca. 1.8 mm long with filaments 1.0–1.1 mm long; *anthers* 1.2–1.4 mm long; *ovary* 3–4 mm long, 1.0–1.7 mm wide, almost glabrous; *style* 1.2–1.3 mm long, trigonous; *stigma* 0.7–0.8 mm long, composed of three oblong, partially fused lobes. *Capsule* 4.5–8.0 mm long, ca. 2.5–4.0 mm diam., glabrous; *seeds* 0.8–0.9 mm long, 0.65–0.7 mm wide; testa black with slightly longitudinally furrowed tuberculate papillae, cuticle smooth (Fig. 2E, F).

Habitat. Wet rocks; on trail in primary forest; 475–850 m altitude.

Vernacular name. Mangitrampango (*Miller & Lowry 3905*).

Observations. Flowering in February, April, June, and October. From *H. angustifolia* var. *luzuloides* it differs in the seed testa sculpture, larger bracts, smaller flowers, and more distinctive papillation on the apex of the inner tepals. In Mada-

Figure 3. *Hypoxis angustifolia* var. *madagascariensis* Wiland. —A. Habit. —B. Papillae on apex of inner tepal. —C. Inflorescence. A & B from *Rakoto & Turk 83*, MO; C from *Zjhra & Hutcheon 273* (MO).

gascar there is no distinct difference in geographical distribution or habitat preference between these two taxa. Field studies are needed to evaluate the relationship between them.

Paratypes. MADAGASCAR. **Toamasina:** Maroantsetra, mountains NE of village Ambanizana, *Lowry, Rakotofazy & Nicoll 4208* (MO). **Fianarantsoa:** National Park of Ranomafana, *Rakoto & Turk 83* (MO, TAN). **Antsiranana:** Nature Reserve of Marojejy, NW of Mandena, *Miller & Lowry 3906* (MO). **Tamatave:** ca. 50 km NW of Tanatave, trail from Fotsimavo to Nature Reserve of Betampona, *Gentry 11311* (MO, TAN).

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New Combinations in Chinese *Pittosporum* (Pittosporaceae)

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ABSTRACT. As part of a revision of Chinese *Pittosporum* Banks ex Gaertner for the forthcoming account of Pittosporaceae in the *Flora of China*, Volume 9, it is necessary to publish seven new combinations. All of the taxa were originally described at specific rank. Six are morphologically similar to five other species, under which they are reduced to varieties: *Pittosporum balansae* Aug. DC. var. *chatterjeeanum* (Gowda) Zhi Y. Zhang & Turland, comb. et stat. nov., *Pittosporum glabratum* Lindley var. *wenxianense* (G. H. Wang & Y. S. Lian) Zhi Y. Zhang & Turland, comb. et stat. nov., *Pittosporum kweichowense* Gowda var. *buxifolium* (K. M. Feng ex C. Y. Wu) Zhi Y. Zhang & Turland, comb. et stat. nov., *Pittosporum kweichowense* var. *podocarpifolium* (C. Y. Wu) Zhi Y. Zhang & Turland, comb. et stat. nov., *Pittosporum podocarpum* Gagnepain var. *hejiangense* (H. Y. Su) Zhi Y. Zhang & Turland, comb. et stat. nov., and *Pittosporum rehderianum* Gowda var. *ternstroemioides* (C. Y. Wu) Zhi Y. Zhang & Turland, comb. et stat. nov. The remaining new combination is *Pittosporum pentandrum* (Blanco) Merrill var. *formosanum* (Hayata) Zhi Y. Zhang & Turland, comb. nov., which is the correct name at varietal rank under *P. pentandrum* when *P. formosanum* Hayata var. *formosanum* and variety *hainanense* Gagnepain are considered to be synonyms.

Key words: China, Pittosporaceae, *Pittosporum*.

As part of a revision of Chinese *Pittosporum* Banks ex Gaertner for the forthcoming account of Pittosporaceae in the *Flora of China*, Volume 9 (Zhang et al., in press), all names described in this family based on Chinese types were carefully evaluated. It was decided that seven new combinations were necessary: six of them originally described as species, here reduced to varietal rank, and the seventh the correct name for a variety where an autonym has priority over the varietal epithet currently in use.

1. **Pittosporum balansae** Aug. DC., Bull. Herb. Boissier, sér. 2, 4: 1071. 1904.

1a. **Pittosporum balansae** var. **chatterjeeanum** (Gowda) Zhi Y. Zhang & Turland, comb. et stat. nov. Basionym: *Pittosporum chatterjeeanum* Gowda, J. Arnold Arbor. 32: 318. 1951. TYPE: "Burma: Kang-fang" [actually China. Yunnan: Tengchong Xian, Gangfang], 1500 m, thickets along river banks, "4-XIII-1938" [sic!], *Kingdon Ward 75* (holotype, A).

Pittosporum chatterjeeanum is sufficiently similar morphologically to *P. balansae* to be conspecific. It differs in having lanceolate leaves 1–3.5 cm wide, vs. oblong leaves 2–5 cm wide in *P. balansae* var. *balansae* and narrowly lanceolate leaves 1–1.5 cm wide in *P. balansae* var. *angustifolium* Gagnepain. Therefore, treating *P. chatterjeeanum* as a variety of *P. balansae* is appropriate. Both *P. balansae* var. *balansae* and variety *angustifolium* occur in western Guangdong, southwestern Guangxi, and Hainan, as well as in Vietnam, while variety *chatterjeeanum* is disjunct from the other varieties, growing in western Yunnan (Tengchong Xian) and adjacent northern Myanmar.

2. **Pittosporum glabratum** Lindley, J. Hort. Soc. London 1: 230. 1846.

2a. **Pittosporum glabratum** var. **wenxianense** (G. H. Wang & Y. S. Lian) Zhi Y. Zhang & Turland, comb. et stat. nov. Basionym: *Pittosporum wenxianense* G. H. Wang & Y. S. Lian, Acta Phytotax. Sin. 34: 210. 1996. TYPE: China. Gansu: Wen Xian, Bikou, 1100 m, 16 Aug. 1993, *Y. S. Lian et al. 93–432* (holotype, NWTC not seen).

From its original description, *Pittosporum wenxianense* is sufficiently similar morphologically to *P. glabratum* to be conspecific. It differs in having leaves obovate to narrowly obovate, with a truncate to obtuse apex, vs. leaves oblong, oblanceolate, narrowly lanceolate, or beltlike, with an acute apex, in both *P. glabratum* var. *glabratum* and *P. glabratum* var. *neriifolium* Rehder & E. H. Wilson. Therefore, treating *P. wenxianense* as a variety of *P. glabratum* is appropriate. *Pittosporum glabratum* var. *glabratum* occurs in Fujian, Guangdong, Guangxi, Guizhou, Hainan, and Hunan, as well as in Vietnam, while variety *neriifolium* has a similar range, occurring also in Hubei, Jiangxi, and Sichuan, but is not yet known in either Hainan or Vietnam. *Pittosporum glabratum* var. *wenxianense* is known only from southern Gansu (Wen Xian), which is at the northern edge of the distribution of *Pittosporum* in China.

3. **Pittosporum kweichowense** Gowda, J. Arnold Arbor. 32: 296. 1951.

3a. **Pittosporum kweichowense** var. **buxifolium** (K. M. Feng ex C. Y. Wu) Zhi Y. Zhang & Turland, comb. et stat. nov. Basionym: *Pittosporum buxifolium* K. M. Feng ex C. Y. Wu, Fl. Yunnan. 3: 318. 1983. TYPE: China. Yunnan: Xichou Xian, 26 Sep. 1947 (fr), *K. M. Feng 12083* (holotype, KUN not seen).

3b. **Pittosporum kweichowense** var. **podocarpifolium** (C. Y. Wu) Zhi Y. Zhang & Turland, comb. et stat. nov. Basionym: *Pittosporum podocarpifolium* C. Y. Wu, Fl. Yunnan. 3: 318. 1983. TYPE: China. Yunnan: Funing Xian, foot of limestone mountain, 11 Apr. 1940 (fl), *C. W. Wang 88305* (holotype, KUN not seen).

From their original descriptions, *Pittosporum buxifolium* and *P. podocarpifolium* are sufficiently similar morphologically to *P. kweichowense* to be conspecific. *Pittosporum buxifolium* differs in having obovoid capsules, vs. cylindric capsules in *P. kweichowense*, while *P. podocarpifolium* differs in having lanceolate leaves 0.5–0.8 cm wide, vs. narrowly oblong leaves 1–2.2 cm wide in *P. kweichowense*. Therefore, treating *P. buxifolium* and *P. podocarpifolium* as varieties of *P. kweichowense* is appropriate. *Pittosporum kweichowense* var. *kweichowense* occurs in southwestern Guizhou (Anlong Xian), western Hunan (Zhijiang Xian), and southeastern Yunnan (Wenshan Xian), while both variety *buxifolium* and variety *podocarpifolium* are known only from southeastern Yunnan (Guangnan Xian and Xichou Xian, and Funing Xian, respectively).

4. **Pittosporum pentandrum** (Blanco) Merrill, Bur. Gov. Lab. (Manila) 27: 19. 1905. Basionym: *Aquilaria pentandra* Blanco, Fl. Filip. 373. 1837.

4a. **Pittosporum pentandrum** var. **formosanum** (Hayata) Zhi Y. Zhang & Turland, comb. nov. Basionym: *Pittosporum formosanum* Hayata, in Matsumura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo 22: 32. 1906. TYPE: China. Taiwan: "Kaisa et kiko," 23 Nov. 1896, *C. Owatari s.n.* (syntype, TI); "Takaw," without date, *A. Henry 52* (syntype, TI); "Reigaryo," 31 Feb. 1898, *C. Owatari s.n.* (syntype, TI).

Pittosporum formosanum Hayata var. *hainanense* Gagnepain, in Lecomte, Fl. Indo-Chine 1: 238. 1909. *Pittosporum pentandrum* var. *hainanense* (Gagnepain) H. L. Li, J. Wash. Acad. Sci. 43: 45. 1953. TYPE: Vietnam: "rapides de Bac-ninh, Quang-yen," without date, *Balansa s.n.* (syntype, P not seen); "vers Ninh-binh," without date, *Bon s.n.* (syntype, P not seen).

When *Pittosporum formosanum* var. *formosanum* and variety *hainanense* are considered to be synonyms (the view adopted by the present authors), the correct name for this taxon at varietal rank under *P. pentandrum* is variety *formosanum*. Chang and Yan (1979: 35) adopted the same taxonomy, but were incorrect to use the combination *P. pentandrum* var. *hainanense* because the autonym, *P. formosanum* var. *formosanum*, was established simultaneously with variety *hainanense* and has priority under Article 11.6 of the *Saint Louis Code* (Greuter et al., 2000). Hatusima (in Hatusima & Amano, 1994: 74) published the combination *P. pentandrum* var. *formosanum*, but invalidly because no basionym was cited (Art. 33.3).

Pittosporum pentandrum var. *formosanum* occurs in southern Guangxi (Hepu Xian), Hainan, and southern Taiwan (including Lan Yu), as well as in Vietnam.

5. **Pittosporum podocarpum** Gagnepain, Notul. Syst. (Paris) 8: 211. 1939.

5a. **Pittosporum podocarpum** var. **hejiangense** (H. Y. Su) Zhi Y. Zhang & Turland, comb. et stat. nov. Basionym: *Pittosporum hejiangense* H. Y. Su, Bull. Bot. Res., Harbin 4(4): 201. 1984. TYPE: China. Sichuan: Hejiang Xian, Fubao-qu, Qilong Commune, 75 m, 2 Aug. 1977, *Hejiang Expedition 0777* (holotype, YBDC not seen).

From its original description, *Pittosporum hejiangense* is sufficiently similar morphologically to *P. podocarpum* to be conspecific. It differs in having sparsely puberulent young branches, vs. glabrous branches in both *P. podocarpum* var. *podocarpum* and *P. podocarpum* var. *angustatum* Gowda, and densely brown pubescent branches in *P. podocarpum* var. *molle* W. D. Han. Therefore, treating *P. hejiangense* as a variety of *P. podocarpum* is appropriate. *Pittosporum podocarpum* var. *podocarpum* occurs in Fujian, Gansu, Guangxi, Guizhou, Hubei, Hunan, Shaanxi, Sichuan, southeastern Xizang, and Yunnan, as well as in northeastern India, Myanmar, and northern Vietnam, while variety *angustatum* has a very similar range, occurring also in Guangdong, but as yet unknown in either Xizang or Vietnam. *Pittosporum podocarpum* var. *molle* is known only from southern Fujian (Hua'an Xian) and southern Guizhou (Libo Xian), while variety *hejiangense* is known only from southeastern Sichuan (Hejiang Xian).

6. **Pittosporum rehderianum** Gowda, J. Arnold Arbor. 32: 297. 1951.

6a. **Pittosporum rehderianum** var. **ternstroemioides** (C. Y. Wu) Zhi Y. Zhang & Turland, comb. et stat. nov. Basionym: *Pittosporum ternstroemioides* C. Y. Wu, Fl. Yunnan. 3: 320. 1983. TYPE: China. Yunnan: Longling Xian, foot of mountain, among shrubs, 10 Aug. 1941 (fr), *C. W. Wang 90010* (holotype, KUN not seen).

From its original description, *Pittosporum ternstroemioides* is sufficiently similar morphologically to *P. rehderianum* to be conspecific. It differs in having capsules each with ca. 8 seeds, vs. capsules each with 21–24 seeds in *P. rehderianum*. Therefore, treating *P. ternstroemioides* as a variety of *P. rehderianum* is appropriate. *Pittosporum rehderianum* var. *rehderianum* occurs in southeastern Gansu, western Hubei, southern Shaanxi, and western Sichuan, whereas variety *ternstroemioides* is disjunct, known only from western Yunnan (Longling Xian).

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A New Species of *Thamnobryum* (Musci: Neckeraceae) from Venezuela, with a Key to the Neotropical Species of *Thamnobryum*

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Abstract. *Thamnobryum liesneri* differs from all other species of *Thamnobryum* in its ligulate to lingulate secondary stem and branch leaves that have exceptionally broad (to 160 μm wide and a third or more of the leaf base width), strongly forked and spurred, subpercurrent costae. It differs from all species of *Porotrichum* and *Porothamnium* in having leaves with very broad costae and short upper cells. A key to the three species of *Thamnobryum* in the Neotropics is given.

Key words: Musci, Neckeraceae, *Thamnobryum*, Venezuela.

Thamnobryum is a handsome genus of frondose or stipitate mosses with 42 species (Crosby et al., 2000) distributed throughout the world. The genus is usually included in the subfamily Thamnioideae of the Neckeraceae (Fleischer, 1905–1906; Brotherus, 1906, 1925; Robinson, 1975; Crum & Anderson, 1981; Vitt, 1984; Enroth, 1989, 1994; Buck, 1998; Buck & Goffinet, 2000). Mönkemeyer (1927), however, placed the genus (as *Thamnium*, an illegitimate name) in its own family. This family (now the Thamnobryaceae) has been expanded by Margadant and During (1982), Walther (1983), Buck and Vitt (1986), Sastre-De Jesús (1987), and Churchill and Linares (1995) to include all members of the Neckeraceae with a frondose or stipitate habit and striate exostomes. As discussed by Buck (1998), however, some thamnoid genera are weakly stipitate, and both striate and papillose exostomes can be found in the thamnoid as well as the neckeroid genera.

The taxonomy of the Thamnioideae is so unsettled that it is difficult to find fault with Robinson's (1975: 56) characterization of them as a ". . . vile group of genera. . . ." This is because the important character states within the group are not discrete, and within this mainly dioicous group that often lacks sporophytes many of its critical characters are sporophytic. In the Neotropics *Thamnobryum* is close to *Porotrichum* and *Porothamnium*. It differs from both genera mainly in having leaves with stronger costae and shorter upper cells (see Robinson, 1975; Sastre-De Jesús, 1987; Buck, 1998).

There are three species of *Thamnobryum* in neotropical South America, one of which is described below as new to science.

Thamnobryum liesneri B. H. Allen & S. P. Churchill, sp. nov. TYPE: Venezuela. Amazonas: Atures, lower forested E slope of unnamed 1760 m peak, 8 km NW of settlement of Yutaje, 3 km W of Río Coro-Coro, W of Serranía de Yutaje, 05°41′N, 66°09′W, *Ronald Liesner & Bruce Holst 21891* (holotype, MO; isotypes, H, NY, US, VEN). Figure 1A–L.

Species haec a congeneris foliis ligulatis-lingulatis, cos-

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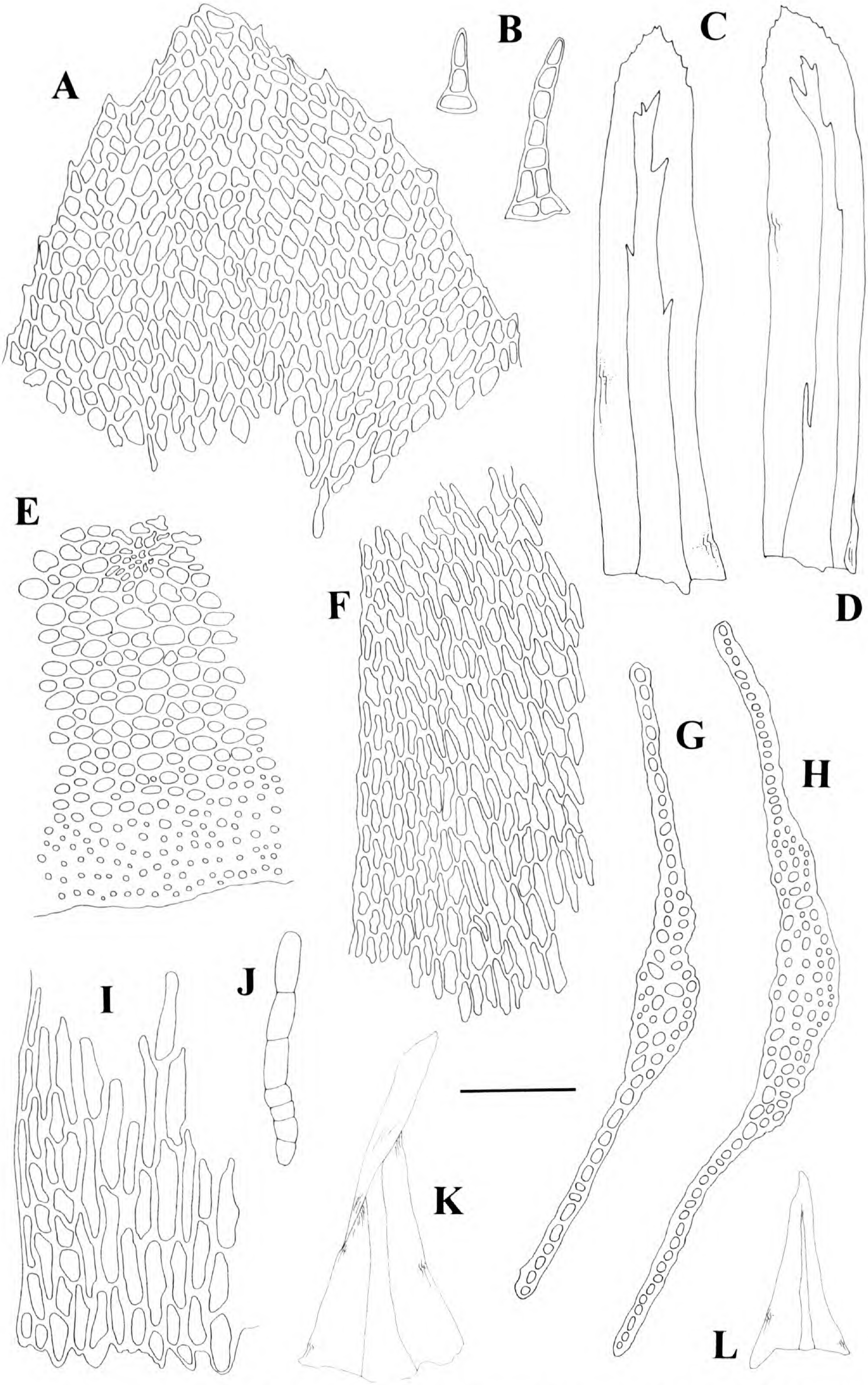

Figure 1. *Thamnobryum liesneri* B. H. Allen & S. P. Churchill. —A. Upper secondary stem leaf apex. —B. Foliose pseudoparaphyllia. —C, D. Upper secondary stem leaves. —E. Cross section of secondary stem. —F. Upper secondary

tis latissimis, calcaratis et furcatis, subpercurrentibusque differt.

Plants slender, dull, light-green, older plants black-brown, in dense, wiry tufts to 4 cm high. Primary stems yellow-red, becoming red-black with age, creeping, in cross section with central strand poorly developed, cortical cells thin-walled, and epidermal cells very thick-walled, to 6 cells thick; rhizoids in circular clusters on the parts of the stems that touch the substrate, red, smooth. Leaves widely spaced, reduced, hastate, to 0.5 mm long, costa single, strong. Secondary stems yellow-red, becoming red-black with age, erect, stipitate below, weakly frondose above, irregularly 1–2 pinnately branched, in cross section central strand weakly developed, cortical cells firm-walled, hyaline, epidermal cells small, thick-walled, golden-yellow to red, in 6–8 rows; foliose pseudoparaphyllia present; axillary hairs 6–7 cells long, lower 3–4 quadrate, upper 2–3 cylindrical, all cells often light red-brown; rhizoids densely clustered at base of secondary stems, red, smooth; secondary stems and branches ending in flagellate tips. Stipe leaves erect to erect-spreading when dry, erect-spreading when wet, widely spaced, reduced, stipe leaves near base hastate, becoming linear-lanceolate above, 1.0–1.8 mm long. Leaves erect to erect-incurved when dry, more spreading when wet, otherwise little changed, well-spaced, ligulate to lingulate, 1.7–2.0 mm long, 0.3–0.4 mm wide, flat to variously concave; apices acute; margins plane to reflexed below, entire in lower ½ to ¾, irregularly toothed to crenulate at apex; lamina unistratose above, uni- or bistratose at base; costae single, very broad (to 160 μm wide at base), subpercurrent (ending 10–20 cells below the apex), often forked at apex, usually spurred below; leaf cells firm-walled, smooth, not porose, apical cells irregularly rhomboid to hexagonal 12–20 × 6–10 μm, upper median cells fusiform-rhomboid, usually obliquely arranged from the costa, basal cells oblong-rectangular, 20–40 × 6–8 μm, alar cells short, weakly differentiated. Dioicous (?). Sporophytes unknown.

Etymology. This species is named for Ronald Lee Liesner, an outstanding vascular plant and bryophyte collector at the Missouri Botanical Garden. Ron Liesner was the actual collector of *Thamnobryum liesneri.*

Habitat. On boulder near stream; 1050–1200 m.

Thamnobryum liesneri differs from all species of *Thamnobryum* familiar to us by its ligulate to lingulate secondary stem and branch leaves that have exceptionally broad (to 160 μm wide and a third or more of the leaf base width), strongly forked and spurred, subpercurrent costae. There are some species of *Thamnobryum* from the Juan Fernandez Islands with costae to 100 μm wide, but these species have ovate-lanceolate or lanceolate leaves with percurrent or excurrent costae. Although the presence of flagellate tips on nearly all the secondary stems and branches of *T. liesneri* seems a distinctive feature of the species, there are many other species of *Thamnobryum* that occasionally have flagellate stem and branch tips. *Thamnobryum liesneri* differs from all species of *Porotrichum* and *Porothamnium* in having leaves with very broad costae and short upper cells.

KEY TO THE NEOTROPICAL SPECIES OF *THAMNOBRYUM*

1. Secondary stem and branch leaves ligulate to lingulate; costae to 160 μm wide at base . . . *T. liesneri* B. H. Allen & S. P. Churchill
1. Secondary stem and branch leaves ovate-ligulate or oblong-ovate; costae 40–60 μm wide at base 2
    2. Secondary stem and branch leaves plicate when dry, ovate-ligulate, 2–4 mm long; stipe leaves 2–3 mm long . . . . *T. fasciculatum* (Hedwig) I. Sastre
    2. Secondary stem and branch leaves smooth when dry, oblong-ovate, 2–3 mm long; stipe leaves to 1 mm long . . . . *T. tumidicaule* (K. A. Wagner) F. D. Bowers

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←

stem leaf median cells and margin. —G. Cross section, upper part of secondary stem leaf. —H. Cross section, lower part of secondary stem leaf. —I. Upper secondary stem leaf basal cells and margin. —J. Axillary hair. —K. Stipe leaf. —L. Primary stem leaf. Scale in mm: bar = 0.05 (B, J); bar = 0.06 (A, E–I); bar = 0.34 (K, L); bar = 0.4 (C, D). All figures from *Liesner & Holst 21891* (holotype).

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Overview of *Sphaeralcea* (Malvaceae) in Southern Utah and Northern Arizona, U.S.A., and Description of a New Species

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ABSTRACT. Described is *Sphaeralcea gierischii* N. D. Atwood & S. L. Welsh, sp. nov., which is distinguished from *S. rusbyi* by the glabrous or glabrescent herbage, with few or no stellate hairs confined to the leaf margin, larger (15–25 mm long) flowers, and restricted range and habitat, and from *S. moorei* in the 3- to 5-parted, narrow leaf lobes, bright green leaves sometimes suffused with red-purple, and different habitat. Two varieties are evaluated at the species level within *Sphaeralcea* based on different morphological features, geographical distribution, and habitat: *S. moorei* (S. L. Welsh) N. D. Atwood & S. L. Welsh, stat. nov., and *S. fumariensis* (S. L. Welsh & N. D. Atwood) N. D. Atwood & S. L. Welsh, stat. nov. A key to the closely related taxa is included, and each of the taxa is provided with a description. The geographical distribution and ecology in southern Utah and northern Arizona, U.S.A., are also discussed.

Key words: Arizona, Malvaceae, North America, *Sphaeralcea*, Utah.

Collections taken over the past half century give indication that southern Utah is an important center for diversity and speciation in the genus *Sphaeralcea*. The genus as a whole consists of taxa whose morphological distinctions are obscured by overlap of practically every characteristic. Floral features tend to be very similar, and their usefulness as diagnostic characters is clouded by intermediates among the constituent taxa. Characteristics of the mature fruiting carpels have been considered as perhaps more important than other floral features. However, mature carpels are seldom collected. As soon as the main flush of flowering is finished most collectors tend to lose interest. Thus only a small fraction of the huge number of specimens collected in this attractive genus bear mature carpels. Some of the intermediacy of morphological features is the result of hybridization among the various taxa, often across sectional lines as defined by Kearney. Thus, numerous specimens intermediate between the taxa tend to accumulate in herbaria without proper identification. The result of the problematic morphology has been the definition of taxa by use of multiple, overlapping characteristics. By such a procedure it has been possible to recognize the main subunits within what is more or less a mosaic of variation. The following short summary is confined to those species involved within sections *Laxae* and *Munroanae* as defined by Kearney (1935). This includes those species that are thought to have been most important in contributing to the diversity of forms present in southern Utah and adjacent Arizona.

The following key is presented to allow discrimination of most specimens of the related and similar taxa known to occur in southern Utah and immediately adjacent northern Arizona.

1a. Herbage only sparingly pubescent, the herbage bright green (the stems sometimes suffused with red-purple).
  2a. Herbage glabrous or glabrescent, stellate pubescence, if any, confined to leaf margins (rarely a few stellate trichomes on the blade surface); calyces glabrous externally; flowers large, the petals 15–25 mm long; plants known only from northern Mohave Co., Arizona, and immediately adjacent Washington Co., Utah, on the Harrisburg Formation . . . . 3. *S. gierischii*
  2b. Herbage definitely, though sometimes sparsely, stellate hairy overall (if sparsely so, of different distribution); calyces stellate externally; flowers large to small, petals mostly less than 20 mm long; plants of other distribution or habitat.
    3a. Leaves 3- to 5-parted or -divided, the lobes with narrow, regularly pinnatifid margins, the teeth nearly right angles to the vein; carpels 4–6 mm high, often with transparent lacunae, reticulate mainly in the lower ca. 1/3; plants local in Washington Co., Utah, and south to southern Arizona . . . . 7. *S. rusbyi*
    3b. Leaves variously lobed, divided, or parted, the lobes with broader margins irregularly toothed or lobed, but not as above; carpels 3–4.5 mm high, with opaque or translucent lacunae, reticulate in the lower 2/5–3/5; plants of various or broader distribution.
      4a. Calyx pubescence almost or quite as dense as that of the herbage, mainly 4.5–7.5 mm long (if longer,

not of Washington Co., Utah) at anthesis; leaf blades with lobes frequently not cut to the base, often wider than long, the terminal lobe mostly less than twice as long as broad; carpels with lacunae in the lower 2/5–1/2 . . . 4. *S. grossulariifolia*

4b. Calyx pubescence more dense than that of the herbage, mainly 6.8–9 mm long at anthesis; leaf blades rather uniformly dissected to the base, mostly longer than broad, the terminal lobe mostly more than half as broad as long; carpels with lacunae in the lower ca. 1/3 . . . . 7. *S. rusbyi*

1b. Herbage moderately to densely pubescent, shaded yellow, white, or gray (the stems sometimes suffused with red-purple).

5a. Inflorescence loosely thyrsoid (appearing paniculate), leafy; flowers not numerous at each node; peduncles generally elongate; calyx surpassing the fruit; carpels with reticulae extending onto back of carpel; leaves with conspicuous, elevated veins beneath, the pubescence often turning yellow in age; plants of Washington and Kane Cos., Utah, and adjacent Nevada, Arizona, and California; Mexico . . . . 1. *S. ambigua*

5b. Inflorescence contracted thyrsoid-glomerate, not especially leafy; flowers often numerous at each node; peduncles generally contracted; calyx often shorter than the fruit; carpels with reticulae confined to lateral face of carpel; leaves conspicuously veined or not, the pubescence seldom if ever turning yellow in age; plants of various or other distribution.

6a. Leaves shallowly 3- to 5-lobed; carpels with well-defined to nearly obscure reticulae on the lower 1/3 of the carpel; plants mainly of western Colorado, west across Utah to Nevada and eastern California, and south to northwestern New Mexico and central Arizona . . . . 6. *S. parvifolia*

6b. Leaves 3- to 5-cleft, -parted, or -divided, carpels with well-defined reticulae on less than half of carpel face; plants of various distribution.

7a. Plants copiously stellate-pubescent, the trichome branches not radiating in a single plane, appearing gray, known only from Smoky Mountain in eastern Kane Co., Utah . . . . 2. *S. fumariensis*

7b. Plants not copiously pubescent or appearing especially gray, the trichome branches mostly radiating in a single plane, of other distribution.

8a. Herbage bright green; leaves thin-textured, often narrowly lobed; plants of Glen Canyon of the Colorado River and its tributaries, in eastern Kane and Garfield, and western San Juan Cos., Utah . . . 5. *S. moorei*

8b. Herbage gray-green to whitish canescent; leaves often thick-textured, seldom narrowly lobed; plants widespread in the western United States . . . . 4. *S. grossulariifolia*

1. Sphaeralcea ambigua A. Gray, Proc. Amer. Acad. 22: 292. 1887.

Stems arising from a woody caudex, several to numerous, 3–10 dm tall, shaded white to yellow canescent, the trichomes becoming yellow in age; leaf blades 1–6 cm long (from sinus to apex), 0.8–5 cm wide, thickened, usually rugose, with veins prominent beneath, ovate, deltate, or nearly orbicular, the base cordate to deeply cordate, obscurely to definitely 3- to 5-lobed, the lobes crenate; inflorescence commonly open glomerate-paniculate, but sometimes narrowly thyrsoid; pedicels usually shorter than calyx; calyx 6–12(–20) mm long at anthesis, usually uniformly and densely stellate-pubescent but sometimes glabrescent on the outer surface, the lobes lanceolate to acuminate; petals 15–22(–35) mm long, orange (grenadine) to orange-pink (fading pink); carpels 3.5–6 mm high, 2–4 mm wide, the reticulate portion comprising ca. 1/3 of the carpel; n = 5.

Habitat and distribution. Creosote bush, Joshua tree, ambrosia, blackbrush, mixed warm desert shrub, and pinyon-juniper communities at 700 to 1750 m in western Kane and Washington Counties, Utah; Nevada, Arizona, and California; Mexico.

Our materials belong to *Sphaeralcea ambigua* var. *ambigua*. The common name slippery elm has been applied due to the mucilaginous condition that allows the bark to peel easily from the stem. The plants are components of forage for both livestock and desert tortoise.

2. Sphaeralcea fumariensis (S. L. Welsh & N. D. Atwood) N. D. Atwood & S. L. Welsh, stat. nov. Basionym: *Sphaeralcea grossulariifolia* (Hooker & Arnott) Rydberg var. *fumariensis* S. L. Welsh & N. D. Atwood, Rhodora: 103: 83. 2001. TYPE: U.S.A. Utah: Kane Co., W side of Little Valley, N of Lake Powell, 6 May 1998, *S. L. Welsh & N. D. Atwood 26968* (holotype, BRY).

Stems few to many from a woody caudex, 2.3–5.5 dm tall or more, the stems typically dark red-purple at least near the base, the herbage gray-green and abundantly stellate pubescent, the trichomes with longest ray 0.8–1.2 mm long, the rays radiating in more than one plane; leaf blades

1.2–3.7 cm long, 2–7.8 cm wide, often wider than long, cordate-ovate or cordate in outline, the base cordate to truncate or obtuse, digitately 3- to 5-lobed, the main lobe 1–3.5 cm long and 0.8–2.5 cm wide, entire or cleft or parted to irregularly toothed; inflorescence rather compactly thyrsoid, with usually more than 1 flower per node, or rather compactly glomerate-paniculate with 2 to 5 flowers on lateral peduncles; pedicels shorter than to longer than the calyx; bracteoles linear, sometimes red-purple, but not especially contrasting with the calyx; calyx 7.5–9.5(–12) mm long at anthesis, green, becoming stramineous in fruit, uniformly and densely stellate-hairy, the rays of hairs radiating in more than a single plane, the lobes ovate to lance-acuminate; petals 12–17 mm long, orange (grenadine); carpels 10–14, 3.3–4.1 mm high, 2.1–2.8 mm wide, the reticulate portion forming ca. 1/2 of the carpel, the lacunae ± opaque.

Habitat and distribution. Matchweed, ephedra, blackbrush, galleta, shadscale, and juniper communities, at 1340 to 1650 m, endemic on the Straight Cliffs, Tropic Shale, and Dakota Formations, and on alluvium derived from those formations, on Smoky Mountain and vicinity, eastern Kane County, Utah.

The copiously stellate-hirsute pubescence gives the plants of *Sphaeralcea fumariensis* a gray-green appearance when dry, and a truly gray appearance in the field. Many of the trichomes are caducous, with abundant residue of stellate trichomes accumulating in the pressing paper. It is possibly most closely allied to *S. moorei*, which occurs nearby in sandy soils along Glen Canyon in Kane County and east through Garfield and San Juan Counties, but differs from that entity not only in the harsh pubescence but in the larger calyces. These features, along with the restricted habitat, markedly separate it from the green, thin-leaved, and narrowly lobed plants of *S. moorei*.

Representative specimens examined. U.S.A. **Utah:** Kane Co., head of Smoky Hollow dugway, T41S, R4E, S8, 17 June 1998, *N. D. Atwood & S. L. Welsh 23859* (BRY); Tibbett Spring, T41S, R3E, S32, 20 May 1999, *N. D. Atwood et al. 24598* (BRY); ca. 7 mi. W of Smoky Mountain, head of Creeks road, T40S, R3E, S36, 20 May 1999, *N. D. Atwood et al. 24614* (BRY); ca. 7 mi. W of Kelly Grade, Croton Canyon Junction, T43S, R3E, S14, 20 May 1999, *N. D. Atwood et al. 24627* (BRY); Drip Tank Canyon, E of Four Mile Bench, T40S, R3E, S24, 6 May 1998, *S. L. Welsh & N. D. Atwood 26938* (BRY); Reeses Canyon, ca. 2 mi. N of confluence of Last Chance Canyon/Reeses Canyon, T40S, R4E, S36, 21 May 1999, *N. D. Atwood et al. 24638* (BRY).

3. **Sphaeralcea gierischii** N. D. Atwood & S. L. Welsh, sp. nov. TYPE: U.S.A. Arizona: Mohave Co., ca. 0.2 mi. N of Black Rock Gulch, T40N, R13W, S3, 24 Apr. 2000, *N. D. Atwood, B. Furniss & L. C. Higgins 25293* (holotype, BRY; isotypes, ARIZ, ASU, BRY, GH, MO, NY, RM, US). Figure 1.

Similis *S. moorei* in habitu sed in floribus majoribus pubescentiis paucioribus vel nullis in laminis et calyces externis et carpelis majoribus discrepantibus, et e *S. rusbyi* in floribus (petalisque et calycibus) majoribus calycis glabris externis divergentibus.

Stems few to many from a woody caudex, 4.3–10.3 dm tall, the stems often dark red-purple, the herbage bright green and subglabrous to almost or quite glabrous; leaf blades 1.2–4 cm long, 1–5 cm wide, usually longer than wide, ovate to cordate-ovate in outline, the base cordate to truncate or obtuse, 3- to 5-lobed, the main division entire or cleft or parted to irregularly toothed; inflorescence thyrsoid, with usually more than 1 flower per node, or glomerate-paniculate with 2 to 5 flowers on axillary peduncles; pedicels shorter than to much longer than the calyx (to 7 cm long); bracteoles linear, often red-purple and contrasting with the calyx; calyx 5–10 mm long, green, becoming stramineous in fruit, uniformly glabrous externally (or rarely with one or few stellate hairs), the rays of hairs mainly radiating in a single plane, the lobes ovate to lance-acuminate; petals 15–25 mm long, orange (grenadine); carpels 10–15, 4.5–5.5 mm high, the reticulate portion forming from 2/5 to 3/5 of the lower portion of the carpel, reticulate on the sides.

Habitat and distribution. Warm desert shrub community, mainly on gypsiferous outcrops of the Harrisburg Member of the Kaibab Formation, at ca. 1090 m, in northern Mohave County, Arizona (near Black Rock), and in closely adjacent Washington County, Utah.

Pubescence is a variable feature throughout the genus, but seldom is it so lacking as in *Sphaeralcea gierischii*, wherein only the inner portion of the calyx and the carpels are routinely copiously stellate. The stems are produced in tall, open clumps, and are only sparingly leafy. Main foliage leaves in the lower portion of the stems are large, with the central lobe greatly elongated and having a long-cuneate base. Pubescence on the herbage is very sparse, and on the calyces consists of one or a few trichomes when any hairs are present at all. The open inflorescence is shared with *S. rusbyi*, and in both cases the feature might be derived in some part or entirely from the contiguous *S. ambigua* A. Gray, which frequently has large flowers (15–22 mm

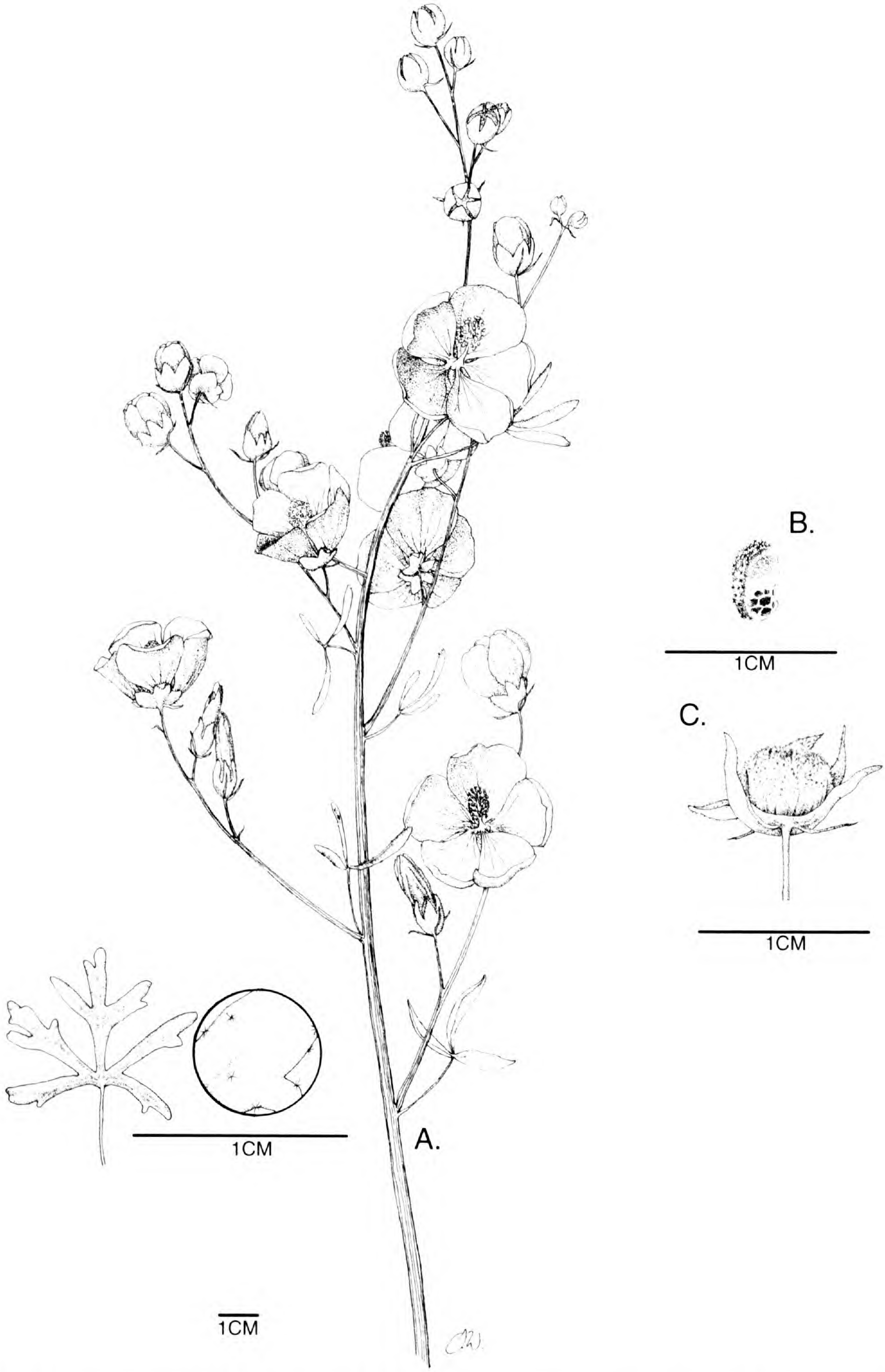

Figure 1. *Sphaeralcea gierischii* N. D. Atwood & S. L. Welsh. —A. Habit. —B. Carpel (longitudinal view). —C. Calyx and schizocarp. Drawn from the holotype collection, *N. D. Atwood, B. Furniss & L. C. Higgins 25293* (BRY).

long), but differs vastly in its dense white to yellow canescent, thick, usually rugose, prominent veined, deltoid to nearly orbicular cordate-based leaves, short pedicels, and larger prominent reticulate carpels (12–16 mm high).

Paratypes. U.S.A. **Arizona:** Mohave Co., Black Knolls, T41N, R12W, S7, 26 May 1978, *R. K. Gierisch 4355* (BRY); Black Knolls, T41N, R12W, S7, 23 Apr. 2000, *N. D. Atwood & B. Furniss 25233* (BRY); Black Knolls, T40N, R13W, S3, 10 May 2000, *N. D. Atwood 25543* (BRY); 1.2 mi. N of Black Rock Gulch, 24 Apr. 2000, *N. D. Atwood 25287* (BRY); S of Black Knolls, 6 June 1980, *C. E. Bundy 119* (BRY). **Utah:** Washington Co., T43S, R16W, S28, 3/4 mi. S of Little Round Valley, ca. 2 mi. S of Atkinville, 29 Apr. 1985, *K. Thorne & N. D. Atwood 3749* (BRY).

The species is named in memory of the late Ralph K. Gierisch, ardent collector of plants in the Intermountain West for more than five decades, who spent several years in the latter part of the century (1970s and early 1980s) investigating the flora of the Mohave Strip, Mohave County, Arizona. He made the first collection of the species from the Black Knolls in 1978.

4. **Sphaeralcea grossulariifolia** (Hooker & Arnott) Rydberg, Bull. Torrey Bot. Club 40: 58. 1913. *Sida grossulariifolia* Hooker & Arnott, Bot. Beechey Voy. 326. 1840. *Malvastrum grossulariifolium* (Hooker & Arnott) A. Gray, Mem. Amer. Acad. II. 4: 21. 1849. *Sphaeralcea pedata* Torrey, in A. Gray, Mem. Amer. Acad. II, 4: 23. 1849. *Sphaeralcea grossulariifolia* subsp. *pedata* (Torrey) Kearney, Univ. Calif. Publ. Bot. 19: 88. 1935; protologue locality: "California. Frémont." TYPE: "Frémont's Expedition to California 411, 1845. Sphaeralcea new (S. Pedata call it). Moving Fork, 1st Camp. Utah" (holotype, NY-Torrey). [Moving Fork is probably in western Colorado (Welsh, 1998: 368).]

Stems few to many from a woody caudex, mostly 3.5–7.5 dm tall or more, the herbage shaded white or gray to yellow canescent to rather sparsely stellate-hairy and green; leaf blades 1.2–5 cm long, 1.3–5.2 cm wide, from longer than wide to wider than long, cuneate-ovate to ovate or cordate-ovate in outline, the base cordate to truncate or obtuse, 3- to 5-lobed, the lobes distinct to the base or confluent to well above the base, the main lobe again few-lobed or less commonly parted or irregularly toothed; inflorescence compact-thyrsoid, with usually more than 1 flower per node; pedicels shorter than to longer than the calyx; calyx 4.5–9 mm long, uniformly stellate or rarely the calyx lobes glabrate, the rays of hairs not or less commonly radiating in a single plane, the longest rays mainly less than 0.5 mm long except on some calyx bases, the calyx lobes ovate to lance-acuminate; petals 8–18 mm long, orange or rarely rose pink; carpels 10–14, 2.9–3.7 mm high, reticulate portion forming from 2/5 to 3/5 of the carpel, the lacunae opaque or nearly so.

Habitat and distribution. Salt, warm, and cool desert shrub, pinyon-juniper, and ponderosa pine communities at ca. 790 to 2290 m in Beaver, Box Elder, Carbon, Emery, Garfield, Grand, Juab, Iron, Kane, Millard, Piute, Salt Lake, San Juan, Sanpete, Tooele, Uintah, Utah, Washington, and Wayne Counties, Utah; Washington, Oregon, California, Nevada, and Arizona.

This is the most common and widely distributed species in Utah except for the only distantly related *Sphaeralcea coccinea* (Nuttall) Rydberg, which is widespread, occurring from Texas to the Western U.S., north to Canada. However, *Sphaeralcea grossulariifolia* forms intermediates with *S. coccinea*, *S. parvifolia*, and with the more northerly distributed *S. munroana* (Douglas) Spach ex A. Gray, which occurs in northern Utah northward. The report by Kearney (1935) of *S. digitata* (Greene) Rydberg apparently belongs here with *Sphaeralcea grossulariifolia*. Leaf variation is great, but the blade dissection is less complex than in the similar and undoubtedly closely allied *S. moorei*, *S. fumariensis*, *S. rusbyi*, and *S. gierischii*. The Colorado Canyons and Kaiparowits endemics, *S. moorei* and *S. fumariensis*, share with *S. grossulariifolia* the feature of the reticulate portion of the carpel covering 2/5 to 3/5 of the surface.

There is much variation within the widely distributed *S. grossulariifolia*, with herbage varying in aspect from gray to gray-green or brownish, to yellow-green, to green. Leaf blades tend not to be cut completely to the base as is often the case in the related *S. moorei*, *S. fumariensis*, *S. rusbyi*, and *S. gierischii*. Most specimens range in size from 3.5 to 5.5 dm in height, while all of the other species, except *S. fumariensis*, commonly tend to exceed that height. It seems probable that most Utah specimens from Washington County, previously identified as *S. grossulariifolia*, are better placed with the taller *S. rusbyi*, which tends to have green or greener herbage, more uniform and more uniformly deeply cut leaf blades, and proportionally less of the carpel base occupied by reticulae.

5. **Sphaeralcea moorei** (S. L. Welsh) N. D. Atwood & S. L. Welsh, stat. nov. Basionym: *Sphaeralcea grossuliariifolia* var. *moorei* S. L. Welsh, Great Basin Naturalist 40: 35. 1980. TYPE: U.S.A. Utah: Kane Co., E side of Last Chance Bay, Lake Powell, Entrada sandstone, 2 May 1972, *S. L. Welsh & N. D. Atwood 11597* (holotype, BRY). Figure 2.

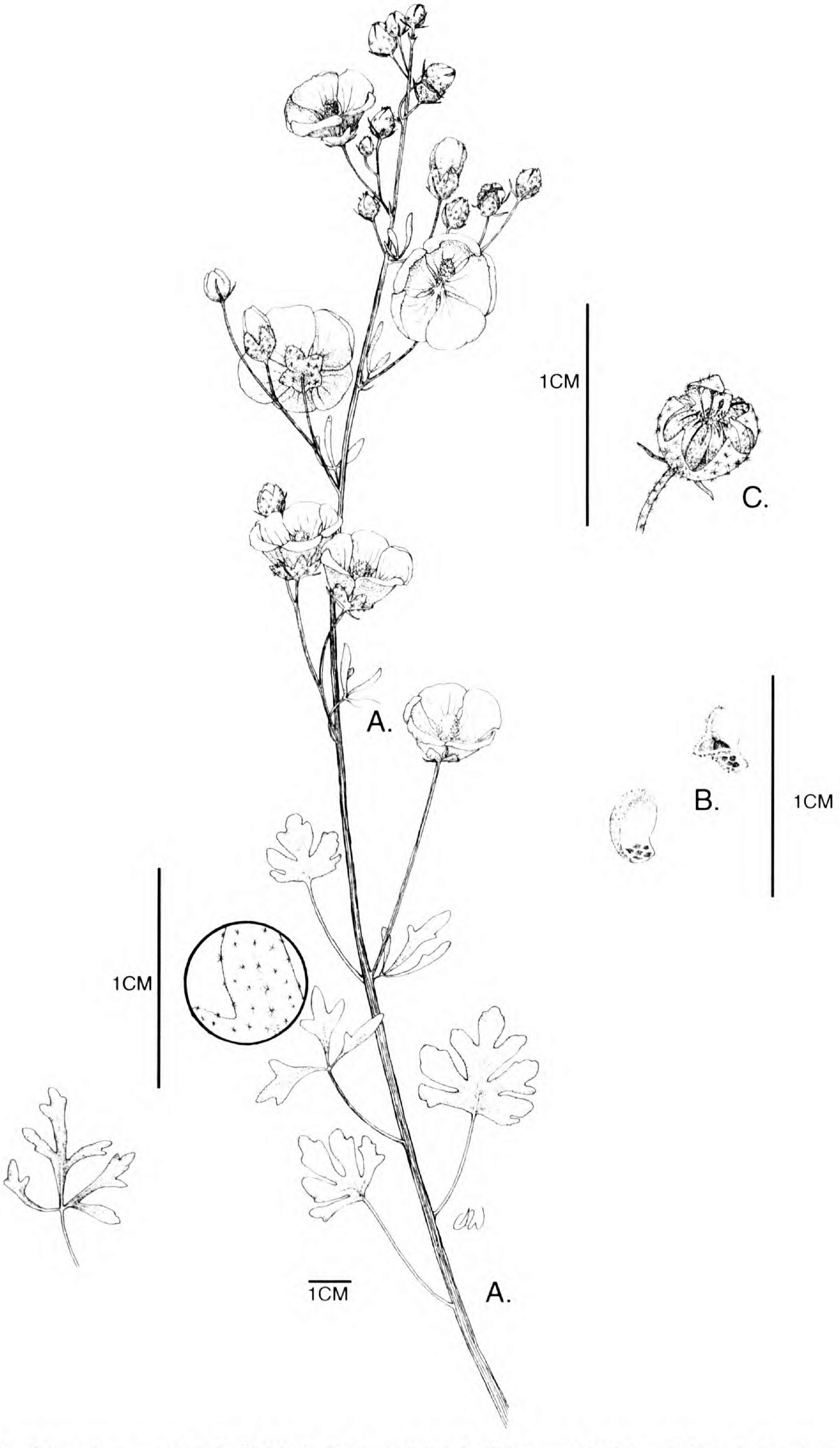

Figure 2. *Sphaeralcea moorei* (S. L. Welsh) N. D. Atwood & S. L. Welsh. —A. Habit. —B. Carpel, closed carpel (left) and open carpel (right). —C. Calyx and schizocarp. Drawn from the holotype collection, *S. L. Welsh & N. D. Atwood 11597* (BRY).

Stems few to many from a woody caudex, 3–7.5 dm tall or more, the stems typically dark red-purple at least near the base, the herbage green and rather sparsely stellate pubescent, the trichomes 0.3–0.8 mm wide, the rays radiating in a horizontal plane; leaf blades 0.9–3.5(–7.4) cm long, 1.0–2.6 (15, a rare exception) cm wide, often longer than wide, ovate to cordate-ovate or cordate in outline, the base cordate to truncate or obtuse, digitately 3- to 5-lobed, the main lobe 0.8–3.5(–7.4) cm long and 0.8–1.5 cm wide, entire or cleft or parted to irregularly toothed, or rarely the blade confluent and merely palmately lobed; inflorescence rather compactly thyrsoid, with usually more than 1 flower per node, or rather compactly glomerate-paniculate with 2 to 5 flowers on axillary peduncles; pedicels shorter than to much longer than the calyx; bracteoles linear, sometimes red-purple, but not especially contrasting with the calyx; calyx 4.5–7.2(–8.5) mm long at anthesis, green, becoming stramineous in fruit, uniformly stellate-hairy or less commonly glabrous externally only near the apex, the rays of hairs mainly radiating in a single plane, the lobes ovate to lance-acuminate; petals 11–15 mm long, orange (grenadine); carpels 10–14, 4.5–5.1 mm high, 2.1–2.3 mm wide, the reticulate portion forming ca. 1/2 of the carpel, the lacunae opaque.

Habitat and distribution. Blackbrush, ephedra, matchweed, Vanclevea, yucca, pinyon-juniper, and sagebrush communities, on alluvium and colluvium, and on the Navajo, Moenkopi, and Cutler, and undoubtedly other, Formations, at 850 to 1830 m, along the Colorado River in Glen Canyon and its tributaries in eastern Garfield and Kane Counties, and in southern San Juan County, Utah, along the San Juan River; endemic.

This is mainly a low-elevation species of sandy tracts along the Lake Powell portion of the Colorado and San Juan Rivers on the Entrada Sandstone Formation. *Sphaeralcea moorei* does extend upward somewhat along the east escarpment of Fifty Mile Mountain, west of Glen Canyon, and evidently reaches its northern limit at Calf Creek, east of Escalante. Some plants with uncut leaves are included here also, especially some from the Three Garden Reentry along Lake Powell. The species tends to intergrade at least morphologically with *S. grossulariifolia*, but not more so than for taxa as a whole in this genus, and it is reasonable to accept it at specific rank.

Representative specimens examined. U.S.A. **Utah:** Kane Co., mouth of Escalante River, Lake Powell, 5 June 1972, *S. L. Welsh & G. Moore 11810* (BRY); Willow Tank, 4 May 1962, *D. A. White 111* (BRY); Escalante Canyon, 5 June 1972, *S. L. Welsh & G. Moore 11827* (BRY); Escalante Canyon, 24 Aug. 1971, *N. D. Atwood & R. Allen 3211* (BRY); Hole-in-the-Rock, 14 May 1953, *B. F. Harrison 12112* (BRY); San Juan Co., 1 mi. E of Hole-in-the-Rock, 16 June 1972, *S. L. Welsh & C. A. Toft 11869* (BRY); Three Garden, Lake Powell, ca. 1 mi. N of confluence with San Juan River Arm, 5 May 1974, *S. L. Welsh 12420* (BRY); Comb Wash, 6 June 1970, *S. L. Welsh & N. D. Atwood 9972* (BRY).

6. **Sphaeralcea parvifolia** A. Nelson, Proc. Biol. Soc. Wash. 17: 94–95. 1904. TYPE: U.S.A. Nevada: Lincoln Co., Caliente, 22 May 1902, *Goodding 916* (RM not seen).

Sphaeralcea marginata York ex Rydberg, Bull. Torrey Bot. Club 33: 145–146. 1906. TYPE: U.S.A. Colorado: Grand Junction, 1901, *C. F. Baker 93* (NY not seen).
Sphaeralcea arizonica Heller ex Rydberg, Bull. Torrey Bot. Club 40: 59. 1913. TYPE: U.S.A. Arizona: Flagstaff (Coconino Co.), 16 June 1898, *McDougal 120* (holotype, NY not seen).

Stems few to many from branching woody caudex; leaf blades 1.5–5.5 cm long, 1.2–5.2 cm wide, ovate to orbicular, reniform, or cordate-ovate, the base cordate to truncate or obtuse, usually shallowly 3- to 5-lobed, the sinuses usually shallow, the lobes crenate-dentate; inflorescence commonly narrowly thyrsoid, typically with more than 1 flower per node; pedicels usually shorter than the calyx; calyx uniformly stellate, the rays of hairs not in a single plane, the lobes lance-ovate to deltoid; petals 7–15 mm long, orange; carpels 10–12, 3–4 mm high, the indehiscent part forming from 1/4 to 1/3 of the carpel, faintly reticulate on the sides.

Habitat and distribution. Blackbrush, other warm desert shrub, salt desert shrub, sagebrush, pinyon-juniper, and mountain brush communities at 820 to 2700 m in Daggett, Duchesne, Emery, Garfield, Grand, Iron, Juab, Kane, Millard, Piute, San Juan, Sevier, Tooele, Uintah, Washington, and Wayne Counties, Utah; Western Colorado, Nevada, Arizona, New Mexico, and California.

Sphaeralcea parvifolia has been compared by Kearney (1935) with *S. ambigua*, which it resembles in habit and leaf morphology. It is, however, the more southern and lower elevation counterpart of *S. munroana*, from which *S. parvifolia* cannot always be distinguished, and with which it could be included without serious damage to the taxonomy of the genus. Otherwise, the relationships of *S. parvifolia* in Utah seem to lie with the largely sympatric *S. grossulariifolia*, but it is apparently transitional with both *S. ambigua* and *S. rusbyi*. The confluent leaf blades of *S. parvifolia* are diagnostic for most specimens from those of *S. grossulariifolia*, and the smaller leaf blades and less apparent venation allow segregation of most specimens from *S. ambigua*, but in neither instance should blade size and confluence be taken as tools for positive identification. As in most taxa within the genus the morphological features blend where the taxa are in geographical contact, and indeed many of the diagnostic features are vegetative ones. However, the characteristics of the fruiting carpels are not absolute as diagnostic tools either.

7. Sphaeralcea rusbyi A. Gray, Proc. Amer. Acad. 22: 293. 1887. TYPE: U.S.A. Arizona: Yavapai Co., Prescott, May 1883, *H. H. Rusby 537* (holotype, NY).

Stems few to many from a woody caudex, 2.4–8.2 dm tall or more, the stems typically dark red-purple at least near the base, the herbage green and rather sparsely stellate-pubescent to rather densely so, the trichomes 0.4–0.8 mm wide, the rays radiating in more than a single plane; leaf blades 1.6–4.3 cm long, 0.6–3.5 cm wide, usually longer than wide, ovate to cordate-ovate in outline, the base cordate to truncate or obtuse, digitately 3- to 5-lobed, the main 1.3–3.8 cm long and 5–2.6 cm wide, entire or cleft or parted to irregularly toothed, or rarely the blade confluent and merely digitately lobed; inflorescence rather compactly thyrsoid, with usually more than 1 flower per node, or compactly glomerate-paniculate with 2 to 5 flowers on axillary peduncles; pedicels shorter than to much longer than the calyx; bracteoles linear, sometimes red-purple, but not especially contrasting with the calyx; calyx 6.5–9.5 mm long at anthesis, green, becoming stramineous in fruit, uniformly stellate-hairy or glabrous externally only near the apex, the rays of hairs mainly radiating in more than a single plane, the lobes ovate to lance-acuminate; petals 12–19 mm long, orange (grenadine); carpels 10–14, 4.5–5.2 mm high, 2.4–2.8 mm wide, the reticulate portion forming ca. 1/3 of the carpel, the lacunae opaque.

Habitat and distribution. Mixed desert shrub and floodplain communities, with cottonwood, oak, juniper, creosote bush, rattany, burrobush, blackbrush, ephedra, snakeweed, rabbitbrush, and fourwing saltbush on Quaternary alluvium and colluvium, Chinle, Moenkopi, and Kaibab and other mostly calcareous formations, at ca. 1030 to 1220 m in Iron and Washington Counties, Utah, and Mohave and other counties, Arizona.

In addition to the features cited in the key, the herbage of *S. rusbyi* is ordinarily green or suffused with dark purple and with rather sparsely stellate hairs, much less so than the calyx; the inflorescence tends to be open glomerate-paniculate, and the flowers average larger (to 18 mm long) than those of the similar *S. grossulariifolia* (mainly less than 15 mm long). The species is apparently most closely allied to *S. gierischii*, however. Its smaller flowers (both calyces and petals) and rather densely stellate calyces are apparently diagnostic. Until recently *S. rusbyi* has been a very obscure and poorly understood species in Utah (Welsh et al., 1993), with specimens examined not at all uniform and many of them included with the previous concept of *S. grossulariifolia*. The main foliage leaves of *S. rusbyi* are rather uniformly ovate-oval in outline, and are rather uniformly pedately lobed. Stems of *S. gierischii* tend to be sparsely leafy, with the blades more broadly ovate in outline, and with the lobes much attenuated at the base. In this manner, *S. gierischii* differs from all other closely allied taxa in southern Utah and northern Arizona, including *S. moorei*, which it somewhat resembles in the narrowly lobed leaves and stem color. The larger set available now allows a better understanding of the taxon within Utah, where it is confined to Washington County, with the exception of one population overlapping the very southeast corner of Iron County.

Representative specimens examined. U.S.A. **Arizona:** Mohave Co., 38 mi. SE of Littlefield, T33N, R15W, 25 Apr. 1997, *N. D. Atwood & S. L. Welsh 21804* (BRY). **Utah:** Iron Co., Camp Creek 1 mi. ESE of I-55, T38S, R12W, S10, 23 Sep. 1987, *K. H. Thorne et al. 5691* (BRY); Washington Co., ca. 1 mi. NE of La Verkin, 30 Apr. 1993, *S. L. Welsh & L. C. Higgins* (BRY); 6 mi. E of Hurricane, 27 May 1968, *N. D. Atwood 1405* (BRY); Kolob Terrace, T39V, R11W, S23, 7 July 1981, *S. L. Welsh 20718* (BRY).

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A New Species of *Abronia* (Nyctaginaceae) from San Juan County, New Mexico, U.S.A.

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ABSTRACT. A new species of *Abronia* is described from northwestern New Mexico, U.S.A., as *Abronia bolackii* N. D. Atwood, S. L. Welsh & K. D. Heil. It is compared to *A. nana* S. Watson based on similarities in stature and anthocarp structure and to *A. fragrans* Nuttall in the caulescent stems. A key to closely related taxa is included.

Key words: *Abronia*, New Mexico, nomenclature, North America, Nyctaginaceae.

The new *Abronia* is part of voucher specimens collected during the 1999 and 2000 field seasons for the San Juan Basin Flora Project. The flora covers all the drainage system and lands in the four corners area of Arizona, Colorado, New Mexico, and Utah that drain into the San Juan River. The target date for publication is 2006. Exploration of the unique habitats in the San Juan Basin area has yielded new state and county records, as well as new taxa. As this study progresses we expect additional taxa will be discovered and named over the next decade or so. Initial attempts at identification were made by use of the early treatments of *Abronia* in New Mexico by Standley (1909), Tidestrom and Kittell (1941), Martin and Hutchins (1980), and the treatment by Galloway (1975). The specimens proved contrary to all of the existing treatments of the genus. The collections of an unidentified species of *Abronia* were subsequently compared to the large set of reference material at Brigham Young University (BRY), as well as that at San Juan College (SJNM), and identified as a new species. Two additional collections from New Mexico were provided by Richard Spellenberg, New Mexico State University (NMC).

Abronia bolackii N. D. Atwood, S. L. Welsh & K. D. Heil, sp. nov. TYPE: U.S.A. New Mexico: San Juan Co., tributary of Stuart Canyon S of San Juan River on Bolack Ranch, 36°40′27.8″N, 108°8′51.4″W, 18 May 2000, *N. Duane Atwood, Kenneth Heil, Steve O'Kane & Arnold Clifford 25673* (holotype, BRY; isotypes, ARIZ, ASU, GH, MO, NY, RM, SJNM, US). Figure 1.

Similis *A. nana* in habitu generali sed rhizomatibus gracilis repentibus, caulibus longioribus, foliis et fructiferis bracteis majoribus, corollae tubo breviori et floribus viridi-albidis, et inflorescentiis axillaribus nec scaposis absimilis; et similis *A. fraganti* in caulibus elongatis sed in rhizomatibus elongatis perianthiis brevioribus et anthocarpis parvioribus et pubescentiis differt.

Perennial, the stems 9–18 cm high above ground, arising from vertical branches from cordlike creeping rhizomes and forming extensive colonies; aerial stems short-caulescent with 1–3 apparent internodes, these shorter than the leaves, puberulent; leaf blades, 1–2.8 × 0.5–1.6 cm wide, elliptic, oblong to ovate, entire, the margins puberulent; petiole 0.5–3.2 cm long; inflorescence glandular-puberulent; the peduncles 1.8–5.5 cm long; bracts 5, green becoming white at maturity, broadly ovate, rounded or apiculate, 6–10 × 4–10 mm, with evident white interrupted veins; flowers 16 to 25 per head, the perianth green-white, the tube 7–11 mm long, glandular, the lobes ca. 3 mm wide; anthocarps obconic, (3- to) 5-winged or angled, puberulent, 5–6.7 mm long.

Habitat and distribution. Gypsiferous clay lens of the Ojo Alamo Formation, from 1678 to 1724 m elevation, in *Juniperus*, *Hilaria*, *Amelanchier*, *Purshia*, and *Ephedra* community. Known only from San Juan County, New Mexico (Fig. 2).

The species is named for Tommy Bolack, the owner and operator of the B-Square Ranch. For years Mr. Bolack has practiced conservation and watershed management and has helped protect the native flora against habitat loss and habitat fragmentation due to development. Along with San Juan College, Mr. Bolack is helping fund the San Juan Flora Project. The type locality of *A. bolackii* is situated in the southeastern portion of his ranch.

Abronia bolackii is similar in stature and anthocarp structure (size and shape) to *A. nana* as indicated in the diagnosis. However, the new taxon differs from *A. nana*, in being caulescent and lack-

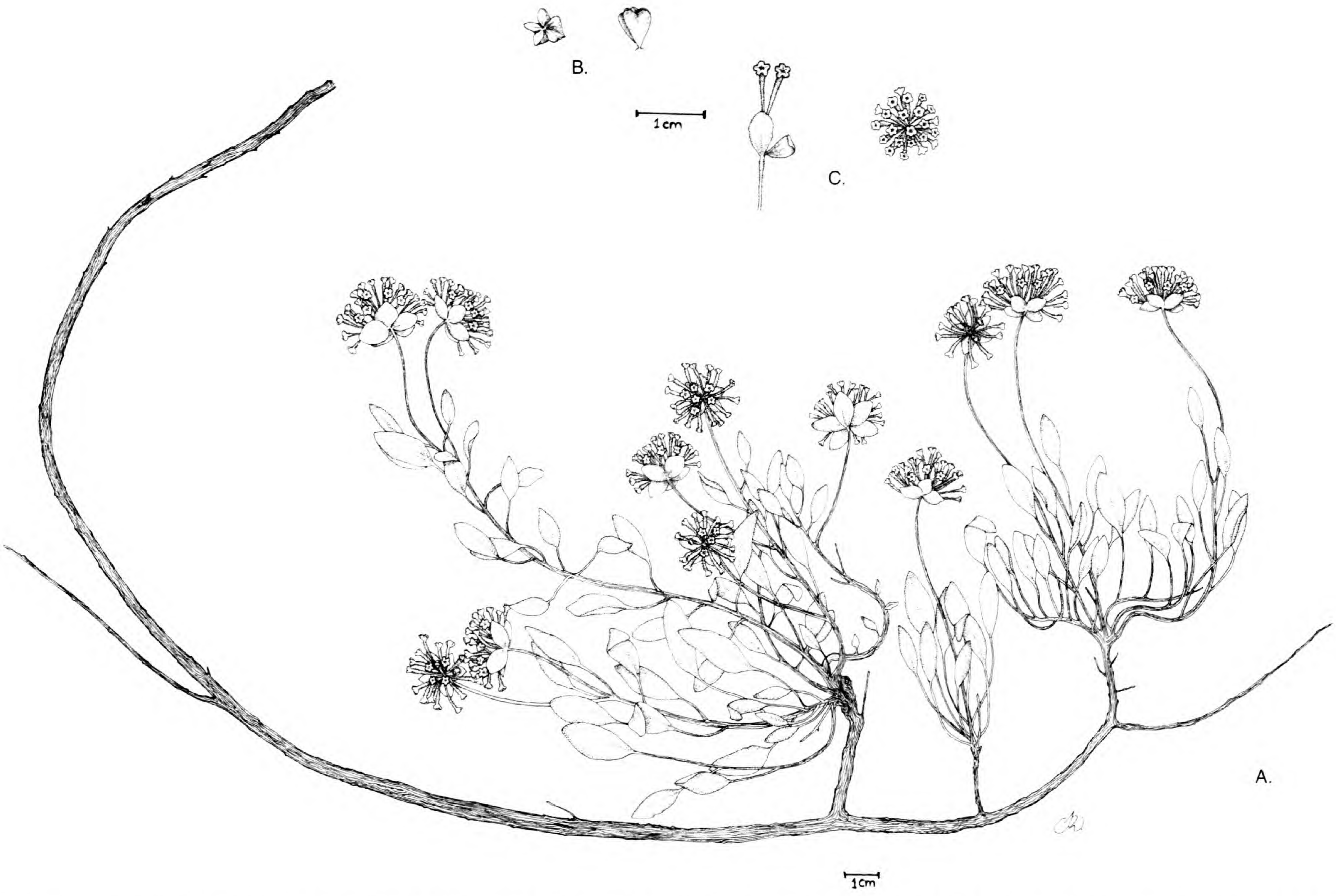

Figure 1. *Abronia bolackii* N. D. Atwood, S. L. Welsh & K. D. Heil. —A. Habit. —B. Anthocarps, top view (left) and side view (right). —C. Flowers and bracts (left) and top view of flower cluster (right). Drawn from the type collection, *Atwood et al. 25673* (BRY).

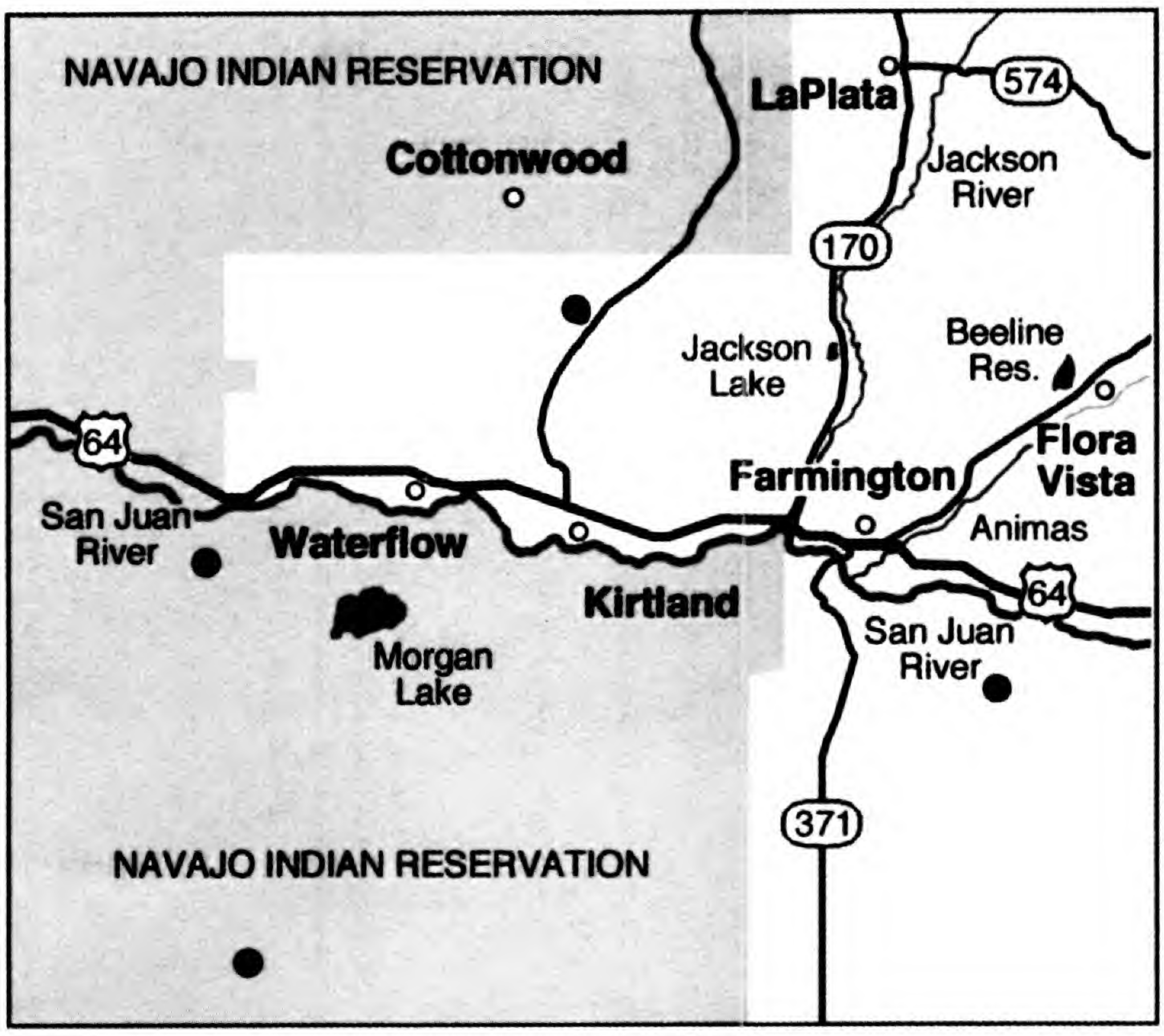

Figure 2. Collection locations of *Abronia bolackii* in San Juan County, New Mexico, U.S.A.

ing persistent leaf bases, not caespitose-subacaulescent and with persistent leaf bases, and in possessing a slender, creeping rhizome. The caulescent nature of *A. bolackii* is similar to and probably indicative of relationship with caulescent *Abronia fragrans*, which occurs in the general vicinity. It differs from that species in being rhizomatous and having shorter and smaller perianths, with the tube 7–11 mm long in *A. bolackii* and 10–25 mm in *A. fragrans*. Additionally, *A. fragrans* is a much larger plant with different anthocarp morphology, larger thicker leaves, usually larger flowers, a taproot, and longer, multicellular, dense trichomes on the anthocarps. Closely allied species, both geographically and possibly genetically based on its morphologic similarities, can be distinguished by the following key:

KEY TO RELATED TAXA

1a. Plants definitely caulescent; caudex arising from deep-seated rhizomes or from a taproot, seldom with a thatch of marcescent leaf bases.
  2a. Plants with slender, cordlike deep-seated rhizomes, forming extensive colonies; flowers greenish white, the tube 7–11 mm long; anthocarps 5–6.7 mm long, the apex short hairy with simple hairs . . . . *A. bolackii*
  2b. Plants lacking rhizomes, arising from taproots; flowers greenish to rose or purplish, the tube 10–25 mm long; anthocarps 5–12 mm long, the apex more densely pubescent with longer multicellular hairs . . . . *A. fragrans*
1b. Plants subscapose, the leaves mostly all basal; caudex often with a thatch of marcescent leaf bases, situated atop a thickened taproot . . *A. nana*

Paratypes. U.S.A. **New Mexico:** San Juan County, B-Square Ranch, first road SE near mouth of Stewart Canyon, up road ca 1.5 mi., 36°40′23.5″N, 108°08′57.3″W, 18 May 2000, *K. Heil 14289* (SJNM); 10 mi. SSW of Waterflow on the Navajo Mine W of the Neck, 2 June 1985, *R. Spellenberg & R. Corral 8213* (NMC); 6 mi. N of Fruitland, T29N, R14W, S7, 12 May 1994, *R. Sivinski & K. Lightfoot 2665* (NMC).

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Una Nueva Especie de *Croizatia* (Euphorbiaceae) del Ecuador

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RESUMEN. Se describe e ilustra una nueva especie de *Croizatia* (Euphorbiaceae) de la Costa Ecuatoriana. *Croizatia cimalonia* es una especie arbustiva o pequeña arbórea que se caracteriza por formar colonias entre alturas de 300–800 m en el Cerro Cimalón de la Reserva Ecológica Manglares-Churute. Se caracteriza por los tallos con corteza externa fisurada, pecíolos cortos de 5–13 mm, estriados, flores pentámeras, verdosas, pedicelos femeninos 25–40 mm de largo, estrigillosos, frutos cápsulas 3-lobada.

ABSTRACT. A new species of *Croizatia* (Euphorbiaceae) from the costal lowlands of Ecuador is described and illustrated. *Croizatia cimalonia* is a shrub or small tree that forms stands between 300 and 800 m on Cerro Cimalón in the Reserva Ecológica Manglares-Churute. It is characterized by trunks with fissured external bark; short, transversely striate petioles (5–13 mm long); greenish pentamerous flowers, shortly strigose pistillate pedicels (25–40 mm long); and 3-lobed, capsular fruits.

Key words: *Croizatia*, Ecuador, Euphorbiaceae.

Croizatia Steyermark es un género de aproximadamente 5 especies de arbustos y árboles pequeños de bosques piemontanos en Sudamérica; se conocen especies de Panamá, Venezuela y Colombia (Webster et al., 1987; Dorr, 1999). En Ecuador una especie no descrita de la Amazonia ecuatoriana, *Øllgaard et al. 38956* (AAU), es citada por Webster et al. (1987) y Jorgensen y León-Yánez (1999). Para la Costa Ecuatoriana, el género es la primera vez que se registra. La localidad donde se ha registrado esta especie es un remanente ubicado en uno de los cerros que forma parte de la Cordillera Costanera, protegida en la Reserva Ecológica Manglares-Churute a unos 30 km del puerto más importante del Ecuador, Guayaquil.

Croizatia cimalonia C. E. Cerón & G. L. Webster, sp. nov. TIPO: Ecuador. Provincia del Guayas: Cantón Naranjal, Reserva Ecológica Manglares-Churute, Cerro Cimalón, 300–400 m, 79°33′W, 02°37′S, Bosque siempre-verde Pie-Montano, 26 julio 1999, *C. E. Cerón, G. Carvajal & R. Romero 38915* (holótipo, QAP femenino; isótipos, AAU, DAV, MO, QCA, QCNE). Figura 1.

Frutex arborescens 1–8 m altus; a *C. neotropica* differt pedicelis fructiferis brevioribus, strigosis; a *C. naiguatensi* differt pedicellis staminatis longioribus, foliis spathulatis non ellipticis; a *C. panamensi* differt stipulis minoribus.

Arbusto o árbol de 1–8 m de alto × 3–5 cm de DAP, algunos arbustos ramificados desde la base, corteza externa fisurada color blancuzco, con presencia de Briophytos, corteza interna rosada, olor acre similar a *Daphnopsis* Martius (Thymeleaceae), madera rosada. Lámina de las hojas generalmente espatulada, ápice ± acuminado, base atenuada, 14–38 cm de largo, 4–9.5 cm de ancho, glabra o inconspicuamente estrigosa en el envés, nervios laterales 9–14 en cada lado, nervios terciarios formando retículos con los secundarios, pecíolo de 5–13 mm de largo, curvado, estrías finas transversales; estípulas escariosas, triangular-acuminadas, erectas en el ápice de las ramitas, color vinoso, 5–8 mm de largo, 3–5 mm de ancho, semideciduas. Flores masculinas color crema, ligero ramifloras; pedicelo de 8–13 mm de largo, hirto; sépalos 5, elípticos, enteros, 3–4.5 mm de largo, 2–3 mm de ancho, hirsutos; pétalos 5, obovados, subenteros con los bordes ciliados, 2–3 mm de largo, 1–1.5 mm de ancho; disco masivo, liso y glabro, 1 mm de alto, 2 mm de ancho; estambres 5, filamentos 1.5–2 mm de largo, hirsutos; anteras elípticas de 1 mm de largo, pistilodio 3-lobado, denso hirsuto, 2 mm de alto. Flores femeninas solitarias en cada axila; pedicelo estrigilloso, de 25–40 mm de largo en el fruto; sépalos 5, persistentes en el fruto, lanceolados, ápice obtuso, color verde, estrigillosos, 5–

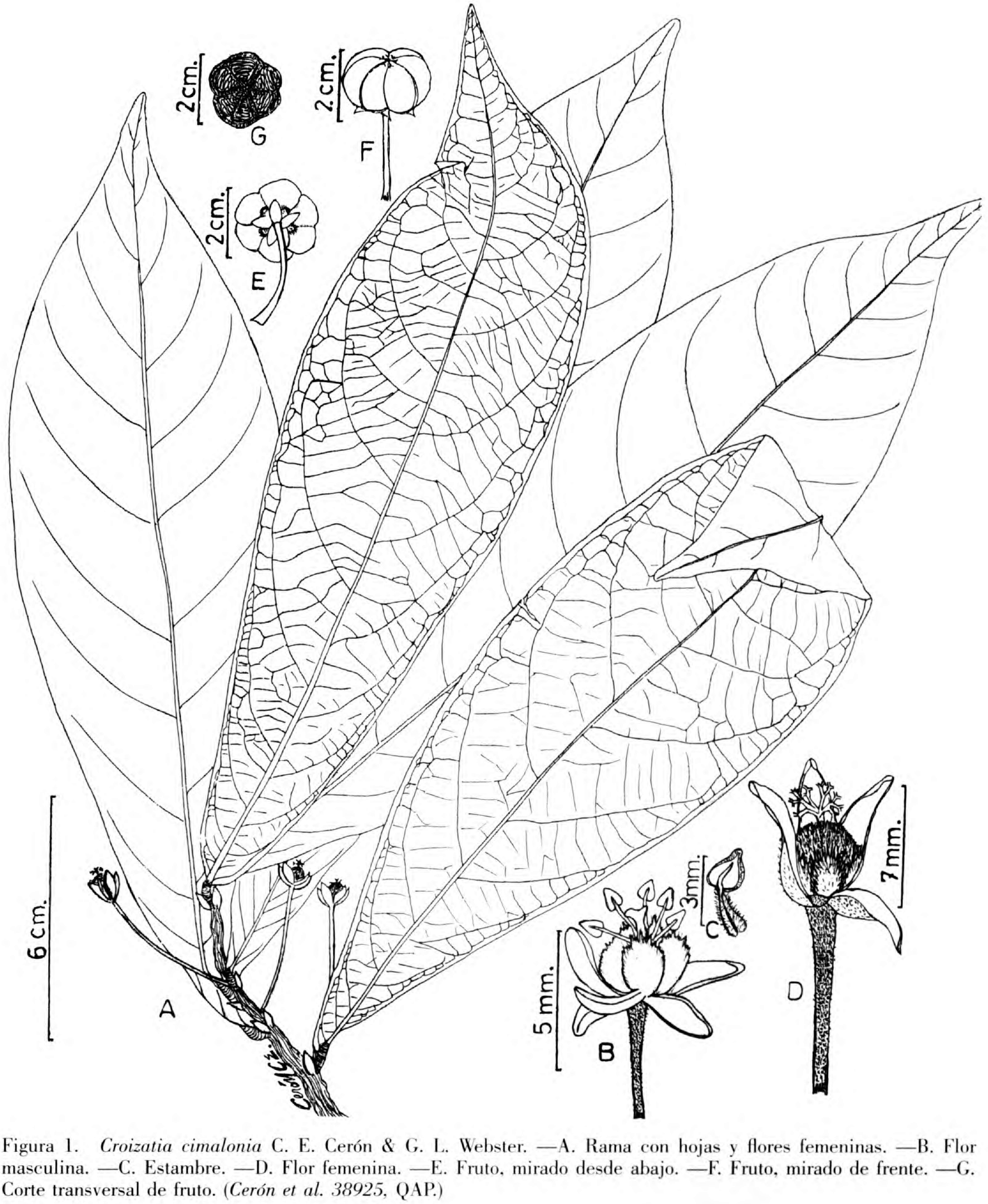

Figura 1. *Croizatia cimalonia* C. E. Cerón & G. L. Webster. —A. Rama con hojas y flores femeninas. —B. Flor masculina. —C. Estambre. —D. Flor femenina. —E. Fruto, mirado desde abajo. —F. Fruto, mirado de frente. —G. Corte transversal de fruto. (*Cerón et al. 38925*, QAP.)

10 mm de largo, 2–5 mm de ancho; pétalos 5, alternos con los sépalos, redondeado obovados o suborbiculares, 1–2.5 mm de largo, 2 mm de ancho, escaso ciliados en el cuerpo y densamente en los bordes, color verde; disco anular, glabro, entero, 5 mm de ancho; ovario denso sericeo, 3 mm de largo y ancho, estilo expandido, 1.5–2.5 mm de largo, tres veces bífido, la porción no ramificada 0.5–1 mm de largo, la porción ramificada media de 1 mm de largo, la porción ramificada apical de 0.3–0.5 mm de largo. Cápsula oblada, 3-lobada, 10–15 mm de alto, 17–23 mm de ancho, glabra, color verde, ligeramente estrigosa en las suturas, estilo persistente de 2–3 mm de largo; eje central de 6 mm de alto, ápice dilatado en 3 alas oblonga-obovadas con el ápice redondeado de 7 mm de largo, 5 mm de ancho. Semillas dos por lóculo, trigonas, lisas, color café, 8–12 mm de largo, 5–7 mm de ancho, hilo

medio de 2 mm de ancho, cotiledones de 10 mm de largo.

Variación y afinidad. *Croizatia cimalonia* difiere de *C. neotropica* Steyermark (Distrito de Bolívar, Venezuela), en los siguientes caracteres: La corteza exterior fisurada, hojas más largas, pedicelo femenino estrigilloso, menos largo, y hay mayor variación en el hábito de la planta, mayor número de los nervios secundarios de las hojas y en las semillas 8–12 mm de longitud. En *C. neotropica*, el pedicelo femenino es glabro, más largo. Menor número de nervios secundarios en las hojas y en las semillas 10.5–12 mm de longitud.

CLAVE DE LAS ESPECIES DESCRITAS DE *CROIZATIA*

1a. Pedicelos de los frutos glabros, 35–45 mm de largo, frutos 1 o (2) por axila . . . . . *C. neotropica*
1b. Pedicelos de los frutos strigosos o hirtellos, 8–40 mm de largo.
  2a. Flores pistiladas 2 o 3 por axila; filamentos libres . . . . *C. brevipetiolata* (Secco) Dorr
  2b. Flores pistiladas solitarias; filamentos libres o connados.
    3a. Filamentos connados; estípulas 10–20 mm de largo, ± persistentes . . . . *C. panamensis* G. L. Webster
    3b. Filamentos libres; estípulas 4–8 mm de largo, ± decíduas.
      4a. Pedicelos estaminados 3–4 mm de largo; pedicelos de los frutos 8–12 mm de largo; pétalos estaminados 1–1.5 mm de largo . . . . *C. naiguatensis* Steyermark
      4b. Pedicelos estaminados 8–13 mm de largo; pedicelos de los frutos 25–40 mm de largo; pétalos estaminados 2–3 mm de largo . . . *C. cimalonia*

Distribución y ecología. La especie nueva es conocida solamente de dos poblaciones en la Reserva Ecológica Manglares-Churute. En el Cerro Cimalón entre 300–400 m, se encuentra en el sotobosque formando densos rodales. En muestreos de transectos en 0.05 ha se ha encontrado hasta 46 individuos (29.6%) y es la especie más frecuente, igual entre 420–470 m, es la especie más frecuente con 82 individuos (45%). La topografía es muy accidentada en el Cerro Cimalón, aunque la especie a veces está en pequeñas mesetas planas de este cerro; el suelo es rojo y pedregoso con muy poco humus, en la transición de los bosques secos a los de neblina. La especie se encuentra también en forma menos abundante en el Cerro Masvale de la misma Reserva Manglares-Churute entre altitudes de 780–800 m, con una presencia de 8 individuos (6.1%) en 0.05 ha. Los dos cerros se encuentran separados entre si por una planicie disturbada y cultivada de aproximadamente unos 4 km de distancia (Cerón, 1996). Se encontró con flores y frutos en agosto–septiembre de 1992 y en julio de 1999.

Esta especie es nombrada por el Cerro Cimalón de la Reserva Ecológica Manglares-Churute, localidad tipo.

Parátipos. ECUADOR. **Guayas:** Cantón Naranjal, Reserva Ecológica Manglares-Churute, Cerro Cimalón, 79°33′W, 02°37′S, bosque siempre-verde Pie-Montano, 300–400 m, 26 jul. 1999, *Cerón et al. 38918, 38925* (DAV, MO, QAP, QCNE); Cumbre del Cimalón subiendo por el Polígono, 350–470 m, 8 ago. 1992, *Cerón et al. 19900* (QAP), 28 sep. 1992, *Cerón et al. 20442* (QAP, QCNE); Cerro Masvale, 780–800 m, 15 ago. 1992, *Cerón et al. 20240* (QAP, QCNE).

Agradecimientos. Nosotros estamos agradecidos a los señores Ramón Romero y Máximo Reyes, guardaparques de la Reserva Ecológica Manglares-Churute por su asistencia en el campo; al herbario QCNE por permitirnos utilizar el mismo; al Simon Laegaard del Herbario AAU, por la revisión del artículo, comentarios y traducción del Resúmen; y al Nigel Pitman de Duke University, por sus comentarios y revisión general del artículo.

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Novae Gesneriaceae Neotropicarum VIII: *Alloplectus grandicalyx*, a New Species from Colombia and Ecuador

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ABSTRACT. A new species, *Alloplectus grandicalyx* J. L. Clark & L. E. Skog, is described from northern Ecuador and southern Colombia. *Alloplectus grandicalyx* is differentiated from other similar species on the basis of larger calyx lobes, longer pedicels, and villous pubescence on the stems, leaves, petioles, and calyx lobes. A key is provided to help distinguish *A. grandicalyx* from other shrubby and resupinate flowered *Alloplectus* species. In addition, the commonly confused and widely spread *Alloplectus tetragonoides* Mansfeld is discussed and neotypified.

Key words: *Alloplectus*, Colombia, Ecuador, Gesneriaceae.

An ongoing study of *Alloplectus* Martius has revealed a new species from Ecuador and Colombia that can be distinguished from congeners by the combined characters of calyx lobes that cover the bottom third to half of the corolla, pedicels that usually exceed the petioles, and villous pubescence on the stems, leaves, petioles, and calyx lobes.

Alloplectus is a genus in need of revision as the most recent treatment of the entire genus is over 100 years old (Hanstein, 1865). Hanstein's publication focused on the Gesneriaceae at the botanical garden in Berlin and provided an overview of the family. *Alloplectus* was only a part of an entire monograph of the Gesneriaceae known at that time, but Hanstein recognized 30 *Alloplectus* species in his treatment. More recent estimates of the genus range from 75 (Burtt & Wiehler, 1995) to 65 (Wiehler, 1973). After a thorough review of the 119 names listed in *Index Kewensis*, only 32 are considered by us to be currently accepted names in *Alloplectus*. Below are described two species of *Alloplectus* that have been confused, one new and the other poorly known and needing neotypification.

Alloplectus grandicalyx J. L. Clark & L. E. Skog, sp. nov. TYPE: Ecuador. Napo: Cantón Archidona, Reserva Ecológica Antisana, Sector Guacamayos, Sendero Jumandy–La Virgen (km 30), path that follows potential oil pipeline, 00°38′S, 77°49′W, 1700–1800 m, 1 May 1998, *J. L. Clark, E. Narvaez & T. Pauchi 5449* (holotype, QCNE; isotypes, AAU, COL, E, MO, QCA, SRP, US). Figure 1.

Haec species *A. tetragonoides* similis sed pedicellis longioribus et calycibus grandioribus differt.

Terrestrial suffrutescent shrub; stem erect, quadrangular, succulent, becoming woody, 0.5–1.5 m tall, to ca. 1 cm diam., usually glabrescent basally, villous pubescent distally, unbranched, internode length 3–15 cm, nodes and leaf scars swollen. *Leaves* opposite, nearly equal in a pair; blades elliptic, 8–22 × 4–10 cm, apex acuminate, base acute, margin serrate, above green, rugose, glabrous, below all green, all red, or green with red tinge, sparsely to densely pilose; petioles terete, 3–8 cm long, green, sparsely to densely pilose. *Inflorescences* axillary, of 1 to 4 pendent, epedunculate flowers per axil; bracts caducous at anthesis, ovate, 1.5–3 × 1–2 cm, red; pedicels 4–9 cm long, red, villous. *Flowers* resupinate, showy, and zygomorphic; calyx lobes 5, conduplicate, erect, nearly equal, ventral lobe narrowly ovate, other lobes ovate, 3–4 × 2–3 cm, red, base cordate, apex obtuse, margin serrate; corolla tubular, 4–5 cm long, dark red with or without yellow lobes, outside sparsely pilose becoming densely pilose at apex, inside glabrous, base gibbous, ampliate toward the limb, the mouth ventricose on dorsal surface, limb 1–1.5 cm wide, the lobes free, nearly equal, 3–5 × 3–8 mm, entire; stamens 4, included, filaments glabrous, connate at base and adnate to corolla tube base for 3–5 mm, anthers included, coherent by their apices, ca. 3.5 × 1.5 mm; disc of a single bilobed, unlobed, or multilobed gland, glabrous;

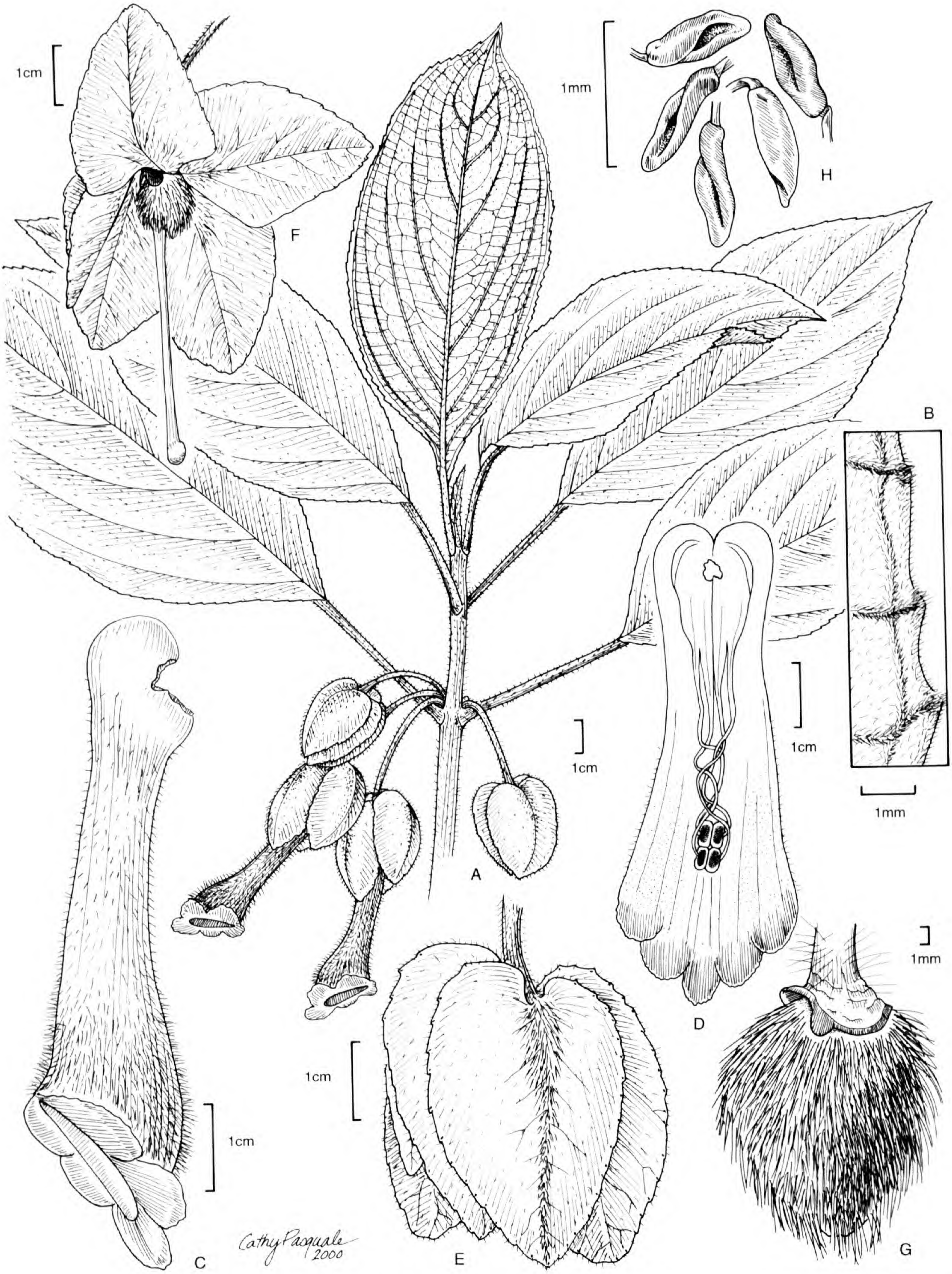


Figure 1. *Alloplectus grandicalyx* J. L. Clark & L. E. Skog. —A. Habit. —B. Leaf margin. —C. Corolla. —D. Corolla opened to show stamens. —E. Calyx. —F. Calyx opened and corolla removed to show bilobed nectary. —G. Young fruit. —H. Seeds. A from *R. E. Schultes & M. Villarreal 7667*; B from *J. Cuatrecasas 8620*; C–F from *M. L. Bristol 366*; G from the isotype, *J. L. Clark, E. Narvaez & T. Pauchi 5449*; H from *A. Gentry, M. Monsalve & P. Silverstone 47657A*.

ovary ca. 0.6 × 0.4 cm, woolly, style included, 4 cm long, glabrous. *Fruit* a fleshy capsule usually hidden in persistent calyx lobes, pendent, ovoid, ca. 1.5 × 1.0 cm, woolly; seeds 0.8–1.1 mm long, numerous, fusiform, dark brown, and longitudinally striate.

Distribution and ecology. *Alloplectus grandicalyx* is found in the montane forests of Ecuador and southern Colombia, but is most common between 1500 and 2500 m on the northeastern slopes of the Ecuadorian Andes. The species frequently overlaps with *A. tetragonoides*, which is trans-Andean and more common at lower elevations. At mid elevations on the eastern slopes of the Andes, these two species are apparently sympatric. In areas where these two species overlap *A. grandicalyx* can be distinguished from *A. tetragonoides* by having larger calyx lobes, longer pedicels, and villous pubescence. The resupinate flowers in these two species are typical of most *Alloplectus* species with tubular ventricose corollas. However, little is known about the adaptive functions of resupinate flowers in *Alloplectus* or other genera in Gesneriaceae where it is known; e.g., *Nematanthus* Schrader (Chautems, 1988).

Alloplectus grandicalyx is distinguished from the similar *Alloplectus tetragonoides* and other species of *Alloplectus* by having unusually large calyx lobes that cover the bottom third to half of the corolla tube. The pedicel is also longer than that normally found in other species of this genus and usually exceeds the length of the petiole. The calyx will commonly appear entire on herbarium sheets because the lobes are imbricate with involute margins. Some characters that are difficult to see on herbarium collections but readily available in the field include the dark red to maroon corollas with or without yellow lobes and the tendency for the leaf blades to be bullate. Also, most other similar *Alloplectus* species will have a lighter red or yellow corolla and non-bullate leaves (e.g., many populations of *A. tetragonoides* from the Napo and Tungurahua provinces of Ecuador). Most *Alloplectus* species have a single or two-lobed nectary gland, whereas *A. grandicalyx* sometimes has a multilobed nectary gland. We are including below a description of *A. tetragonoides* because of the possible confusion with *A. grandicalyx* and *A. tetragonus* (Hanstein) Hanstein. In order to stabilize the species concept of *A. tetragonoides* we have selected a neotype.

Paratypes. COLOMBIA. **Caquetá:** Río Hacha, *J. Cuatrecasas 8553* (US); Guadalupe–Florencia road, km 14, W of pass, *X. Londoño & L. P. Kvist 99* (COL, US). **Huila:** eastern slope of Cordillera Central, Finca Merenberg, km 101 La Plata–Popayan road, *B. A. Stein 3730* (MO, US); Cordillera Oriental, San Andrés, *J. Cuatrecasas 8620* (COL, US). **Putumayo:** Sibundoy, near Río Blanco (via Mocoa), *E. Hernández, A. Guerrero & A. Estrada 401-A* (US), *404* (US); Río Mocoa drainage, between Schamate and San Antonio, *J. A. Ewan 16693* (MO, US); valley of Sibundoy, *R. E. Schultes & M. Villarreal 7475* (US), *R. E. Schultes & M. Villarreal 7667* (US), *J. Cuatrecasas 11460* (US), *M. L. Bristol 366* (COL, GH, US). ECUADOR. **Carchi:** 12 km E of Maldonado on road to Tulcán, *A. H. Gentry & G. Shupp 26626* (MO, SEL); Río Verde and ridge flanking Cerro Golondrinas, *W. S. Hoover 2354* (MO). **Morona-Santiago:** Tumbes, 17–18 km N of Gualaquiza on road to Indanza, *G. Harling & L. Andersson 24222* (GB, US); Limon Indanza, Cordillera de Huaracayo, E of Cordillera del Cóndor and Río Coangos, E of Shuar village of Tinkimints, *D. Neill & J. Manzanares 13126* (MO, QCNE, US). **Napo:** Baeza Tena road, S slope of Cordillera de los Guacamayos, *J. L. Luteyn & M. Lebron-Luteyn 5669* (CAS, MO, NY, SEL, US), *G. Harling & L. Andersson 19501* (GB, US), *W. G. D'Arcy 14089* (MO, US), *W. Palacios 6896* (MO, QCNE, US), *W. Palacios 5931* (MO, QCNE, US), *B. A. Stein 2647* (MO, US), *J. H. Kirkbride, Jr. & H. Chamba R. 4191* (U, US); Comunidad de Santa Lucía de Bermejo, *A. Alvarez, O. Brito & S. Romero 867* (MO, QCNE, US); Cosanga, trail E of town, *J. D. Boeke & J. B. McElory* (GH, NY, SEL, US); Yanayacu Biological Station and Center for Creative Studies, 5 km W of Cosanga, *J. L. Clark & H. F. Greeney 5774* (QCNE, US). **Orellana:** Sumaco Napo Galeras National Park, Volcán Sumaco, *J. L. Clark 2282* (QCNE, US). **Sucumbios:** Reserva Ecológica Cayambe Coca, Volcán Reventador, trail between Río Quijos and refugio, *J. L. Clark 4448* (QCNE, US). **Tungurahua:** Hacienda San Antonio, 2 km E of Baños on Río Ulba, *B. A. Stein 2929* (NY); Río Verde, forested trail from Baños Puyo road towards Cascada de San Miguel, *J. L. Clark, E. Narvaez & E. Varros 5719* (QCNE, US). **Zamora-Chinchipe:** W of Zamora, *J. Hart 1172* (A); Agua Rica, along main road from Limón (Gral Leonidas Plaza Gutiérrez) to Gualaceo, *J. L. Clark, L. Jost & F. Sanchez 5939* (AAU, AZUAY, COL, K, MO, NY, QCA, QCNE, US).

Alloplectus tetragonoides Mansfeld, Biblioth. Bot. 116: 144–145. 1937. TYPE: Ecuador. Tungurahua: Cantón Baños, Parroquia Río Negro, near Río Topo, 01°23′S, 78°10′W, 1400 m, 17 Jan. 2001, *J. L. Clark & V. Duran 6000* (neotype, designated here, QCNE; isoneotypes, AAU, COL, F, K, MO, NY, QCA, S, US).

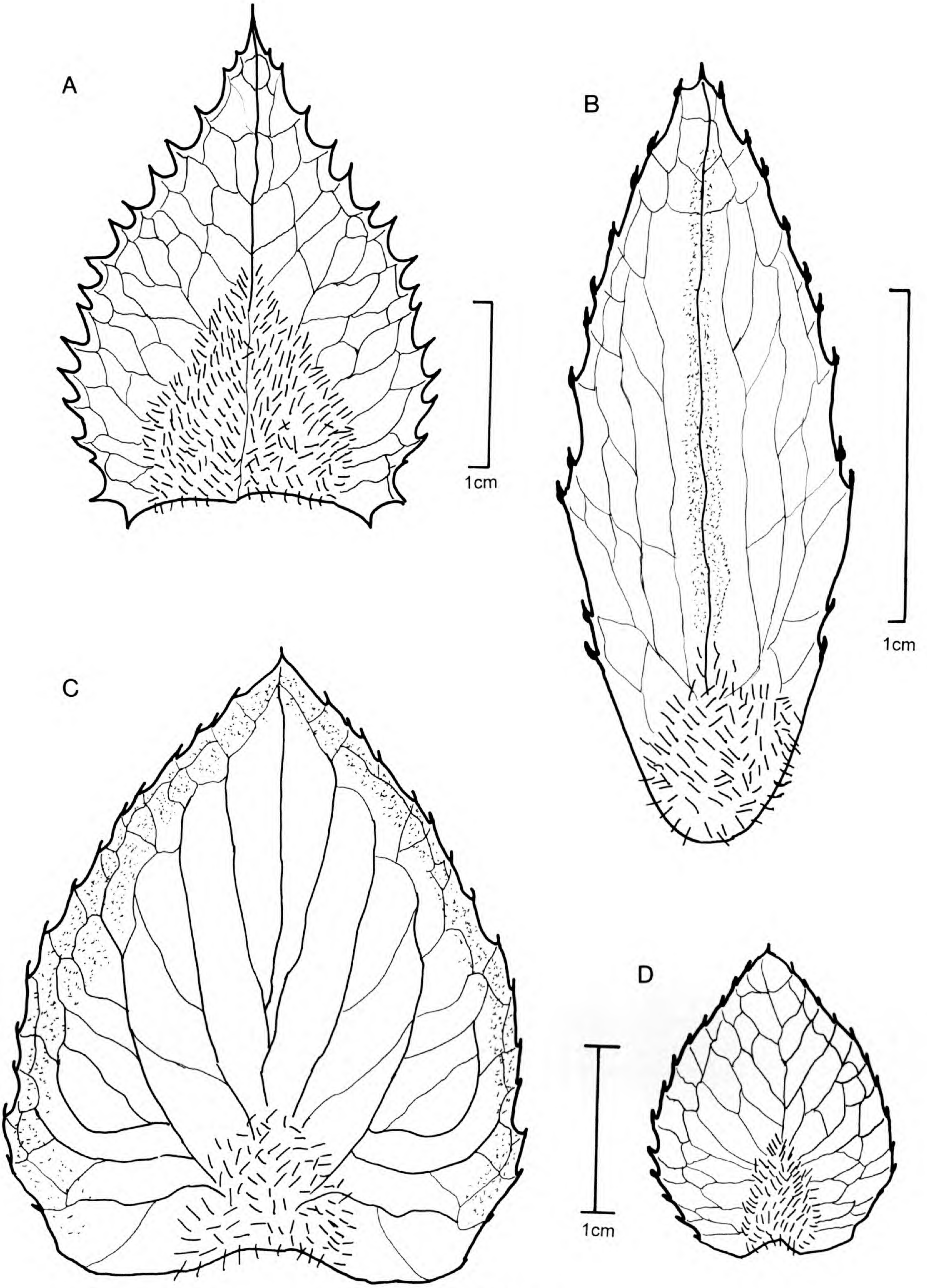
Terrestrial suffrutescent shrub or rarely epiphytic herb; stem erect, quadrangular, succulent, becoming woody, 0.5–2.0 m tall, to ca. 1 cm diam., usually glabrescent, sometimes sparsely pubescent distally, unbranched, internode length 3–12 cm, nodes and leaf scars swollen. *Leaves* opposite, nearly equal in a pair; blades elliptic, sometimes ovate, 9–39 × 3.5–24 cm, apex acuminate, base cuneate or acute, margin serrate, above green and sparsely pilose, below green, red, or green with red tinge, sparsely pilose to densely pilose (especially pilose on young foliage); petioles sulcate, 2–14 cm long, green, glabrous to densely pilose. *Inflorescences* axillary, of 1 to 4 pendent, epedunculate flowers per axil; bracts caducous at anthesis, ovate, 2–3 × 0.5–1.5 cm, red or green; pedicels 1–5 cm long, glabrous to pilose. *Flowers* resupinate, showy, and zygomorphic; calyx lobes 5, erect, nearly equal, ventral lobe narrowly ovate, other lobes ovate, 1.5–2.5 × 1–2 cm, all green, all red, red with green margins, or green with red margins, sparsely pilose to hirsute, midvein especially pilose, base truncate to slightly cordate, apex acute to acuminate, margin serrate to serrulate; corolla tubular, 3–6 cm long, red, yellow, or red with yellow lobes, outside densely pilose, inside glabrous, the base gibbous, ampliate toward the limb, the mouth ventricose, limb 1.4–2.0 cm wide, the lobes free, nearly equal, ca. 4–5 × 5–8 mm, entire; stamens 4, included, filaments glabrous, connate at base and adnate to corolla tube base for 3–5 mm, anthers included, coherent by their apices, ca. 2.0 × 2.5 mm; disc of a single bilobed or unlobed gland, glabrous; ovary ca. 0.7 × 0.5 cm, hirsute, style included, 5 cm long, glabrous. *Fruit* a fleshy capsule usually hidden in persistent calyx lobes, pendent, ovoid, ca. 1.5 × 1 cm, green; seeds ca. 0.9 × 0.3 mm, numerous, fusiform, dark brown, and longitudinally striate.

Distribution and ecology. Alloplectus tetragonoides is common in Andean montane forests throughout Ecuador and Colombia. It occurs on the Western and Central Cordilleras of Colombia and both eastern and western Andean slopes of Ecuador. The species is frequent between 1500 and 1800 m, but occurs occasionally to 2200 m. The low mountains along the border with Panama and the drier forests of northern Colombia probably act as an ecological barrier to this species' range and may explain why it has not been collected in montane forests north of Colombia.

Alloplectus tetragonoides is highly variable, leading to its confusion with other species (see key below). The undersurface of the leaves can be totally green, green with a tinge of red, to totally red. Calyces can be green or red, and with either completely yellow, completely red, or yellow with red lobed corollas. It is common to find individuals with green calyces and yellow corollas with red lobes growing sympatrically with individuals that have completely red perianths. The most useful character in differentiating *A. tetragonoides* from similar species such as *A. tetragonus* and *A. grandicalyx* is its smaller calyx with lobes having serrulate margins (Fig. 2). In comparison to *A. tetragonoides*, the calyx lobe margin of *A. tetragonus* is more dentate. The calyx of *A. grandicalyx* is two to three times larger than that of *A. tetragonoides* and *A. tetragonus* (viz. Fig. 2). All of the illustrated species in Figure 2 differ from *Alloplectus cucullatus* C. V. Morton (included in key, but not in illustration) by having calyx lobes that are plane relative to the cucullate calyx lobes of *A. cucullatus.*

The first author visited the Río Topo area in the Tungurahua province of Ecuador in January of 2001. This area is where Ludwig Diels made the original collection selected for the holotype of *Alloplectus tetragonoides* (Mansfeld, 1937). No duplicates of *L. Diels 1002* are known to exist. Although many pre-World War II photos of Gesneriaceae type specimens from the Berlin herbarium are extant, we have not been able to locate photos of the collections that Mansfeld designated as type specimens. Most of Mansfeld's publications on Gesneriaceae were in the later part of the 1930s. Therefore, the collections that Mansfeld used for his species concepts probably only existed as types for a few years until they were subsequently destroyed in the aftermath of Allied bombing of Berlin in 1943. Thus, to stabilize the concept of the species, we have designated a neotype collected from the type locality where the species is extremely common.

Representative specimens. COLOMBIA. **Cauca:** Carretera Mococa Pitalito, sitio Sajonia, *F. Betancur et al. 5538* (COL, US). **Chocó:** Mpio. de San José del Palmar, SW of town, *E. Forero et al. 3402* (COL, US(2)). **Huila:** Río Villalobos, region of the confluence of Ríos Villalobos and Cauchos, *R. E. Schultes & M. Villarreal 5204* (GH, US). **Nariño:** 10 km de Guayacana por la via Tumaco Junín, *X. Londoño et al. 510* (US). **Putumayo:** along road between Pasto and Mocoa, El Selencia, *H. Kennedy 210* (US). **Valle del Cauca:** Cordillera Occidental, hoya del Río Sanquininí, *J. Cuatrecasas 15503* (US); Mpio. Dagua, Corregimiento el Carmen, *M. Amaya & J. F. Smith 581* (COL). ECUADOR. **Carchi:** cloud forest above Maldonado, *C. Luer et al. 3374* (SEL). **Imbabura:** Carretera Otavalo Selva Alegre, *H. van der Werff & W. Palacios 10558* (MO, US). **Manabí:** Carmen, *G. H. H. Tate 472* (US). **Morona-Santiago:** Cordillera del Cóndor, Cuangos, 20 km E of Gualaquiza, *A. Gentry 80029* (MO, US (2)); Cordillera Cutucú, above Río Tzontza, *F. Prieto CuP-12* (NY). **Napo:** Cantón Archidona, Reserva Ecológica Antisana, comunidad Shamato, entrada por km 21 Shamato, *J. L. Clark 5033* (AAU, COL, E, MO, QCNE, SRP, US). **Orellana:** Southern slopes of Volcán Sumaco, Hollín Loreto road, Km 25, *D. Neill & M. Asanza 8882* (MO, QCNE, US). **Pastaza:** Baños Puyo road, 5 km W of Mera, *L. P. Kvist 60334* (QCA, US). **Pichincha:** along old road between Santo Domingo–Quito and Chiriboga, *Mendoza et al. 625* (QCA, QCNE, US). **Sucumbios:** Reserva Ecológica Cayambe Coca, Volcán Reventador, trail between Río Quijos and refugio, *J. L. Clark 4454* (AAU, COL, E, MO, NY, QCA, QCNE, SRP, US). **Tungurahua:** 5 km W of Baños, *C. H. Dodson & L. B. Thien 977* (US(2)); between Río Mapoto and Río Margaritas, *C. W. Penland & R. H. Summers 186* (GH, US); roadside between Ambato and Baños, *W. D'Arcy*



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1999

Figure 2. Lateral calyx lobe variation in *Alloplectus*. —A. *A. tetragonus*. —B. *A. panamensis*. —C. *A. grandicalyx*. —D. *A. tetragonoides*. A from *E. Hernández et al. 751*; B from *K. Sytsma & L. Andersson 4611*; C from the isotype, *J. L. Clark, E. Narvaez & T. Pauchi 5449*; D from *D. Neill & M. Asanza 8882*.

14017 (MO, US). **Zamora-Chinchipe:** 10 km E of Paquisha, *G. Harling & L. Andersson 24095* (US).

KEY TO COMMONLY CONFUSED SHRUBBY *ALLOPLECTUS* SPECIES WITH RESUPINATE FLOWERS

(This key is not intended for the non-resupinate or lianoid species of *Alloplectus*.)

1a. Distal leaves and calyx lobes covered with villous or puberulous-pilose pubescence.
  2a. Calyx lobe margin denticulate to dentate, lobes plane, ovate, and acute at apex; corolla red or appearing yellow due to the dense yellow pubescence; widespread throughout the mountains of Panama and Costa Rica, rarely collected in Colombia . . . *A. tetragonus*
  2b. Calyx lobe margin serrulate to serrate, lobes plane to cucullate, ovate to oblong, and apex acute to obtuse; corolla completely red, completely yellow, or yellow with red lobes.
    3a. Pedicels longer than petioles; calyx at least one third the length of the corolla tube, red; corollas dark red to maroon, with or without yellow lobes; leaves sometimes bullate; montane forests of northern Ecuador and southern Colombia . . . . *A. grandicalyx*
    3b. Pedicels shorter than petioles; calyx less than one third the length of the corolla tube, color variable; corolla color variable, red, yellow, and sometimes yellow with red lobes; leaves not bullate; common in Andean montane forests throughout Ecuador and Colombia . . . . *A. tetragonoides*
1b. Distal leaves and calyx lobes covered with tomentose-woolly pubescence.
  4a. Calyx lobes cucullate and ovate; corollas red with dense yellow pubescence; transitional and montane forests of northern Nicaragua, Honduras, and Guatemala . . . . . *A. cucullatus*
  4b. Calyx lobes plane and oblong; corolla red with white hirsute pubescence; common in wet forests from Panama to Colombia, and occasionally reaching Ecuador . . . . *A. panamensis* C. V. Morton

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A New Genus and Species in Cupressaceae (Coniferales) from Northern Vietnam, *Xanthocyparis vietnamensis*

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ABSTRACT. Botanical explorations of heretofore poorly inventoried limestone formations in the northern Vietnamese border province of Ha Giang have yielded a new taxon of conifer that is to be classified in a cupressoid clade of Cupressaceae. It has foliage and ovuliferous cone characters that compare closely to *Chamaecyparis nootkatensis* (D. Don) Spach, as well as a feature peculiar to it and rare in conifers: the simultaneous occurrence of juvenile and mature leaves on normal plagiotropic branching systems of mature trees. It is proposed in this paper to unite *C. nootkatensis* with the newly discovered species in a new genus *Xanthocyparis*; of this new genus and species a full description and illustrations are provided. Additional contributions to this paper include observations on its habitat, conservation status, and a taxonomic discussion.

Key words: conifers, conservation, Cupressaceae, North America, taxonomy, Vietnam, *Xanthocyparis.*

The discovery of a new living conifer that is sufficiently distinct so as not to be accommodated comfortably in any known genus is an exceptional event which has only occurred a few times in the last 50 years. The conifers have received much attention from taxonomists and others over a long time even though they are a small group of plants with no more than 650 species worldwide. This discovery has become even more interesting because detailed comparisons and subsequent analysis have revealed it to be related to a species of which the generic placement has been controversial. It has thus not only enlarged our knowledge of biodiversity, but also increased our understanding of phylogenetic relationships of the conifers in the wider context of the family Cupressaceae to which it belongs. Implied in these relationships is a biogeographic history encompassing eastern Asia and North America that has been known from numerous previously discovered relationships among plants of both continents. The new conifer, its characters, and taxonomic relationships are presented below.

Xanthocyparis Farjon & Hiep, gen. nov. TYPE: *Xanthocyparis vietnamensis* Farjon & Hiep.

A genere *Chamaecypari* stomatibus utrinque in superficiebus foliorum maturorum lateralium equaliter dispositis, foliis maturiis lateralibus apices liberos (non adpressos) gerentibus, strobilis bracteis-squamis 4 (raro 6) suffultis; a genere Cupresso strobilis minoribus bracteis-squamis seminibusque minus numerosis diagnoscenda.

Small or large evergreen trees, monoecious, with fibrous bark exfoliating in longitudinal strips; heart wood yellowish, slow growing. Foliage branches spreading in plagiotropic sprays or drooping, forming a pyramidal, conical, or irregular flat-topped crown. Foliage of three types: juvenile linear leaves, transitional leaves, and mature scale leaves. Juvenile leaves present on seedlings only or also in mature trees, radially disposed in alternating whorls of four; foliage branchlets with this type of leaves always sterile. Transitional leaves present on seedlings only or also in mature trees, decussate, divided in facials and laterals of nearly equal size, the laterals weakly disposed in a plane; foliage branchlets with this type usually sterile. Mature leaves present in mature trees, decussate, dimorphic in shape and size with the laterals strongly flattened and disposed in a plane; foliage branchlets with this type often fertile. Leaves in whorls of four or decussate. Pollen cones terminal and solitary on lateral branchlets with small scale leaves, 2.5–5 × 2–2.5 mm; microsporophylls 10 to 16, decussate, peltate, bearing 2 (or 3) relatively large microsporangia. Seed cones terminal and solitary on lateral branchlets with unmodified scale leaves, maturing to 7–11 × 10–12 mm, opening wider. Bract-scale complexes in 2 (sometimes 3) decussate pairs, fused at base, the upper pair(s) connate, spreading wide to release the seeds, valvate to subpeltate, with a prominent central umbo. Central columella present or absent, small. Ovules axillary to bracts, 1 to 5 per bract; seeds usually fewer, concentrated on the upper pair (if 2 pairs) or middle pair (if 3 pairs) of scales, flattened, with two thin lateral wings. Seedlings with 2 cotyledons, followed by juvenile linear leaves in whorls of four.

Eponymy. From Greek *xantho* = yellow, the color of the wood, and *cyparis* = cypress.

1. **Xanthocyparis vietnamensis** Farjon & Hiep, sp. nov. TYPE: Vietnam. Ha Giang: Quan Ba, Bat Dai Son, Bat Dai Son Provincial Protected Area, 10 Feb. 2001, *D. K. Harder, N. T. Hiep, P. K. Loc, L. V. Averyanov, G. E. Schatz & S. Bodine DKH 6091* (holotype, HN; isotypes, HN, K, LE, MO). Figure 1.

Arbor 10–15-metralis, sempervirens, monoica; cortex fibrosus. Rami longes, horizontaliter dispositi; ramulorum frondes dimorphae foliis adultis et juvenilibus praeditae. Folia adulta decussata, inconspicue glandulifera; ea ramulorum (sub)ultimorum 1.5–3 mm longa, 1–1.3 mm lata, dimorpha: folia dorsi-ventralia (anglice "the facials") adpressa, anguste angulato-ovata vel rhombica, in parte distali carinata, margine minute denticulata praeter apicem versus integra, apice acuto; folia lateralia moderate longiora, conduplicata, basin versus decurrentia, recta vel falcata, margine minute denticulata praeter apicem versus integra, apice libero acuto vel pungenti; stomata foliorum adultorum inconspicua plerumque adaxialia, pauca in parte proximali superficiei abaxialiae. Folia juvenilia in verticillis quadrifolii disposita, basin versus decurrentia, patentia, 15–20 mm longa, 1.5–2 mm lata, monomorphia, linearia, eglandulifera, margine integra, apice acuto; stomata foliorum juvenilium in vittis 2 in superficie abaxiali solum disposita. Amenta mascula solitaria, in ramulis folia adulta gerentibus terminalia, 2.5–3.5 mm longa, 2–2.5 mm lata; microsporophylla 10–12, peltata; microsporangia 2(–3), abaxialia. Strobili feminei solitares, in ramulis folia adulta gerentibus terminales vel subterminales, post duos annos maturi, subglobosi, post dehiscentia 9–11 mm longi, 10–12 mm lati; bracteae-squamae 2(–3) paribus, oppositae, decussatae, pare supero majore connato vel recluso valvato vel subpeltato, distaliter latiores, rugosae et recurvo-umbonatae. Semina ca. 8–9, ovoidea vel irregularia, 4.5–6 mm longa, 4–5 mm lata, testa in alas 0.5–1 mm latas expansa.

Small to medium-sized tree to 10–15 m; trunk monopodial, terete, up to 50 cm diam.; bark smooth and thin on branches, purplish to red-brown, exfoliating in thin flakes and strips, on the trunk of larger trees becoming soft and fibrous, brown to gray-brown, exfoliating in numerous thin strips. Branches long, spreading ± horizontally; foliage branches numerous, spreading mostly in plagiotropic overlapping sprays or slightly drooping, forming a pyramidal crown in young trees but a spreading, irregular or flat-topped crown in old trees. Foliage in mature trees predominantly with mature leaves, also with juvenile leaves, often also with transitional leaves. Foliage sprays with juvenile leaves bushy, sparsely branched, ultimate branchlets 20–50 mm long, not flattened. Foliage sprays with mature leaves flattened, with rounded outline; leading foliage branches quadrangular to terete, with ca. 4 orders of branching, still covered with green leaves in 3rd to 4th year of growth; subultimate branchlets pinnate, ultimate branchlets of unequal and irregular length and spreading at 30°–45°, 5–20 × 1.5–3 mm, distinctly flattened. Juvenile leaves in whorls of four, decurrent, monomorphic, the distal part spreading at nearly 90°, the proximal decurrent part 4–5 mm long, the distal free parts 15–20 × 1.5–2 mm, linear, margins entire, tapering to a fine point. Stomata in two whitish bands on the abaxial side only, in each band ca. 6–7 irregular rows, oriented parallel to the leaf axis. Transitional leaves similar to mature leaves but longer (5–7 mm), lanceolate, the laterals spreading at 45°. Mature leaves decussate, short decurrent, imbricate, dimorphic, on (sub)ultimate branchlets 1.5–3 × 1–1.3 mm (the laterals slightly longer than the facials); the facials narrowly ovate-rhombic, keeled, ± appressed, margins minutely denticulate to entire toward the acute or acuminate and free apex; the laterals conduplicate, the proximal part decurrent, the distal part

Figure 1. Photograph of the holotype of *Xanthocyparis vietnamensis* Farjon & Hiep, *D. K. Harder, N. T. Hiep, P. K. Loc, L. V. Averyanov, G. E. Schatz & S. Bodine DKH 6091*(HN).

spreading free from the leaf above at ca. 30°, straight or falcate, margins minutely denticulate except toward the acute or pungent apex. Stomata on mature leaves inconspicuous, mostly adaxial, a few scattered on the proximal abaxial faces, covered with a layer of cuticular wax. Glands inconspicuous, in a depression below the keeled distal part of some of the facials. Pollen cones 2.5–3.5 × 2–2.5 mm, oval-terete; microsporophylls 10 to 12, ca. 1 × 1 mm, with erose-denticulate margins and mucronate apex, green turning yellow-brown; each bearing abaxially two large, subglobose yellow microsporangia containing spherical pollen. Seed cones sparse but sometimes grouped with 2 or 3 together at the outer margins or nearer the base of foliage sprays with mature leaves, initially consisting of the 2 upper pairs of green leaves (bracts) with axillary ovules. Mature cones developing in two years, green, turning dark or dull brown, subglobose, 9–11 × 10–12 mm when open, some ± persistent after seed dispersal. Bract-scale complexes in 2 (sometimes 3) decussate pairs in normally developed cones (irregular or underdeveloped cones are found), valvate to subpeltate (the third pair if present ± peltate and 4–5-angled), the lower pair oblong, all widest distally, with rounded but irregular upper margin; outer surface smooth, becoming rugose or radiately furrowed from a prominent, 1–2.5 mm long umbo (including the bract apex); inner surface red-brown marked proximally with white or gray seed scars; a small columella present or absent at the shoot apex. Ovules 1 to 3 per fertile bract (upper bracts in 6-scaled cones sterile); seeds max. 8 or 9 per cone, ovoid or irregular, flattened (1.5–2 mm thick), 4.5–6 × 4–5 mm including two lateral wings, body of seed ± pustulate, light brown or red-brown, with white hilum at base and micropylar beak often persistent at the apex; seed wings 0.5–1 mm wide, thinly membranous, lighter colored. Seedlings not seen.

Distribution. Vietnam: North Vietnam, Ha Giang Province, very locally in the Bat Dai Son mountain system near the Chinese border; altitudinal range 1060–1180 m.

Ecology. In mixed angiosperm-conifer cloud forest with the conifers *Amentotaxus argotaenia* (Hance) Pilger, *Nageia wallichiana* (C. Presl) Kuntze, *Pseudotsuga sinensis* Dode var. *brevifolia* (W. C. Cheng & L. K. Fu) Farjon & Silba, *Podocarpus pilgeri* Foxworthy, and *Taxus chinensis* (Pilger) Rehder. Dominant among angiosperms are species of *Acer, Carpinus, Lithocarpus, Quercus,* and *Ulmus*; frequent are *Pistacea weinmannifolia* J. Poisson ex Franchet and *Platycarya strobilacea* Siebold & Zuccarini. In a second stratum under the ca. 20 m tall canopy species of *Elaeocarpus, Eriobotrya, Sorbus, Schefflera,* and many others frequently occur. Shrubs and herbs abound; among the latter are numerous species of Orchidaceae, terrestrial as well as epiphytic, sometimes determining the aspect of the ground cover vegetation. Ferns and especially bryophytes are similarly abundant both as lithophytes and as epiphytes. The limestone ridges on which *Xanthocyparis* occurs are extremely eroded, composed of resistant, marble-like rock outcrops interspersed with thin soil pockets. The climate is subtropical but damp and wet much of the year.

Conservation. Newly discovered *Xanthocyparis vietnamensis* is restricted to a few localities in close proximity, mostly now in inaccessible sites on steep limestone ridges. Logging has increased in recent years and is estimated to have caused serious decline in numbers of larger, well-growing trees. This practice may have had negative effects on genetic diversity. Regeneration is poor due to heavy competition in remaining populations. This species is Critically Endangered under the IUCN Red List Categories Version 3.1 (IUCN, 2001): CR (B2a–c).

Uses. This species produces fine, yellow-brown, very hard, fragrant timber. The superb quality of the wood, in conjunction with the widespread desirability of cupressaceous wood in traditional uses of many kinds in eastern Asia, combined with slow growth, has made it a highly prized timber. Due to lack of transport facilities and other factors, most of the timber has been traded locally.

Paratypes. VIETNAM. **Ha Giang:** Quan Ba, Bat Dai Son, Bat Dai Son Provincial Protected Area, 10 Feb. 2001, *D. K. Harder et al. DKH 6090* (HN, MO, LE), 12 Feb. 2001, *D. K. Harder et al. DKH 6224* (HN, K, MO, LE); Can Ty, Sing Xuoi Ho, 12 Oct. 1999, *Nguyen Tien Hiep, L. V. Averyanov & P. J. Cribb NTH 3594* (HN, MO, LE, K).

In October 1999 a conifer was found in North Vietnam (*N. T. Hiep et al. NTH 3594*) that appeared to have morphological characters suggesting a relationship with species in the cupressoid clade of Cupressaceae s.l. (Gadek et al., 2000). The specimen compared in particular with *Chamaecyparis* and *Cupressus*, yet showed some traits not found in any known species in these or related genera, immediately suggesting that a new taxon could have been found. The only known species in that group that are certain to be indigenous in this part of Asia (including most of Myanmar, North Laos, South Yunnan, Guangxi, Guangdong, and Hainan [China]) are *Calocedrus macrolepis* Kurz and *Fokienia hodginsii* (Dunn) A. Henry & H. Thomas. The new co-

Figure 2. —A. Tree of *Xanthocyparis vietnamensis* at Bat Dai Son (photograph by L. Averyanov). —B. Branch of *X. vietnamensis* with two different foliage types (photograph by D. K. Harder). —C. Branchlet of *X. vietnamensis* with mature seed cones (photograph by D. K. Harder). —D. Branchlet of *X. vietnamensis* with pollen cones (photograph by D. K. Harder).

nifer (Figs. 2, 4) appeared to occur very locally on limestone karst ridges known to have yielded other narrow endemics, some of which have turned out to be new species, e.g., orchids. Such habitats are also frequently the refuges of relict conifer taxa, presumably because these conifers have adapted to the poor growing conditions associated with karst where competitor broad-leaf tree species could not follow. The most conspicuous feature of this new conifer taxon is the occurrence of juvenile leaves, transitional leaves, and mature leaves in the foliage of crowns of mature trees (Figs. 2B, 4). These juvenile, monomorphic leaves 15 × 1.8 mm can alternate on a branch with mature dimorphic leaves 2.5–3 × 1.2–1.3 mm (*D. K. Harder et al. 6224*). This trait is reminiscent of the foliage in mature trees of *Callitris macleyana* F. Mueller; however, unlike that species, *Xanthocyparis vietnamensis* does not produce cones on branchlets with these juvenile leaves. In *Widdringtonia nodiflora* (L.) E.

Figure 3. Branchlet of *X. nootkatensis* with mature seed cones (photograph by A. Farjon).

Powrie, coppiced (fire-damaged) plants produce similar juvenile leaves usually on basal reiterated branches (Pauw & Linder, 1997). A mixture of needle-like and scale-like leaves is common in *Juniperus chinensis* Roxburgh, where the needle leaves represent the juvenile stage because such leaves are the first to appear after the cotyledons. Indeed, in all species of Cupressaceae s.l. (Farjon, 1998, 2001) this transition from juvenile (via transitional forms) to mature leaves takes place in the seedlings, often accompanied by a change in phyllotaxis. Normally, in most cupressoid taxa, juvenile leaves do not reoccur; when they are present these branches are often the result of reiteration. This seems to be the case in some specimens of *X. vietnamensis* (e.g., *N. T. Hiep et al. NTH 3594*), but in others (e.g., *D. K. Harder et al. DKH 6091* holotype, *D. K. Harder et al. DKH 6224*) the branching pattern of both foliage types shows a normal alternation not suggesting reiteration. In the known species of *Chamaecyparis* and *Cupressus* juvenile leaves are restricted to the seedling stage. However, juvenile leaf characters have been retained in some cultivars of *Chamaecyparis*. It is possibly a neotenic trait controlled by certain genes that can be "switched on or off" at different stages of growth in several taxa. By itself, this would be a somewhat doubtful character to indicate the existence of a distinct species; however, its coexistence with mature foliage throughout the life history of the tree is rare in conifers.

Careful comparison of the morphology of the new discovery in Vietnam with that of other, more or less similar, species in Cupressaceae leads to *Chamaecyparis nootkatensis* (Fig. 3) as the most similar species. This taxon has very similar seed cones with 4(to 6) bract-scale complexes ("–12" is certainly an error for *C. nootkatensis* in Taylor & Sziklai, 1976), which are quite distinct from both its congeners and from those of *Cupressus*, with which *Chamaecyparis* has been united from time to time (see, e.g., Camus, 1914, for a monographic treatment). There has been debate concerning the placement of *C. nootkatensis* in either genus, with some authors arguing for inclusion in *Cupressus* based on characters of the ovuliferous cones (Frankis, 1993; Jagel & Stützel, 2001). Recent cladistic evidence based on molecular data (*mat*K gene) gives only weak support for its inclusion in *Cupressus* (Gadek et al., 2000); similar evidence using a combined data set (*mat*K + non-molecular data) does not and places it as a sister group to *Cupressus* + *Juniperus* with stronger bootstrap support (Gadek et al., 2000). Inclusion of the new Vietnamese species in a phylogenetic analysis of Cupressaceae s.l. based on morphological data (a full account of which will be published later) resulted in a separate clade for *C. nootkatensis* + *X. vietnamensis* within a major clade distinct from both *Chamaecyparis* and *Cupressus* (Fig. 5). Sequencing of DNA of *X. vietnamensis* has yet to be undertaken.

Apart from the markedly different ages of plants between *C. nootkatensis* and *X. vietnamensis* in which juvenile leaves still occur, the leaf morphology of both is very similar, both of juvenile, transitional and mature (Figs. 2D, 3, 4) leaves. In both species the mature leaves are markedly dimorphic (differently shaped facials and laterals) on plagiotropic foliage branchlets. This is common in all Cupressaceae with such branching systems, causing a bilateral flattening of the leaf-covered branchlets. Growth of branches profoundly determines leaf shape in Cupressaceae (Daguillon, 1899; Rouane, 1973; Offler, 1984). Unlike other taxa with this marked leaf dimorphism (e.g., *Chamaecyparis* s. str., *Calocedrus, Fokienia, Platycladus, Thuja, Thujopsis*), in which the distribution of abaxial stomata is asymmetrical, i.e., largely confined to the physiological underside of the lateral leaves and the abaxial side of facials on that side of the branchlet, both *Chamaecyparis nootkatensis* and *Xanthocyparis vietnamensis* have only a weakly developed stomatal asymmetry. In this respect they resemble certain species of Asian *Cupressus* with (weakly) dimorphic adult leaves on pendulous branchlets (*C. cashmeriana* Royle ex Carrière, *C. funebris* Endlicher). Leaf dimorphism in Cupressaceae is strongly correlated (i.e., adaptive) with moist climates (e.g., *Chamaecyparis, Fokienia, Thuja*); monomorphism of mature leaves resulting in quadrangular to terete branchlets is correlated with (seasonal) aridity (e.g., *Cupressus arizonica, Juniperus* sect. *Sabina*). Glands on the facial mature leaves of *X. vietnamensis* are less conspicuous than those of *Chamaecyparis nootkatensis*; neither normally produce droplets of resin.

Pollen cones of both species are very similar (in *C. nootkatensis* slightly larger) with 2(or 3) relatively large microsporangia; in *Chamaecyparis* s. str. and especially *Cupressus* the latter are more numerous (3 to 6) and relatively smaller (Figs. 2D, 4). Seed cones of *Xanthocyparis vietnamensis* (Fig. 2C) and *Chamaecyparis nootkatensis* (Fig. 3) are also similar; the most striking feature is the predominance of only two decussate pairs of bract-scale complexes in the mature cones. In both species an occasional third distal pair develops (or sometimes only one of these); although the sampling of *X. vietnamensis* studied is still somewhat limited (ca. 30 cones seen) it seems that this is somewhat more frequent in this species (Figs. 2C, 4). In both taxa a small columella develops at the shoot apex of 4-scaled cones, sometimes consisting of two parts. As in all Cupressaceae s.l. (incl. Taxodiaceae) the ovuliferous cone starts with ovule development borne on, subtended by, or surrounded by leaves (bracts); the scale forms by secondary (intercalary) growth. In both species this growth is more pronounced on the adaxial side of the bracts and more rapid in the second pair of the bract-scale complexes, resulting in semi-valvate cone scales that remain largely fused proximally. The only other taxon in the cupressoid clade (Gadek et al., 2000) with somewhat similar cone development is *Tetraclinis*; this type is more fully developed in the callitroid clade (Gadek et al., 2000) with which both fossil (e.g., Engelhardt & Kinkelin, 1908) and Recent species (Li, 1953) of *Tetraclinis* have erroneously been identified. Whereas in *Tetraclinis* the number of bract-scale complexes (2 pairs) seems primary in origin, in *Chamaecyparis nootkatensis* and *Xanthocyparis vietnamensis* it is almost certainly reduced, as evidenced by the occasional third pair that is much smaller and never associated with the ovules. Poorly developed, smaller cones of *Cupressus lusitanica* Miller sometimes have only 2 pairs (instead of 3 to 4, rarely 5 pairs) but they are more peltate. The ontogeny of the bract-scale complexes and the placement of ovules of *X. vietnamensis* and *Chamaecyparis nootkatensis* are likely to be similar but were only studied in detail for the latter species (Jagel & Stützel, 2001). Seedling development and seedling characters of *X. vietnamensis* remain to be studied.

Considering the evidence based on morphology, it is very likely that there is a closer relationship of *Xanthocyparis vietnamensis* with *Chamaecyparis nootkatensis* than with any other Recent taxon in Cupressaceae. We appear to have found a very interesting relict taxon on the western margin of the Pacific that belongs to a lineage distinct from both *Chamaecyparis* and *Cupressus* and is possibly more ancient than either of these. A comparison with the Late Cretaceous taxon *Mesocyparis* McIver & Basinger, which has been found in northwestern North America and northeastern Asia (McIver & Basinger, 1987; McIver & Aulenback, 1994) is of interest. In this fossil genus short dimorphic leaves appear on opposite (pen)ultimate lateral branchlets, and long dimorphic leaves follow a series of short leaves on leading shoots. Although the opposite branching pattern contrasts with the alternate branching in Recent cupressoid genera, the alternation of two leaf shapes is also found in *Xanthocyparis vietnamensis*, but with monomorphic (juvenile) longer leaves. The seed cones of *Mesocyparis*

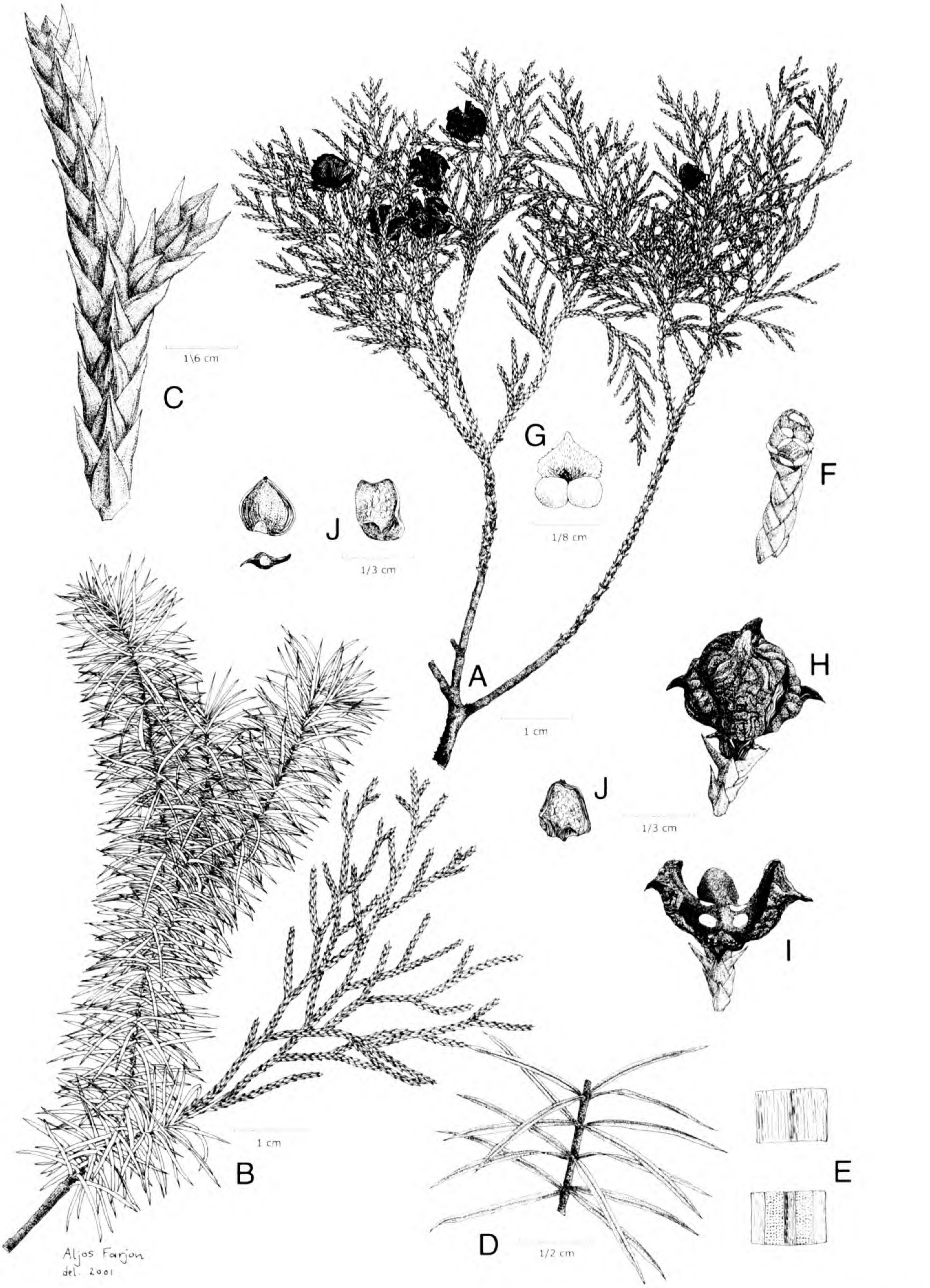

Figure 4. *Xanthocyparis vietnamensis* Farjon & Hiep. —A. Branchlet with scale leaves and seed cones. —B. Branchlet with scale leaves and needle leaves. —C. Branchlet with scale leaves. —D. Branchlet with needle leaves. —E. Detail of upper and lower side of needle leaf. —F. Branchlet with pollen cone. —G. Microsporophyll with two microsporangia. —H, I. Seed cones, closed and open. —J. Seeds. [A, C, F–J = *Harder et al. 6091* (HN, K); B, D, E = *Harder et al. 6224* (K). Illustration by Aljos Farjon.

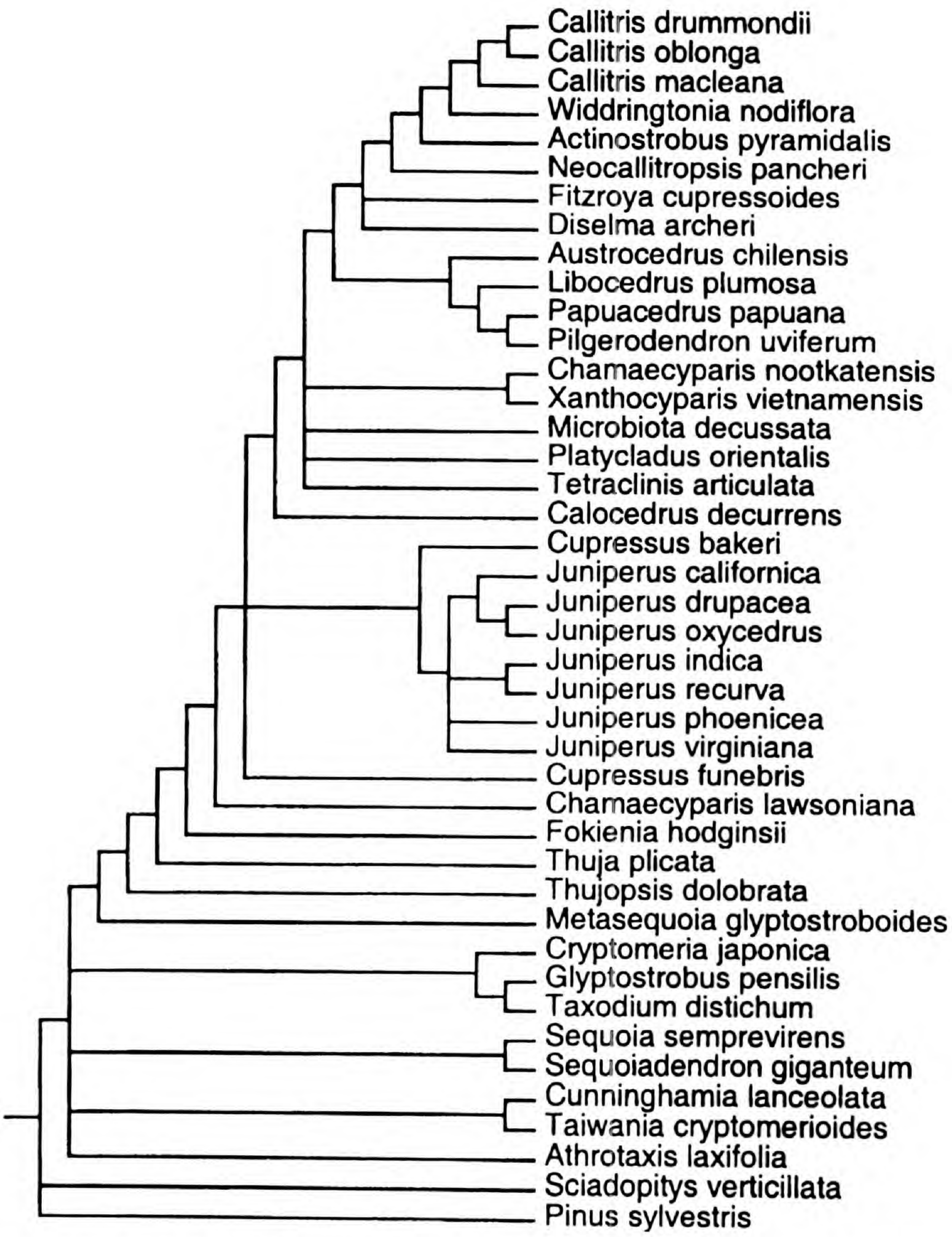

Figure 5. Strict consensus of 144 equally parsimonious trees of 523 steps found from a heuristic search of morphological and anatomical data (53 characters) in Cupressaceae s.l. and *Sciadopitys verticillata*, using *Pinus sylvestris* as outgroup. CI = 0.2428; RI = 0.3077; RC = 0.0747. [A full account of the characters and the data set will be given by Farjon in his monograph of Cupressaceae.]

umbonata McIver & Basinger are similar to those of *Chamaecyparis nootkatensis* and *X. vietnamensis* with two paired bract-scale complexes. However, the position of seed cones on the foliage branches of *Mesocyparis umbonata* is quite different especially from *C. nootkatensis*. They are not terminal on foliage sprays but appear lower on foliage shoots, on opposite, very short branchlets axillary to long leaves. A lower position does also occur in *X. vietnamensis*, but these cones are not in decussate pairs. Early developmental stages observed in fossil seed cone specimens of *Mesocyparis umbonata* are essentially similar to those in *C. nootkatensis* (McIver & Aulenback, 1994) but in the fossil the cones remain notably smaller, i.e., development after pollination of the ovules lags behind. In both *C. nootkatensis* and *X. vietnamensis* seed cone growth after pollination alters the relative sizes of bract and scale, considerably influencing the size and shape of these bract-scale complexes at maturity. The seeds of fossil *Mesocyparis* and of *Chamaecyparis* and *Xanthocyparis* are very similar. Another Late Cretaceous fossil, *Chamaecyparis corpulenta* (Bell) McIver (McIver, 1994) from Vancouver Island, Canada, has leaves more similar to other Recent species in *Chamaecyparis*, but again very small seed cones with four scales. This low number of bract-scale complexes is apparently primitive, as it occurs in all earliest (Cretaceous) members of Cupressaceae thus far known (McIver, 1994).

We conclude from the above evidence that *Chamaecyparis nootkatensis* should be placed with *Xanthocyparis vietnamensis* in a separate genus.

Xanthocyparis has retained several characters or traits that were evident in similar cupressoid members of Cupressaceae s.l. in the Late Cretaceous, but which have been lost or replaced by other features in more advanced members of *Chamaecyparis* and *Cupressus* during the Tertiary.

The following new combination has to be made as a result of the new taxonomy here proposed:

2. Xanthocyparis nootkatensis (D. Don) Farjon & Harder, comb. nov. Basionym: *Cupressus nootkatensis* D. Don, in Lambert, Descr. Pinus 2: 18. 1824. *Chamaecyparis nootkatensis* (D. Don) Spach, Hist. Nat. Vég. Phan. 11: 333. 1841. *Cupressus nutkatensis* Hooker, Fl. Bor. Amer. 2 (10): 165. 1838. *Chamaecyparis nutkaensis* Lindley & Gordon, J. Hort. Soc. London 5: 207. 1850. TYPE: Canada. British Columbia: Hecate Strait, Banks Island ["northwest coast of North America behind Bank's Island"], 1787, *A. Menzies s.n.* (holotype, not seen; isotypes, K, MO).

Thuja excelsa Bongard, Mém. Acad. Imp. Sci. Saint-Petersbourg, sér. 6, Sci. Math. 2: 164. 1832. *Cupressus americana* Trautvetter, Pl. Imag. Descr. Fl. Russ. 1 (1/2): 12, t. 7. 1844. TYPE: U.S.A. Alaska: Baranof Island, Sitka, "Dr. Mertens" s.n. (no date) (holotype, not seen; isotype, MO).

Thujopsis borealis hort. ex Carrière, Traité Gén. Conif.: 113. 1855. TYPE: Unknown, based on cultivated plant.

The species *Cupressus macrocarpa* Hartweg ex Gordon is considered to be the male parent of the generic hybrid ×*Cupressocyparis leylandii* (A. B. Jackson & Dallimore) Dallimore & A. B. Jackson; the female parent, from which hybrid seeds were collected, is thought to be *Chamaecyparis nootkatensis* (D. Don) Spach (Jackson & Dallimore, 1926). Reversed parentage was also reported to have occurred (Jackson & Dallimore, 1926), but both the protologue and the type specimens at K indicate that this hybrid was first raised from seed obtained in 1888 from *C. nootkatensis*. Two further nothospecies with male parentage from *C. nootkatensis*, but involving as female parents *Cupressus arizonica* Greene var. *glabra* (Sudworth) Little and *Cupressus lusitanica* Miller, were described by Mitchell (1970). Under the rules of the *Code* (Art. H6.2; Greuter et al., 2000) the name of a nothogeneric hybrid is to be combined from the first part or the whole of one and the last part or the whole of the other parent. The reclassification of *Chamaecyparis nootkatensis* in a new genus *Xanthocyparis* therefore requires a name change of the hybrid genus of which it is one of the parents; after ample deliberation it has been considered best practice to effect as minimal a change as possible. The necessary new combinations are given below.

×**Cuprocyparis** Farjon, nom. nothogen. nov.

Cupressocyparis Dallimore & A. B. Jackson, Forestry 11: 3. 1937; Roy. Bot. Gard. Kew Hand-list Conif., ed. 4: 37. 1938.

3. ×**Cuprocyparis leylandii** (A. B. Jackson & Dallimore) Farjon, comb. nov. Basionym: *Cupressus leylandii* A. B. Jackson & Dallimore, Kew Bull. 1926: 114. 1926. ×*Cupressocyparis leylandii* (A. B. Jackson & Dallimore) Dallimore & A. B. Jackson, Forestry 11: 3. 1937; Roy. Bot. Gard. Kew Hand-list Conif., ed. 4: 37. 1938. TYPE: England. Northumberland: Haggerston Castle (cultivated), 26 Nov. 1925, *E. J. Leyland s.n. (specimen marked D, with cones)* (lectotype, designated here, K).

Hybrid formula: ♂*Cupressus macrocarpa* Hartweg ex Gordon × ♀*Xanthocyparis nootkatensis* (D. Don) Farjon & Harder [*Cupressus macrocarpa* Hartweg ex Gordon × *Cupressus nootkatensis* D. Don; *Cupressus macrocarpa* Hartweg ex Gordon × *Chamaecyparis nootkatensis* (D. Don) Spach]

4. ×**Cuprocyparis notabilis** (A. F. Mitchell) Farjon, comb. nov. Basionym: ×*Cupressocyparis notabilis* A. F. Mitchell, J. Roy. Hort. Soc. 95 (10): 453. 1970. TYPE: England. Hampshire: Forest Research Station, Alice Holt Lodge, 31 July 1963, *A. F. Mitchell s.n.* (holotype, K).

Hybrid formula: ♀*Cupressus arizonica* Greene var. *glabra* (Sudworth) Little × ♂*Xanthocyparis nootkatensis* (D. Don) Farjon & Harder.

5. ×**Cuprocyparis ovensii** (A. F. Mitchell) Farjon, comb. nov. Basionym: ×*Cupressocyparis ovensii* A. F. Mitchell, J. Roy. Hort. Soc. 95(10): 454. 1970. TYPE: England. Hampshire: Forest Research Station, Alice Holt Lodge, 1970, *A. F. Mitchell s.n.* (holotype, K).

Hybrid formula: ♀*Cupressus lusitanica* Miller × ♂*Xanthocyparis nootkatensis* (D. Don) Farjon & Harder.

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Nomenclatural Clarification in *Aristea* Section *Racemosae* (Iridaceae) in the Cape Flora of South Africa

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ABSTRACT. We demonstrate that the correct names for three species of section *Racemosae* of the Afro-Magadagascan genus *Aristea* are: *Aristea capitata* (L.) Ker Gawler, *A. bracteata* Persoon, and *A. bakeri* Klatt. A neotype is selected for *Gladiolus capitatus* L. (1753), the basionym of *A. capitata* (L.) Ker Gawler (1802). *Aristea major* Andrews (1801) is placed in taxonomic synonymy with *A. capitata*. The typification and identity of *Ixia thyrsiflora* D. Delaroche (1766), basionym of *Aristea thyrsiflora* (D. Delaroche) N. E. Brown (1929), often regarded as conspecific with *A. major*, remain in question; however, due to priority of publication of the basionyms *A. thyrsiflora* presents no threat to the stability of *A. capitata*. Weimarck effectively lectotypified the superfluous and illegitimate name *Moraea caerulea* Thunberg (1787), basionym of *Aristea caerulea* (Thunberg) Vahl (1805). *Aristea bracteata* Persoon (1805) is accepted as a replacement name for *M. caerulea*, and is the oldest legitimate name available for this species. *Aristea monticola* Goldblatt (1971) was also published as a replacement name for *M. caerulea*, and thus falls into synonymy with *A. bracteata*. *Aristea bakeri* Klatt (1894) was published as a replacement name for the illegitimate later homonym *A. paniculata* Baker (1892). *Aristea macrocarpa* G. J. Lewis (1940) and *A. confusa* Goldblatt (1970) are placed in taxonomic synonymy with *A. bakeri*.

Key words: *Aristea*, Cape Flora, Iridaceae, South Africa.

The identity of *Gladiolus capitatus* L. (1753), the basionym of *Aristea capitata* (L.) Ker Gawler, has always been uncertain because no type has ever been found. Early botanists dealing with the southern African Iridaceae, including Linnaeus's contemporary, C. P. Thunberg, were unanimous that the plant represented a robust species of a group that is now recognized as the Afro-Madagascan genus *Aristea* Aiton (ca. 50 species). The name *Gladiolus capitatus* has long been associated with the species currently known as *A. major* Andrews (1801) or *A. thyrsiflora* (D. Delaroche) N. E. Brown (1929), both of which represent the same plant (Ker Gawler, 1802; Baker, 1892, 1896), or with two other species, *A. macrocarpa* G. J. Lewis or *A. confusa* Goldblatt. The last two names were published for plants known at the time as *A. capitata*, which the respective authors rejected because this name lacked a type and could not be reliably identified to species (Lewis in Weimarck, 1940; Goldblatt, 1971). Confusion about *A. capitata* was such that Weimarck (1940) recognized *A. capitata* despite including its intended replacement name *A. macrocarpa* in the same account. In her account of *Aristea* for the *Flora of the Cape Peninsula*, Lewis (1950c) also regarded *A. capitata* and *A. macrocarpa* as separate species, despite her earlier treatment (Lewis in Weimarck, 1940). To add to the confusion, Goldblatt (1971) published yet another name, *A. confusa*, for the plants called *A. capitata* by Lewis (1950c).

These species are fairly closely related and were all included by Weimarck (1940) in *Aristea* sect. *Racemosae*, a taxon defined by woody capsules with three broad, radial wings that develop from the locules of the ovary with each locule containing between two and twelve radially compressed, lamellate seeds (seed number depending on the species)

(Goldblatt & Manning, 1997). Most members of the section are robust plants, often 1 m or more in height, with tough fibrous leaves, and a highly branched compound inflorescence (a synflorescence of binate rhipidia), but a few species are relatively small plants. Goldblatt and Le Thomas (1997) maintained section *Racemosae* in a phylogenetic analysis of *Aristea* that included several pollen characters. They showed that all the species of the section examined have unspecialized pollen grains with a single, smooth aperture and reticulate exine with small lumina. Goldblatt and Le Thomas included section *Racemosae* in *Aristea* subg. *Aristea*, which has two more sections, *Aristea* and *Singulares*. These two sections comprise small plants that resemble section *Racemosae* in their winged capsules and lamellate seeds (doughnut-shaped in *Aristea singularis* of sect. *Singulares*), but they have a dichotomously branched flowering stem, and in section *Aristea* unusually large pollen grains with complex, trisulcate to spiral, confluent apertures and reticulate exine with large lumina.

Aristea capitata was one of the first two species of the genus to be described, the other being *A. africana* (L.) Hoffmannsegg: basionym *Ixia africana* (Linnaeus, 1753). The latter is the type species of *Aristea*, formally named in 1789 in Aiton's *Hortus Kewensis*, actually as we now know by the Swedish botanist Daniel Carl Solander, who was never formally credited with authorship of the genus (Ker Gawler, 1802; Krok, 1925). At the time of its description, *Aristea* included only *A. cyanea* [Solander in] Aiton, an illegitimate synonym of *Ixia africana*. The British petaloid monocot expert John Ker Gawler (1802) transferred *Gladiolus capitatus* to *Aristea* and included *Ixia thyrsiflora* (Delaroche, 1766), *Aristea major* (Andrews, 1801), and *Moraea caerulea* Thunberg (now *A. bracteata* Persoon) as synonyms, indicating a broader interpretation of the species than we now believe is correct. In order to establish a stable taxonomy for *Aristea*, we have the choice of formally proposing the rejection of *Gladiolus capitatus*, an undertaking not certain of favorable outcome, or of choosing a suitable neotype for the species. We have decided on the latter alternative.

NEOTYPIFICATION OF *GLADIOLUS CAPITATUS*

As outlined above, the identity of *Gladiolus capitatus*, the earliest species referable to *Aristea* sect. *Racemosae*, has always been uncertain because of the absence of a type. The name has consistently been used for species of *Aristea* sect. *Racemosae* and has been applied either to the plant currently known as *A. major* or to another species, variously called *A. bakeri*, *A. macrocarpa*, or *A. confusa*. The most likely species that Linnaeus had in mind when he described *G. capitatus* is the species later called *Aristea major* (Goldblatt & Manning, 2000), which has also been called *A. thyrsiflora* (Brown, 1929; Weimarck, 1940). The protologue of *G. capitatus* (Linnaeus, 1753: 37) refers to a large plant with blue flowers (*planta maxima*, *floribus caeruleis*), a branched stem (*caule ramoso*), a capitate flowering stem (*capitulis pedunculatis*), and a tuberous rootstock (*radice tuberosa*). *Aristea major* closely matches this description, particularly regarding the crowded and relatively compact synflorescence of numerous, blue flowers borne at the apex of an unbranched flowering stem (or peduncle), usually 1–1.5 m high (Goldblatt & Manning, 2000). The distinctive, dense synflorescence may well have prompted the specific epithet *capitatus*, meaning head-like. *Aristea major* has a range extending from the Cape Peninsula north to the Piketberg and east through the coastal Cape mountains to George. It is likely that a plant from the Cape Peninsula or nearby was one that came to Linnaeus's attention before 1753, for exploration of the then Dutch colony had not extended significantly into the interior at that time. Thus, from both morphological and geographical points of view the selection of a specimen currently assignable to *A. major* seems the ideal choice as a neotype for *A. capitata*, and *A. major* thus falls into synonymy.

This selection will stabilize the taxonomy of *Aristea* sect. *Racemosae* and has the added benefit of circumventing a nomenclatural controversy about the identity of *Ixia thyrsiflora* D. Delaroche (1766), which is most likely a species of *Aristea*. N. E. Brown (1929) maintained that a specimen in the Burman Collection at Geneva was the type of *I. thyrsiflora*, and that it represented *A. major*, making this an earlier name for that species. Goldblatt and Barnard (1970) disagreed that the Geneva specimen was the type, citing discrepancies in the protologue between the description, Delaroche's manuscript notes (in the Leiden Herbarium), and the Burman specimen. We are not prepared to clarify the typification of *I. thyrsiflora* in this paper; however, due to the priority of publication the name *Aristea thyrsiflora* presents no threat to the stability of *A. capitata*.

Aristea capitata (L.) Ker Gawler, Curtis's Bot. Mag. 17: pl. 605. 1802. *Gladiolus capitatus* L., Sp. pl. 37. 1753. TYPE: South Africa. Western Cape: foot of Du Toit's Kloof, 15 Oct. 1949, *W. F. Barker 6075* (neotype, designated here, NBG; isoneotypes, K, MO, PRE).

Aristea major Andrews, Bot. Repos. 3: pl. 160. 1801. TYPE: South Africa. Western Cape: without precise locality or collector, illustration in Andrews, Bot. Repos. 3: pl. 160. 1801.

Aristea thyrsiflora sensu N. E. Brown, Kew Bull. 1929: 36. 1929, non *Ixia thyrsiflora* D. Delaroche, Diss. pl. nov. 20. 1766.

In the imperfect 19th century taxonomy of *Aristea* sect. *Racemosae* more than one species was included under the name *Aristea capitata*, most commonly *A. bakeri* or *A. bracteata*. Weimarck (1940) made significant progress in distinguishing the species of the section, admitting in addition to *A. capitata*, *A. thyrsiflora* (with *A. major* as a synonym), *A. macrocarpa* (described in this monograph by G. J. Lewis), the nomenclaturally superfluous *A. caerulea* (Thunberg) Vahl, and *A. bakeri* Klatt. The name *A. capitata* was applied to plants that we cannot at present distinguish in any way from Lewis's *A. macrocarpa* except for the smooth spathes and bracts, but specimens cited by Weimarck include plants that we would now refer to *A. major*. Moreover, the reference illustration cited by Weimarck (1940) for *A. capitata*, *Curtis's Botanical Magazine* plate 605, also seems to differ in no significant way from *A. major*. Other members of *Aristea* sect. *Racemosae* that Weimarck recognized, but do not directly concern the history of *A. capitata*, are *A. juncifolia* Baker, *A. racemosa* Baker, and *A. rigidifolia* G. J. Lewis.

This paper also deals with two nomenclatural and taxonomic questions in *Aristea* sect. *Racemosae* related to the neotypification of *Gladiolus capitatus*: the correct name for *A. confusa* Goldblatt, a substitute name for the illegitimate and superfluous *A. caerulea* (Thunberg) Vahl (basionym *Moraea caerulea* Thunberg); and the circumscription and earliest names for plants currently called *A. bakeri* Klatt, *A. confusa*, and *A. macrocarpa* (Goldblatt & Manning, 2000).

THE CORRECT NAME FOR *ARISTEA CAERULEA*

In 1787 Thunberg described *Moraea caerulea* for what we now know was the second species of *Aristea* sect. *Racemosae* to be named, the first being *A. capitata*. In fact, specimens in the Thunberg collection at Uppsala, Sweden, show that his concept of *M. caerulea* included two species, the lectotype (effectively designated by Weimarck in 1940), which is now *Aristea bracteata*, and the species that we now call *A. capitata*. *Moraea caerulea* is superfluous under ICBN Art. 52.1 (Greuter et al., 2000), because Thunberg cited the name *Gladiolus capitatus* L. in the protologue which, under ICBN Art. 52.2, constitutes inclusion of its type. Since *M. caerulea* is a superfluous basionym, it is illegitimate and not available for later use. Ker Gawler (1802) included *M. caerulea* in the synonymy of *A. capitata*, but other contemporaries evidently disagreed with him, and Vahl made the combination *A. caerulea* in 1805. South African born Hendrik Persoon (1805) also recognized *Aristea*, admitting five species to the genus, one of them *A. bracteata*, a new species, in which he included Thunberg's *Moraea caerulea*. Inclusion of that name in synonymy would seem to make *A. bracteata* a superfluous name, but inasmuch as *M. caerulea* is itself superfluous, Persoon's new name is valid and legitimate. Persoon cited the figure of *M. caerulea* in Thunberg's *Dissertatio de Moraea* (1787), which makes it easy to interpret *A. bracteata*, since Persoon probably did not see the specimens in Thunberg's collection, given the difficulties of travel and communication at the time. Thus, *A. bracteata* Persoon is a nomenclaturally acceptable name for *A. caerulea* (Thunberg) Vahl. The new name *A. monticola* proposed for *Moraea caerulea* (Goldblatt, 1971) becomes an unnecessary nomen novum and later synonym.

J. G. Baker followed Ker Gawler (1802) in treating *Aristea caerulea* as a synonym of *A. capitata* in his accounts of the genus in *Handbook of the Irideae* (1892) and *Flora Capensis* (1896), but Weimarck (1940) definitively recognized *A. caerulea*, pointing out its morphological differences including the conspicuously hispid-papillate, firm-textured spathes, relatively narrow leaves 3–6 mm wide, broad spathes and bracts, and relatively short capsules.

Aristea bracteata Persoon, Syn. pl. 1: 41. 1805, nom. nov. for *Moraea caerulea* Thunberg, Dissertatio de Moraea no. 12. 1787, nom. illeg. superfl. pro *Gladiolus capitatus* L. *Aristea caerulea* (Thunberg) Vahl, Enum. pl. 2: 124. 1805. *Aristea monticola* Goldblatt, J. S. African Bot. 37: 234. 1971. TYPE: South Africa. Without precise locality or date, *Thunberg s.n.* "*M. caerulea* α" (lectotype, designated by Weimarck (1940), UPS).

Aristea caerulea var. *robusta* Weimarck, Acta Univ. Lund, n.s. 36: 74. 1940. Syn. nov. TYPE: South Africa. Western Cape: without precise locality, Oct. 1915, *R. Marloth 7173* (holotype, PRE).

Aristea caerulea var. *elongata* Weimarck, Acta Univ. Lund, n.s. 36: 73. 1940. Syn. nov. TYPE: South Africa. Western Cape: Saron, Sep. 1919, *L. Bolus s.n.* (syntypes, BOL 16739, K).

As outlined above, *Aristea bracteata* is readily recognized by the relatively large individual flower clusters enclosed by broad, more or less dry, brown, firm-textured spathes and the relatively narrow leaves with prominent, hyaline margins. The spathes are also conspicuously scabrid or hispid, a feature shared with *A. rupicola* Goldblatt & J. C. Manning (1997) and *A. macrocarpa* (here included in *A. bakeri*), in which the character is weakly expressed and sometimes evidently absent. The latter species has distinctive, elongate capsules mostly 20–30 mm long and large flowers, the tepals ca. 20 × 15 mm versus 12–17 × 12–15 mm in *A. bracteata* (Lewis, 1950a, 1950b). As in other tall species of section *Racemosae*, there is some variation in branching pattern. Of the two additional varieties included in *A. caerulea* by Weimarck, *A. caerulea* var. *elongata* represents a plant with short lateral branches and sessile upper flower clusters, while variety *robusta* also has sessile upper flower clusters and capsules to 14 mm long, compared with capsules ca. 10 mm in the typical variety (Weimarck, 1940). We see no need to recognize these local variants.

The lectotypification of *Moraea caerulea* (Weimarck, 1940) is somewhat unsatisfactory, because Weimarck clearly designated the sheet annotated by Thunberg as "*M. caerulea* α," which consists only of the leafy part of the stem. In the protologue of *M. caerulea*, Thunberg listed two localities for his two collections (now mounted on three sheets), one from "between the Outeniqua Mts and the Langkloof" and the other from "hills around the Cape," without linking the localities to specific herbarium sheets. The narrow leaves of "*M. caerulea* α" belong with the flowering stem of the sheet marked "*M. caerulea* χ," which is the plant illustrated in the *Dissertatio* (plate 2, fig. 2) and specifically cited by Persoon. This plant corresponds to our interpretation of *A. bracteata*, and Thunberg's cited locality, "hills around the Cape," agrees with this interpretation. The specimen "*M. caerulea* β" is the eastern form of *Aristea capitata* (presumably from "between the Outeniqua Mts and the Langkloof"). This form has darker rhipidial spathes and bracts and a somewhat less crowded synflorescence than the typical, western form.

DELIMITATION OF *ARISTEA BAKERI*

Among the robust members of *Aristea* sect. *Racemosae* are plants with a panicle-like, compound inflorescence, broad, fibrous, strap-like leaves, and capsules at least three times as long as wide and mostly 18–28 mm long, that contain 3 or 4 seeds in each locule. Originally plants with such compound inflorescences and broad leaves were included in *A. capitata* sensu Ker Gawler (1802), probably because the capsules were not known. Baker (1892, Aug.) was the first to distinguish the species as *A. paniculata*, a later homonym of *A. paniculata* Pax (1892, Apr.). Klatt (1894) provided the replacement name *A. bakeri* shortly thereafter for Baker's homonym, *A. paniculata*. *Aristea macrocarpa* was a new species described by the South African G. J. Lewis in Weimarck (1940) for plants until then included in *A. capitata*. Important features that Lewis used to distinguish *A. macrocarpa* were the elongate capsules, bristly abaxial surface of the spathes, and the entire, rust-brown bracts.

In view of Lewis's recognition of *Aristea macrocarpa*, the inclusion by Weimarck (1940) of *A. capitata* in his account is puzzling. Weimarck associated the name with plants from the southern Cape and elsewhere, and cited, as a reference specimen, the illustration in *Curtis's Botanical Magazine* pl. 605 (Ker Gawler, 1802), which we regard as *A. capitata* as the species is neotypified here. Specimens cited by Weimarck are either that species or few-branched specimens of *A. bakeri*. Equally puzzling is Lewis's (1950c) account of *Aristea* in *Flora of the Cape Peninsula*, where she provided descriptions for both *A. macrocarpa* and *A. capitata*, and accommodated them in her key. Given the background Lewis gave for describing *A. macrocarpa* the treatment is, at best, confusing. Nevertheless, Lewis's field understanding of the Iridaceae and of *Aristea* was widely held to be sound. Respecting that, Goldblatt (1971) provided an alternative, *A. confusa*, for plants from the Cape Peninsula called *A. capitata*. Lewis (1950c) distinguished *A. capitata* from *A. macrocarpa* by the smooth rather than hispidulous bracts, narrower tepals 16–20 × 6–8 mm (vs. 18 × 14 mm for the outer tepals in *A. macrocarpa*), and capsules 12–20 mm long. The habit and details of the spathes (except for the scabridity) were essentially identical between the two species while the capsules of *A. macrocarpa* are longer, 18–35 mm.

Weimarck (1940), however, recognized one more species, *Aristea bakeri*, that closely resembled *A. macrocarpa* in general habit, spathe morphology, and in the diagnostically critical elongate capsules. The range of *A. bakeri* extended from Riversdale and Knysna eastward to the Vanstaden's River Mountains, thus overlapping that of Weimarck's *A. capitata* (i.e., *A. confusa* sensu Goldblatt) in the west, the range of which was seen as extending from the Cape Peninsula eastward to Knysna. As mentioned in our key to the species of section *Racemosae* (Goldblatt & Manning, 1997), *Aristea bakeri* is separated from *A. capitata* sensu Weimarck (and *A. confusa* Goldblatt) on doubtful grounds. Weimarck's key criteria were: bracts brown and persisting; branches of the synflorescence erect; seeds dark, 3–4(–5) mm long for *A. capitata*; versus bracts gray-green and caducous; branches of the synflorescence spreading; seeds brown, 1.5–2 mm long for *A. bakeri*.

The distinction simply does not hold when the specimens in southern African herbaria, most of them not seen by Weimarck and collected after the 1950s, are examined. Branching in the species is somewhat variable, and caducous bracts are misleading. The bracts (by which we assume Weimarck meant leaves subtending the branches, not the spathes or floral bracts) in fact rarely fall. Lastly, the seed size distinction does not seem correct, for seeds of plants collected since Weimarck's time do not fall into his two size classes. We conclude that there is but one wild species for plant specimens variously called *Aristea bakeri*, *A. confusa*, or *A. macrocarpa*. The earliest available and legitimate name is Klatt's (1894) *A. bakeri*.

Aristea bakeri Klatt, in Durand & Schinz, Conspect. fl. afr. 5: 169. 1895 [as 1894], nom. nov. for *Aristea paniculata* Baker, Handb. Irid. 144. 1892, Aug., nom. illeg., non *A. paniculata* Pax, Bot. Jahrb. Syst. 15: 151. 1892, April. TYPE: South Africa. Western Cape: Galgebosch, near Vanstaden's River, Dec. 1872, *P. MacOwan 2077* (holotype, K; isotypes, GRA, SAM).

Aristea macrocarpa G. J. Lewis, in Weimarck, Acta Univ. Lund., n.s. 36: 74. 1940. TYPE: South Africa. Western Cape: Cape Peninsula, Kirstenbosch, Nov. 1935, *G. J. Lewis s.n.* (holotype, BOL 21665).

Aristea confusa Goldblatt, J. S. African Bot. 36: 308. 1970. Syn. nov. TYPE: South Africa. Western Cape: Table Mountain, Nov. 1930, *T. P. Stokoe s.n.* (holotype, BOL 17518).

As circumscribed here, *Aristea bakeri* may be distinguished by the elongate, broadly winged capsules somewhat truncate at the apex and (12–)18–28(–35) mm long that contain 3 or 4 lamellate seeds per locule. The rhipidial spathes and bracts are broadly ovate, dry, rusty brown, and entire, although often becoming irregularly torn with age. Specimens from the west of its range, previously included in *A. macrocarpa*, have the abaxial surfaces of the spathes and sometimes the bracts lightly bristly or scabrid, a feature often obscure and visible only under the microscope, and even then sometimes only with careful examination. The open branching of the flexuose flowering stem helps distinguish the species from *A. capitata*, which has short capsules mostly 8–10 mm long and about twice as long as wide, and narrow, lanceolate spathes and bracts, the margins of which are translucent and the midlines darkly pigmented. *Aristea bracteata*, which has prominently bristly spathes and bracts, can be distinguished by the larger rhipidia, slightly smaller flowers, short capsules 10–12(–14) mm long, and narrow leaves 3–6 mm wide.

Recent research in connection with the preparation of an account of *Aristea* in *Cape Plants* (Goldblatt & Manning, 2000) led us to conclude initially that *A. confusa* was conspecific with plants from the southeastern Cape called *A. bakeri* by Klatt (1894). At the time we still believed that *A. macrocarpa* was distinct from *A. bakeri/confusa* and separated them on the basis of the rhipidial spathes being scabrid-papillate (*A. macrocarpa*) or smooth (Goldblatt & Manning, 1997, 2000). That distinction is weak because the papillae are often poorly developed and seem to be absent in old inflorescences, and sometimes even in plants of the same collection. There appears to be no other distinction between the two species. Although we now include *A. macrocarpa* in *A. bakeri*, we recognize that the distinction in the spathe and bract vestiture may subsequently be linked with one or more characters that will prove our decision incorrect.

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A New Species of *Homozeugos* (Poaceae) from Angola

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ABSTRACT. As a result of recent revisionary studies in the genus, a new species, *Homozeugos conciliatum*, is described from the central highlands of Angola in western Africa. It is differentiated from the more common *Homozeugos eylesii* C. E. Hubbard by a much shorter ligule, inrolled leaves, and longer microhairs on the abaxial surface of the leaves with a lower ratio of basal cell length to distal cell length. A full description of the new species and its predicted habitat is given.

Key words: Angola, *Homozeugos*, Poaceae.

Recent revisionary (Guala, 1997, 1998a, 1998b) and biogeographic (Guala, 1998a, 1998b, 2000) studies by the author on the genus *Homozeugos* (Panicoideae: Andropogoneae) have shown that a specimen collected in the central highlands of Angola in 1969 during the war for independence is of a species previously unknown to science. The current civil war has precluded new fieldwork on the species for the last 26 years, but sufficient herbarium material exists from the original collection to determine that it is indeed a previously undescribed species. A description of the predicted habitat is also given here. It is based on extrapolation from a GIS database of 44 layers of spatial environmental parameters for the point of collection. The original data for the GIS composite were drawn from the NOAA-EPA Global Ecosystems Database Project (1992). A complete discussion of the materials and methods is given by Guala (1998a, 2000).

Homozeugos conciliatum G. F. Guala, sp. nov. TYPE: Angola. Huambo: Chianga, "frequente no terreno que ladeia, á esquerda, a estrada para a Chianga," ca. 1710 m, 14 Apr. 1969, *B. Teixeira 13216* (holotype, LISC; isotype, LISJC). Figure 1.

Homozeugos eylesii affine sed ligulis minoribus, laminis involutis et micropilis longioribus differt.

Caespitose perennial. Rhizomes generally short and knotty. Bud scales sparsely pubescent, becoming shiny indurate and then stramineous. Culms ca. 1 m tall, 1.3–3.6 mm wide; nodes villous, 1.8–3.7 mm wide. Leaves green; sheath shorter than the lamina in the midculm leaves, 14–47.2 cm long; lamina inrolled, glabrous to sparsely hirsute, 13–59 cm long (excluding the most distal leaf), 2.3–5 mm wide (when flattened), linear to lanceolate with a prominent midvein; margin minutely antrorsely scabrous; ligule 4–5.4 mm long on the penultimate leaf, 1.4–5.4 mm long overall, domed to truncate. Inflorescence of 4 to 5 racemose segments; each segment 8.5–14.5 cm long with 20 to 35 spikelets; rachis segments between the spikelet pairs 5.35–5.6 mm long; pedicels 4.3–5.2 mm long, hairs to 2.5 mm. Sessile and pedicellate spikelets weakly appressed to the rachis; callus 1.2–1.4 mm long, pungent, velutinous, with the hairs becoming progressively longer distally, to 3 mm; first glume 7.3–8 mm long, 2.3–2.4 mm wide, the lamina with 2 minutely scabrous keels appearing as the margins, each ca. 0.6 mm wide distally grading into the margin basally; the abaxial surface of the lamina glabrate to villous with hairs to 3.6 mm long; second glume 7.3–8.1 mm long, symmetrical, similar in texture to the first glume, glabrous to villous with hairs to 1.7 mm long; sterile lemma 5.5–5.7 mm long, hyaline, ovate to linear, 2-keeled, the apex acute to minutely bifid, the margins villous; fertile lemma 6.2–7 mm long, bifid at the apex with teeth ca. 0.3 mm long, the awn straight to geniculate, 15–24 mm long, hirsute to villous with hairs to 0.5 mm long; palea 1.1–1.2 mm long; anthers 3.9–4.3 mm long, dehiscing from teardrop-shaped apical pores; lodicules 0.4–0.5 mm long. Diaspore composed of

→

Figure 1. *Homozeugos conciliatum* G. F. Guala. —A. Habit. Bar = 1 cm. —B. Transverse section of a portion of the leaf lamina. Bar = 1 mm. —C. Dissection of a spikelet: left to right: first glume, second glume, sterile lemma, fertile lemma, pistil, lodicule, palea, lodicule, three anthers, callus. Bar = 1 mm. Drawn from *Teixeira 13216* (holotype, LISC; isotype, LISJC).

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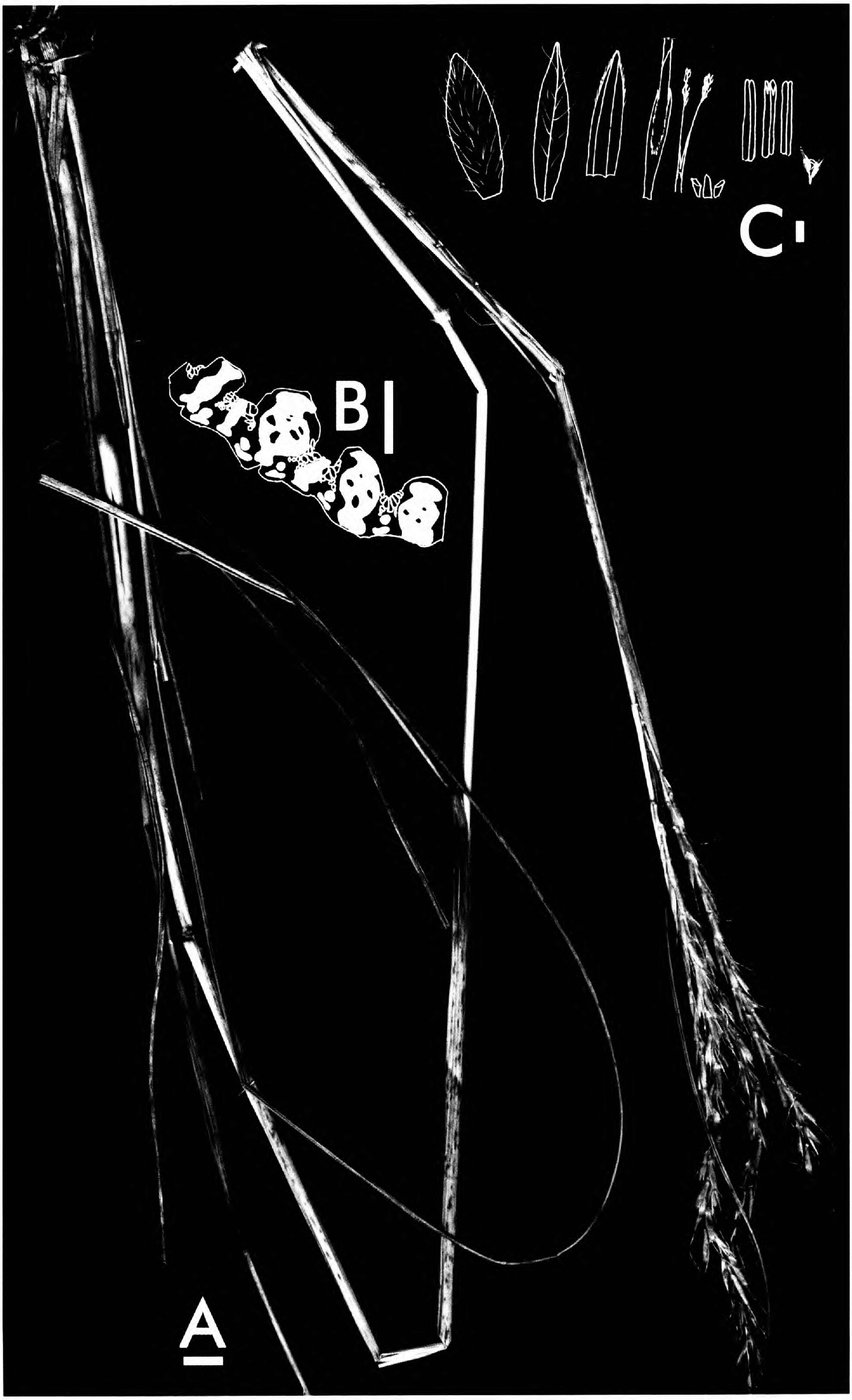
A
B
C

the hermaphrodite spikelet with its awn. Caryopsis ca. 5 mm long.

Leaves in cross section involute, with generally 3 sizes of bundles: the largest and midsize bundles with bundle caps on both the adaxial and abaxial sides and spanning the thickness of the leaf, the largest with conspicuously large vessels, the midsize bundles in sets of 1 to 3 intercalated between each pair of large bundles, without conspicuously large vessels, the smallest bundles intercalated in sets of 1 to 3, between each pair of midsize bundles, these always with an abaxial bundle cap, but without an adaxial one. Bulliform cells in discrete fan-shaped groups of ca. 5 to 10, in a single adaxial layer with smaller ones stacked and progressively smaller abaxially forming narrowly triangular arms between the vascular bundles, sometimes containing tannin-like substances. Both surfaces of the lamina similar in appearance with respect to the costal areas, smooth, occasionally with a few hooked prickles near the margins, the stomata in lines alternating with single or rarely pairs of fusiform cells; bicellular microhairs generally present on both surfaces at the edges of the costae; abaxial microhairs 54.24–55.14 μm long with their basal cell 22.97–23.86 μm long and their distal cell 31.26–31.28 μm long, the ratio of basal to distal cell length 0.73–0.76; adaxial microhairs 45.64–59.95 μm long with their basal cell 20.71–29.6 μm long and their distal cell 24.92–31.29 μm long, the ratio of basal to distal cell length 0.84–0.98; straight trichomes to ca. 5 mm long also sometimes present. Silica bodies occurring singly in cells that occur singly or in lines, dumbbell- to 4-leaf-clover-shaped.

Phenology. The type, collected in April, is at anthesis.

Distribution and habitat. *Homozeugos conciliatum* is known from a single locality on the road to Chianga in Huambo Province at 1710–1715 m elevation. Estimated coordinates: 12.80°S latitude and 15.75°W longitude. Because there is only one known locality for the species, a single point (the type locality) was queried in the GIS database (see Guala, 2000, 1998a) and the values are presented here. Habitat parameters: the percentage of possible sunshine hours that are actually sunny in Jan. 36%, Feb. 40%, Mar. 38%, Apr. 49%, May 69%, June 80%, July 76%, Aug. 71%, Sep. 56%, Oct. 43%, Nov. 35%, Dec. 35%. The mean monthly precipitation in Jan. is 219 mm, Feb. 179 mm, Mar. 238 mm, Apr. 146 mm, May 14 mm, June 0 mm, July 0 mm, Aug. 1 mm, Sep. 20 mm, Oct. 121 mm, Nov. 228 mm, Dec. 233 mm; with a mean annual precipitation of 1311 mm. The mean monthly temperature in Jan. is 19.7°C, Feb. 19.9°C, Mar. 19.9°C, Apr. 19.8°C, May 18.2°C, June 16.4°C, July 16.7°C, Aug. 19°C, Sep. 21°C, Oct. 20.9°C, Nov. 20°C, Dec. 19.8°C; with a mean annual temperature of 19.2°C, and a surface albedo in Oct. of 18%. The generalized vegetation index (GVI) in Jan. 1990 was 134, in July 1990, 124. The percentage of sand in the top 1 m of soil was 51%; percentage of silt in the top 1 m of soil 17%; percentage of clay in the top 1 m of soil 32%. In summary, the habitat is characterized by a very dry and sunny winter (May–September), with a warm wet growing season.

Eponymy. The name is a plea for peace and reconciliation in Angola. The home of this species in Huambo is the site of some of the most intense fighting amidst the general hostilities paralyzing Angola (INS Resource Information Center, 2000; Standley, 1999). As a result of the war, scientific research on the country's biota has been stifled for decades.

DISCUSSION

Homozeugos conciliatum, known only from the type collection, is clearly distinct from its five congenitors (Guala, 1998a, 1998b) and easily recognized by its short ligules and involute leaves. It was not mentioned by Clayton (1973), and he apparently never saw the collection.

In a cladistic analysis of the entire genus (Guala, 1997, 1998a), *H. conciliatum* shares long distal cells of the adaxial microhairs only with *Homozeugos katakton* Clayton, a generally much larger species that has awns 45–76 mm long, culms 1.2–1.9 m tall, glumes > 9 mm long, and flat leaves 2.8–6.3 mm wide. Although *H. conciliatum* most closely resembles *H. eylesii* morphologically, that species is known only from several localities in Zambia, Democratic Republic of Congo, Tanzania, and Malawi, in contrast to all other species of *Homozeugos*, which are restricted to Angola or (in the case of *H. katakton*) Angola and western Zambia.

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A New Combination in *Morella* (Myricaceae) in Mesoamerica

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ABSTRACT. While completing the account of Myricaceae for *Flora Mesoamericana* it was discovered that a new combination was necessary in the genus *Morella*: *M. lindeniana*. It is here provided along with a short synopsis of the distribution of the species and its differences from the widespread *Morella cerifera*.

Key words: Mesoamerica, *Morella*, *Myrica*, Myricaceae.

The small family Myricaceae contains much morphological variation, and currently taxonomists recognize four genera: *Myrica* L., *Morella* Loureiro, *Comptonia* L'Héritier ex Aiton, and *Canacomyrica* Guillaumin (Wilbur, 2001). These genera correspond to previously recognized subgeneric groupings used by the last monographer of the family (Chevalier, 1901), but recently it has come to light that Chevalier (1901) incorrectly lectotypified the genus *Myrica* with *Myrica cerifera* L. (see Wilbur, 2001, for a full discussion). Verdcourt and Polhill's (1997) proposal to conserve the generic name *Myrica* with a conserved type of *Myrica cerifera* was rejected by the Committee for Spermatophyta (Brummit, 1999). This necessitates the transfer of specific epithets for a large number of species from *Myrica* to *Morella*. Many of these transfers have already been made (Wilbur, 1994; Killick et al., 1998; Wilbur, 2001), or are in the process of being made (Parra-Osorio, pers. comm.), but one such transfer is necessary now to provide a valid name for a species recognized in the treatment of Myricaceae for *Flora Mesoamericana*.

Morella lindeniana (C. DC.) S. Knapp, comb. nov. Basionym: *Myrica lindeniana* C. DC., Prodr. 16(2): 150. 1864. TYPE: Mexico. Chiapas: *J. Linden 10* (holotype, G).

Morella lindeniana is morphologically similar to the more common and widespread *Morella cerifera* (L.) Small, but differs from it in its uniformly serrate leaves, with the serrations not confined to the distal margins, its longer leaves with more numerous and prominent secondary veins (Burger, 1977), and in its higher-elevation distribution. *Morella lindeniana* is found in the Mexican state of Chiapas, Guatemala, and Honduras from 1600 to 2700 m in moist mixed forests, while *M. cerifera* is primarily found below 1600 m in a wide variety of drier habitats.

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New Combinations and a New Name in *Syzygium* (Myrtaceae) from Madagascar and the Comoro Islands

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ABSTRACT. Acceptance of current generic concepts in Myrtaceae results in the proposal of 14 new combinations and 1 new name in *Syzygium* Gaertner. Those taxa from Madagascar and Mayotte originally described in *Eugenia* L. that have terminal inflorescences and calyptrate corollas should be accommodated within *Syzygium*. Complete synonymy and typification are given for all accepted taxa.

RÉSUMÉ. Les nouveaux concepts génériques chez les Myrtaceae nous amènent à proposer 14 combinaisons nouvelles et un nouveau nom dans le genre *Syzygium* Gaertner. Ces taxa de Madagascar et Mayotte, originellement décrits dans *Eugenia* L. et qui possèdent des inflorescences terminales et des corolles en calyptre, doivent être placés dans le genre *Syzygium*. La synonymie complète et la typification sont données pour tous les taxa acceptés.

Key words: Comoro Islands, *Eugenia*, Madagascar, Myrtaceae, *Syzygium*.

In both his treatment of Myrtaceae for the *Flore de Madagascar et des Comores*, as well as its precursor in which new taxa were described, Perrier de la Bâthie (1952, 1953) adopted the broad view of *Eugenia* L., including those taxa with terminal inflorescences and calyptrate corollas, which he ascribed to "Section *Syzygium*." More recent studies (Schmid, 1972) have definitively shown that numerous characters, including both gross floral morphological as well as anatomical characters, can be utilized to separate *Eugenia* from *Syzygium* Gaertner. This concept of two distinct genera is now generally accepted in modern treatments of the Myrtaceae, as evidenced by numerous accounts for regional floras, including *Flora Zambesiaca* (White, 1977), *Flore des Mascareignes* (Scott, 1990), and *Flore des Seychelles* (Friedmann, 1994). Thus, in line with current generic concepts, and to conform with the adjacent regional floristic treatments cited above, we propose the following new combinations and a replacement name for Malagasy *Syzygium*.

Comprised of over 500 species, the genus *Syzygium* is strictly Old World with a center of diversity in the Australasian region. Within Myrtaceae, it is allied to a group of Australasian–Malesian genera that together form the *Acmena* Alliance (Briggs & Johnson, 1979), sharing predominantly terminal inflorescences, the absence of standard myrtaceous hairs, and a mostly glabrous condition. The wood anatomy and unitegmic ovules of *Syzygium* argue against a close relationship with *Eugenia* s. str. (Johnson & Briggs, 1984). Apart from the *Syzygium* taxa enumerated below, the remaining native Malagasy Myrtaceae all belong to *Eugenia* s. str., a genus of ca. 1000 mostly New World species. With the transfer of several species originally described in *Myrtus* L. (Scott, 1980), and the description of several new species (Miller, 2000), *Eugenia* now numbers ca. 39 species in Madagascar and the Comoro Islands. Although not all *Syzygium* species possess a calyptrate corolla, all Malagasy *Syzygium* can be distinguished from *Eugenia* by their calyptrate corollas and terminal (never cauliflorous) inflorescences, versus free petals and axillary or cauliflorous (never terminal) inflorescences in *Eugenia*.

Syzygium aurantiacum (H. Perrier) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia aurantiaca* H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 190. 1952. TYPE: Madagascar. Bords de la Lokoho (N.E.), 1000 m, 2 Jan. 1949, *G. Cours 3428* (holotype, P).

This species is only known from the type specimen collected in northeastern Madagascar, within or near the Marojejy Strict Nature Reserve.

Syzygium baronii J.-N. Labat & G. E. Schatz, nom. nov. Replaced name: *Eugenia cyclophylla* Baker, J. Bot. 20: 111. 1882; non *Eugenia cyclophylla* Berg, in Martius, Fl. Bras. 14(1): 287. 1857; non *Eugenia cyclophylla* Thwaites ex Duthie, in Hooker f., Fl. Brit. Ind. 2: 494. 1878. TYPE: Madagascar. Central, sine loc., *R. Baron 219* (holotype, K).

Eugenia vacciniifolia Baker, J. Linn. Soc., Bot. 20: 145. 1883. Syn. nov. Non *Syzygium vaccinifolium* Merrill, Philipp. J. Sci. 79: 420. 1951. TYPE: Madagascar. Central, sine loc., *R. Baron 1919* (holotype, K; isotype, P).

Eugenia loiseleuroides Baker, J. Linn. Soc., Bot. 21: 341. 1884. Syn. nov. TYPE: Madagascar. Sine loc., *R. Baron 2641* (holotype, K; isotype, P).

Perrier de la Bâthie (1952, 1953) used the name *E. vacciniifolia* Baker for this species, perhaps because he was aware that the name *Eugenia cyclophylla* had been used previously by two other authors before Baker. A nomen novum is now necessary because *Syzygium vaccinifolium* Merrill already exists. *Syzygium baronii* is distributed in humid montane forest of the Imerina region of the Central High Plateau, and is apparently common in the Ankaratra Massif between 1600 and 1800 m altitude.

Syzygium bernieri (Drake) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia bernieri* Drake (as "*Bernieri*"), Bull. Mens. Soc. Linn. Paris 2: 1221. 1896. TYPE: Madagascar. Ste.-Marie, 1834, *A. C. J. Bernier 195* (as "*155*") (lectotype, designated by Perrier de la Bâthie (1952), P; isolectotype, P).

Eugenia chapelieri Drake (as "*Chapelieri*"), Bull. Mens. Soc. Linn. Paris 2: 1222. 1896. Syn. nov. TYPE: Madagascar. [Environs de Tamatave], *L. A. Chapelier s.n.* (holotype, P; isotype, P).

Eugenia maroana Aug. DC., Bull. Herb. Boissier, Sér. 2, 1(6): 573. 1901. Syn. nov. TYPE: Madagascar. Environs de Maroantsetra, 1897, *A. Mocquerys 348* (holotype, G).

This species varies considerably throughout its range (mainly in leaf size and shape and flower size), and, like *S. emirnense*, requires a thorough systematic revision prior to the recognition of additional specific or infraspecific taxa. Therefore, the three varieties (*Eugenia bernieri* var. *oblanceolata*, *Eugenia bernieri* var. *latericolor*, *Eugenia bernieri* var. *tampinensis*) described by Perrier de la Bâthie (1952), which moreover are invalid in lacking Latin diagnoses, are not recognized here. *Syzygium bernieri* is widely distributed in the humid forest along the east coast of Madagascar as well as the Sambirano region including Nosy Bé, from sea level to ca. 1000 m altitude, but more common at the lower elevations.

Syzygium condensatum (Baker) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia condensata* Baker, J. Bot. 20: 112. 1882. TYPE: Madagascar. Central, Betsileo-land, *R. Baron 237* (holotype, K; isotype, P).

Syzygium condensatum, *S. micropodum*, and the very polymorphic species *S. emirnense* together constitute a difficult complex of species that requires a thorough systematic revision. We provisionally adopt Perrier de la Bâthie's concept of specific limits within the complex, but exclude *E. aggregata* from synonymy under *S. condensatum*. As treated below, further study of the lectotype of *E. aggregata* (*R. Baron 4917*) clearly indicates that it is conspecific with *S. phillyreifolium*. *Syzygium condensatum* is distributed in humid montane forest on the Central High Plateau around Antananarivo, as well as in the Andapa region including the Marojejy Strict Nature Reserve.

Syzygium danguyanum (H. Perrier) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia danguyana* H. Perrier (as "*Danguyana*"), Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 195. 1952. TYPE: Madagascar. Ambodimanga à Antanambao [near Lac Alaotra], 1200 m, 11 Oct. 1945, *G. Cours 2800* (lectotype, designated here, P).

This species is known from relatively few collections in low- to mid-elevation humid forest up to 1200 m altitude, from Farafangana to the Masoala Peninsula as far west as Lac Alaotra. The variety *Eugenia danguyana* var. *rotranala*, invalidly described by Perrier de la Bâthie (1952), is not recognized here.

Syzygium emirnense (Baker) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia emirnensis* Baker, J. Linn. Soc., Bot. 20: 145. 1883. TYPE: Madagascar. Central, sine loc., *R. Baron 1076* (lectotype, designated here, K; isolectotype, P).

Eugenia cuneifolia Bojer ex Baker, J. Linn. Soc., Bot. 20: 144. 1883. Syn. nov. *Eugenia emirnensis* f. *cuneifolia* (Bojer ex Baker) H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 187. 1952. TYPE: Madagascar, Central, sine loc., *R. Baron 1254* (lectotype, designated by Perrier de la Bâthie (1952), K; isolectotype, P).

Eugenia richardiana Cordemoy, Fl. Ile Réunion: 430. 1895. Syn. nov. *Syzygium richardianum* (Cordemoy)

Guého & A. J. Scott, Kew Bull. 34: 494. 1980. TYPE: Réunion. Versants des montagnes, *J. M. C. Richard s.n.* (holotype, MARS).

Eugenia emirnensis var. *elongata* Hochreutiner, Annuaire Conserv. Jard. Bot. Génève 11 and 12: 76. 1908. Syn. nov. TYPE: Madagascar. District of Vatomandry, 21 Feb. 1904, *J. Guillot 101* (holotype, G; isotype, K).

Eugenia condensata Baker var. *thouvenotii* P. Danguy ex Lecomte, Les Bois de la forêt d'Analamazaotra: 106. 1922. Syn. nov. TYPE: Madagascar. Analamazoatra, 1919, *E. Thouvenot 124* (holotype, P; isotypes, MO, P).

After examination of the abundant material available, it appears that the considerable variability in both vegetative and reproductive characters may correspond to habitat differences and thus local ecological specialization. Comprehensive field studies are needed to clarify the patterns of variation prior to possible recognition of additional taxa (see also notes under *S. condensatum* and *S. micropodum*). *Eugenia richardiana*, which is based on a J. M. C. Richard specimen that is probably incorrectly indicated as having been collected in Réunion, corresponds to *S. emirnense* (see the editor's note in Scott, 1990: 29). In its broad conception as here accepted, *S. emirnense* is widely distributed and common throughout all of the humid to montane forest of eastern and central Madagascar. The variety *Eugenia emirnensis* var. *submaritima* and forma *Eugenia emirnensis* f. *podocarpifolia* invalidly described by Perrier de la Bâthie (1952) are here considered to lie within the overall variability of *Syzygium emirnense*.

Syzygium humblotii (H. Perrier) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia humblotii* H. Perrier (as "*Humblotii*"), Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 193. 1952. TYPE: Comores. Mayotte, Forêt de Combani, 19 Oct. 1884, *L. Humblot 1329* [incorrectly cited by Perrier de la Bâthie as "Madagascar, Nossivé, *L. Humblot 329 vel 1329?*"] (holotype, P; isotype, P).

This species, which is known only from the type specimen, is endemic to the island of Mayotte in the Comoros Archipelago. In the protologue of *E. humblotii*, Perrier de la Bâthie (1952) cited the type specimen as "*Humblot 329 vel 1329?*," indicating the locality for the collection as Nossivé in Madagascar. Examination of Humblot's field books at P reveals that *Humblot 329* from Madagascar represents "*Psychotria lantzii*," a Drake manuscript name that was later published as *Cremocarpon lantzii* Bremekamp (Rubiaceae). Humblot's collections from the Comoros were also numbered beginning with 1, but then subsequently renumbered at P to avoid confusion with his Malagasy collections (see Dorr, 1997). Thus, his Mayotte collection from October 1884 bearing field number *329* (but inexplicably numbered *2329* in the second of three Comoros field books at P) was then renumbered *1329*, and is therefore the correct citation for the type of *E. humblotii*.

Syzygium lugubre (H. Perrier) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia lugubris* H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 187. 1952. TYPE: Madagascar. Forêt d'Analamazoatra, 800 m, Feb. 1912, *H. Perrier de la Bâthie 6487* (holotype, P).

This species is distributed in humid forests of central eastern Madagascar at mid-elevations, from the regions of Andramasina and Tsinjoarivo to the southeast of Antananarivo to the Lac Alaotra region. The forma *Eugenia phillyreaefolia* f. *obscurifolia* invalidly described by Perrier de la Bâthie (1952) and then later presented as a variety (Perrier de la Bâthie, 1953), represented by *M. Louvel 87*, is here considered to belong to *Syzygium lugubre*.

Syzygium micropodum (Baker) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia micropoda* Baker, J. Linn. Soc., Bot. 20: 143. 1883. TYPE: Madagascar. Central, sine loc., *R. Baron 388* (holotype, K; isotype, P).

This species is widely distributed in mid-elevational to montane humid forest, mainly above 1000 m altitude, from Andohahela to Tsaratanana including the higher elevations of the Masoala Peninsula. Plants collected in the littoral forest on sand along the eastern Malagasy coast between Ft. Dauphin and Ambila-Lemaitso correspond to the specimens cited by Perrier de la Bâthie (1952) (*H. Perrier de la Bâthie 14299*; *E. Ursch 107*) under invalidly described *Eugenia micropoda* var. *littoralis* and may represent a distinct taxon. Specimens representing the forma *Eugenia emirnensis* f. *subrotundifolia*, invalidly described by Perrier de la Bâthie (1952), are here placed under *Syzygium micropodum*. Further detailed studies are necessary before the naming of additional taxa within this species complex that includes *S. condensatum*, *S. emirnense*, and *S. micropodum*.

Syzygium onivense (H. Perrier) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia onivensis* H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 188. 1952. TYPE: Madagascar. Environs du confluent de l'Onive et du Mangoro, 600 m, Feb. 1926, *H. Perrier de la Bâthie 16990* (holotype, P).

This species is known from relatively few collections in mid-elevation humid forest between 600 and 1100 m altitude from the Tanala region to Lac Alaotra.

Syzygium parkeri (Baker) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia parkeri* Baker (as "*Parkeri*"), J. Linn. Soc., Bot. 20: 144. 1883. TYPE: Madagascar. Central, sine loc., *G. W. Parker s.n.* (holotype, K).

Eugenia ibitensis Drake, Bull. Mus. Hist. Nat. (Paris) 9: 42. 1903. Syn. nov. *Eugenia parkeri* Baker var. *ibitensis* (Drake) H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 194. 1952. TYPE: Madagascar. Imerina, Mont Ibity, 13 Jan. 1901, *G. Grandidier s.n.* (holotype, P).

This species is widely distributed in humid to montane forest from the Andringitra Massif to Montagne d'Ambre, and from sea level along the eastern coast to the Ibity Massif in central Madagascar. Like *S. emirnense*, *S. parkeri* is here accepted in its broad conception of Perrier de la Bâthie (1953), the confirmation of which requires further field investigations and systematic study.

Syzygium phillyreifolium (Baker) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia phillyreaefolia* Baker, J. Linn. Soc., Bot. 20: 145. 1883. TYPE: Madagascar. Central, sine loc., *R. Baron 958* (holotype, K; isotype, P).

Eugenia aggregata Baker, J. Linn. Soc., Bot. 22: 475. 1886. Syn. nov. TYPE: Madagascar. Sine loc., *R. Baron 4917* (lectotype, designated by Perrier de la Bâthie (1952), K; isolectotype, P).

This species is widely distributed throughout the Central High Plateau from the Andringitra and Isalo Massifs to the Tampoketsa d'Ankazobe, and as far west as the Bongolava region to the west of Tsiroanomandidy.

Syzygium sakalavarum (H. Perrier) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia sakalavarum* H. Perrier (as "*Sakalavarum*"), Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 189, pl. 13. 1952. TYPE: Madagascar. Tsarasaotra, Nov. 1897 [as "Ouest. Secteur Ambongo-Boina: bords de tous les cours d'eau du secteur"], *H Perrier de la Bâthie 369* (lectotype, designated here, P; isolectotypes, P, P (Drake)).

This species is widely distributed throughout western Madagascar from Ft. Dauphin to Antsiranana in dry to sub-arid deciduous forest mainly along watercourses up to 1000 m altitude. Among the syntypes originally cited, three of the sheets of *H. Perrier de la Bâthie 369* at P bear labels with a precise locality and date, two of which also bear type stickers probably affixed by Perrier de la Bâthie himself; one of these latter two is thus here designated as the lectotype. Two other sheets at P also numbered as *H. Perrier de la Bâthie 369* bear labels without the precise locality, but instead correspond to the more regional designation given for the collection included in the protologue. Moreover, on these more general labels, one sheet with flowers only is ascribed to October, and the other with fruits to January. It is therefore likely that although these two sheets are numbered as *H. Perrier de la Bâthie 369*, they were probably collected at different times and places than the specimen bearing the Type sticker, and are thus not considered here to represent isolectotypes. Capuron (1966) suggested that *E. sakalavarum* was a synonym of *S. guineense* (Willdenow) DC. Lacking more detailed systematic studies, we prefer to retain Perrier de la Bâthie's concept.

Syzygium sambiranense (H. Perrier) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia sambiranensis* H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 193. 1952. TYPE: Madagascar. Sambirano: vallée du Sambirano, 200–800 m, Dec. 1922, *H. Perrier de la Bâthie 15137* (holotype, P; isotype, P).

This species is only known from the type specimen.

Syzygium tapiaka (H. Perrier) J.-N. Labat & G. E. Schatz, comb. nov. Basionym: *Eugenia tapiaka* H. Perrier (as "*Tapiaka*"), Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 190. 1952. TYPE: Madagascar. Tsaramandroso, Ambato-Boéni, Bevaza (Réserve Naturelle n° 7 [Ankarafantsika]), 13 Oct. 1947, *Réserves Naturelles 1094-RN* (holotype, P; isotypes, K, MO, P).

This species is restricted to the dry deciduous forest on sand at the Ankarafantsika Strict Nature Reserve.

TAXA OF UNCERTAIN SYSTEMATIC POSITION

Eugenia tanalensis Baker, J. Bot. 20: 111. 1882. TYPE: Madagascar. Forests of Tanala, *R. Baron 295* (holotype, K not found).

Perrier de la Bâthie (1952) initially considered *E. tanalensis* to be a synonym of *E. phillyreaefolia*, stating that "Le type de *E. tanalensis* Baker (*R. Baron 1477*) n'a que des fleurs déformées, parasitées, indéterminables; mais les feuilles intactes sont celles de l'*Eugenia phillyreaefolia*." However, the type of *E. tanalensis* is *R. Baron 295*; *R. Baron 1477* must surely have been determined by Baker as *E. tanalensis* at some later date. Moreover, although some branches of the Kew specimen of *R. Baron 1477* clearly show signs of insect parasite deformation, others do not and can be identified as *Syzygium onivense*, a conclusion Perrier de la Bâthie also shared later (1953) in removing *E. tanalensis* from synonymy under *E. phillyreaefolia* and designating it as an "incompletely known species." Unfortunately, we have been unable to locate any material of *R. Baron 295*, and it is therefore impossible to clarify the identity and status of *E. tanalensis*.

Three other species described by Perrier de la Bâthie (1952) in *Eugenia* sect. *Syzygium* have subsequently been treated by other authors:

Eugenia cotinifolioides H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 185. 1952. TYPE: Madagascar. Pentes orientales du Marojejy, à l'ouest de la rivière Manantenina, affluent de la Lokoho, vers 1600 m, Dec. 1948, *H. Humbert 22634* (holotype, P). = **Memecylon cotinifolioides** (H. Perrier) Jacques-Félix, Bull. Mus. Natl. Hist. Nat., sér. B, Adansonia, 7(1): 14. 1985.

Eugenia cupulifera H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 190. 1952. TYPE: Madagascar. Forêt d'Analamazoatra, *Gouv. Général de Madagascar 3* (holotype, P). = **Carallia brachiata** (Loureiro) Merrill, Phillipp. J. Sci. 15(3): 249. 1919; Capuron, Adansonia, sér. 2(1): 128. 1962.

Eugenia goudotiana H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(2): 193. 1952. TYPE: Madagascar. Sine loc., *J. P. Goudot 914* (holotype, P). = **Syzygium zeylanicum** (L.) DC., Prodr. 3: 260. 1828; Capuron, Adansonia, sér. 2 (1): 128. 1962.

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Seventeen New Species of Lobelioideae (Campanulaceae) from South America

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ABSTRACT. Almost 11% of the 400 unidentified specimens of South American Lobelioideae (Campanulaceae) examined recently cannot be equated with any known species. They are described here as 17 new species: 6 of *Burmeistera*, 6 of *Centropogon*, and 5 of *Siphocampylus*. Several are characterized by morphological characters or combinations of characters that are unique or unusual in their respective genera or in the subfamily as a whole. Six of the novelties are endemic to Ecuador, four to Peru, three each to Venezuela and Colombia, and one to Bolivia.

Key words: *Burmeistera*, Campanulaceae, *Centropogon*, Lobelioideae, *Siphocampylus*, South America.

The neotropical endemics *Burmeistera* Triana, *Centropogon* C. Presl, and *Siphocampylus* Pohl are the largest genera of Lobelioideae (Campanulaceae) after cosmopolitan *Lobelia* L. Together, these three closely related genera (Pepper et al., 1997; Lammers, 1998a; Buss et al., 2001) comprise well over 500 species, found from southern Mexico to northern Argentina and in the West Indies, with their greatest diversity in high-elevation habitats of the Andes. All are large robust plants (herbaceous or suffruticose perennials, shrubs, subshrubs, lianas, and woody rosette plants), with large flowers (corollas averaging 30–60 mm long) borne singly in the axils of the upper leaves or aggregated into terminal foliose or bracteate inflorescences (racemes, corymbs, umbels); the corolla tube is neither fenestrate nor cleft dorsally and if the lobes are dimorphic, it is the dorsal pair that is larger (Lammers, 1998a, in press a, in press b).

Between 1990 and 1997, I examined approximately 750 specimens of neotropical Lobelioideae that had been sent to me for identification (Lammers, 1997); 28 of these (3.7%) could not be equated with known species and were described as 19 new species (Lammers, 1993, 1998a). At that time, I indicated that several hundred additional specimens remained to be identified; 400 of these have now been studied. Of these, 43 (10.8%) could not be referred to any known species. They are here described as 17 species new to science: 6 in *Burmeistera*, 6 in *Centropogon*, and 5 in *Siphocampylus*. With these additions, the 3 genera collectively total 545 species.

The incredible diversity evident from the foregoing discussion merits some comment. Altogether, 1150 specimens of neotropical lobelioids were examined over the past decade. Of these, 6.2% or 1 out of every 16 specimens sent to me for identification represented a species previously unknown to science. Furthermore, many of these novelties possess features or combinations of features that are unique or unusual (Lammers, 1997, 1998a). Among those described here, for example, *Burmeistera arbusculifera* is the first species of its genus with arbusculiform hairs and *B. fimbriata* the first with a fimbriate leaf margin, while *B. brighamioides* and *B. hippobromoides* have flowers far longer than any of their congeners. *Centropogon candidatus* is unique in its combination of two character states rare within the group: white arbusculiform trichomes and pinnately lobed leaves. Similarly, *Siphocampylus ambivalens* is the first species in the subfamily to combine an umbellate inflorescence with whorled leaves, *S. prevaricator* the first to combine an umbel with arbusculiform trichomes, while *S. plegmatocaulis* is unique in its dimorphic twining stems and dimorphic trichomes surrounding the orifice of the anther tube.

My experience is by no means unique. A generation ago, one of the foremost students of Lobelioideae, Rogers McVaugh (b. 1909), described many new species of South American Lobelioideae on the basis of specimens sent to him with requests for identification. Several (e.g., *Burmeistera pteridioides* McVaugh, *Centropogon varicus* McVaugh) were characterized by unique features or combinations of features. He commented that "almost every mountain in the Andes seems to have different species [of Lobelioideae] on it . . . a host of new and puzzling things turn up in every new collection from the Andes, and it is apparent that there is still a lifetime of work for someone interested in these

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bizarre and beautiful plants" (McVaugh, 1965: 400).

McVaugh's quote is as true today as it was 35 years ago. Diversity in these genera is far from exhausted, and further exploration of the Andes will continue to yield new species of *Burmeistera*, *Centropogon*, and *Siphocampylus* for many years to come. Furthermore, if these genera are at all representative of the neotropical flora as a whole, it is clear that a very significant proportion of the biotic diversity of that region remains to be named and described.

I. **Burmeistera** Triana, Nuev. Jen. Esp. 13. 1855. TYPE: *Burmeistera ibaguensis* Triana.

With the addition of the 6 novelties described here, *Burmeistera* comprises 102 species, distributed from Guatemala to Peru (Lammers, 1998a; Lammers & Maas, 1998). The genus may be distinguished from *Centropogon* and *Siphocampylus* 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. The genus was divided into two sections by Wimmer (1932, 1943, 1968): *Burmeistera* ("Imberbes," nom. invalid.), with all five anthers sparsely soft-hairy or glabrous at apex; and *Barbatae* F. E. Wimmer, with the ventral pair of anthers densely bearded at apex.

1. **Burmeistera arbusculifera** Lammers, sp. nov. TYPE: Ecuador. Carchi: Espejo, El Gualtal, Cerro Golondrinas Hembra, 00°51′N, 78°08′W, bosque muy húmedo montano bajo, bosque alto dominado por *Clusia*, árboles de 25 m de altura, 2800 m, 21 Aug. 1994, *W. Palacios & J. Clark 12465* (holotype, OSH; isotypes, MO, QCNE not seen). Figure 1.

Ab omnibus caeteris speciebus *Burmeisterae* indumento trichomatum arbusculiformium differt; species sect. *Barbatarum* affinis *B. asperae*, sed ab hac specie hypanthio obconico 3.5–5 mm diametro basi cuneato, calycis lobis longioribus 7–11 mm longis, corolla breviora 30 mm longa cum tubo 15 mm longo sed ventralibus lobis 10–11 mm longis, et dorsalibus antheris brevioribus 4.2 mm longis distinguenda.

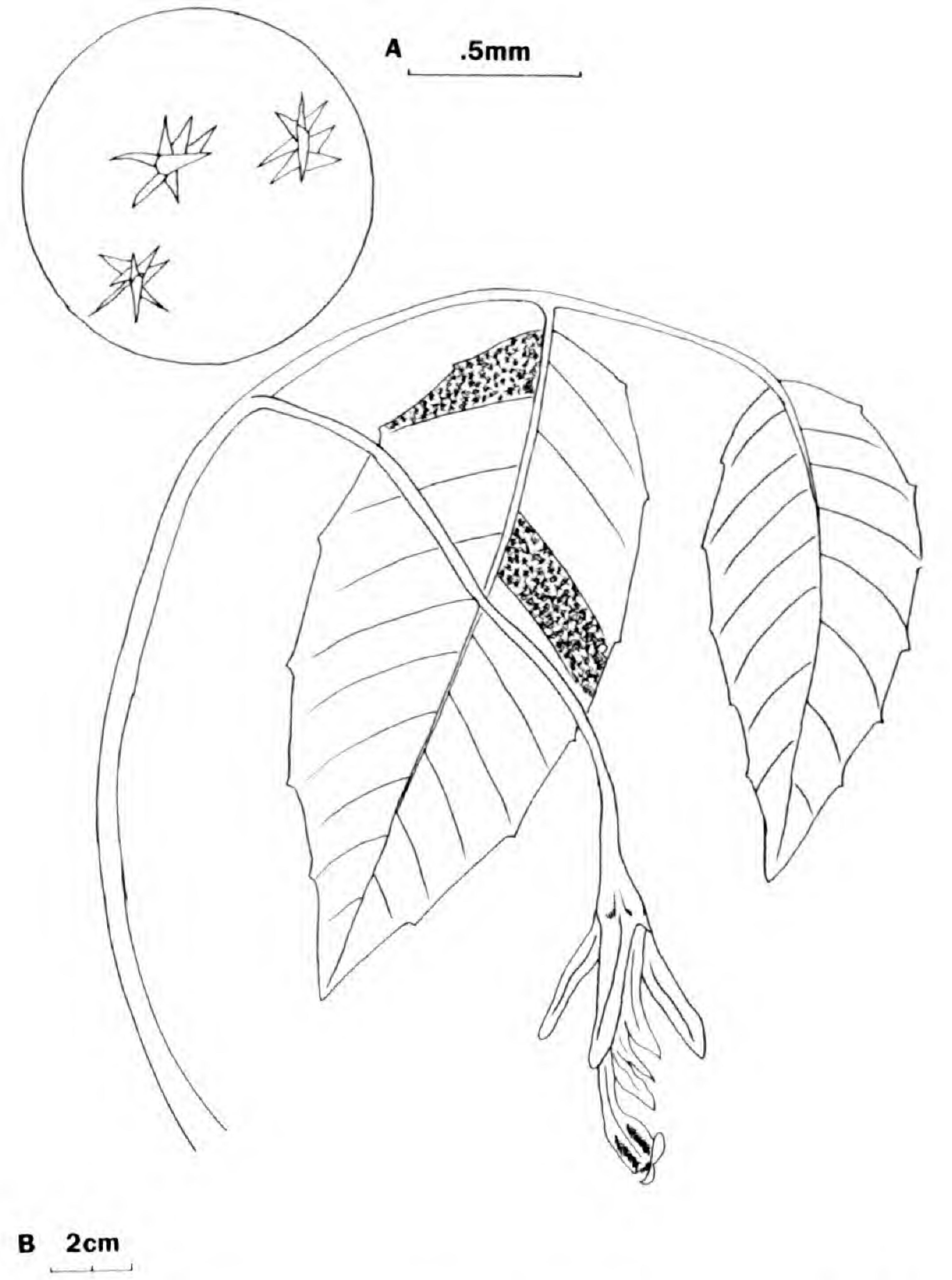

Figure 1. *Burmeistera arbusculifera* Lammers. —A. Arbusculiform trichomes on abaxial leaf surface. —B. Upper portion of stem with flower. (Drawn from the holotype, *Palacios & Clark 12465*.)

Hemiepiphytic liana; stems moderately leafy, 1.8–2.2 mm diam. toward apex, up to 26 mm diam. at base, branched, sparsely to moderately pubescent with arbusculiform trichomes toward the apex, scabrid (through abrasion of these trichomes) below; latex cream-colored. Lamina ovate, 2.3–5.5 × 1.1–2.8 cm, subcoriaceous; adaxial surface dull dark green, glabrous; abaxial surface dull green-white, pubescent especially on the veins with arbusculiform trichomes; margin somewhat revolute, denticulate with remote dark callosities; apex acuminate; base rounded or obtuse; petiole 5–10 mm long, 0.6–1.3 mm diam., 1/4–1/7 as long as the lamina, pubescent with arbusculiform trichomes. Flowers solitary in the upper leaf axils; pedicels straight or somewhat curved, ascending, 17–29 mm long, 0.6–0.8 mm diam., ebracteolate, glabrous. Hypanthium obconic, 6–9 mm long, 3.5–5 mm diam., 1/5–1/3 as long as the corolla, glabrous; base cuneate, distinct from pedicel. Calyx lobes lanceolate, ascending, 7–11 × 2–3.5 mm, as long as the hypanthium up to half again as long, 1/2–3/4 as long as the corolla tube, glabrous; apex acute; margin denticulate with 3 dark callosities on each side. Corolla bilabiate, pale green irregularly blotched with purple, 30 mm long, glabrous; tube suberect, 15 mm long, 6 mm diam. at base, gradually tapering to 3 mm diam. at middle and mouth; dorsal lobes lanceolate, falcate, 15 × 3.5 mm, as long as the tube, the apex acute; lateral lobes ovate, deflexed, 11 × 5–5.5 mm, the apex acute; ventral lobe 10 × 5.5 mm, the apex acute. Staminal column exserted between the dorsal lobes; filament tube suberect, 29 mm long, 1.7 mm diam. at mouth of corolla, flaring to 3 mm diam. at base of anther tube, glabrous; anther tube 3.2 mm diam., slightly deflexed, its surfaces glabrous; dorsal anthers 4.2 mm long, 1/7 as long as the filament tube; ventral anthers 2.8 mm long, their apex sparsely pubescent with soft wispy hairs 0.5 mm long. Fruit and seeds not seen, but apex of ovary flat.

Distribution, habitat, and phenology. Apparently endemic to northern Ecuador, collected twice in the Cerro Golondrinas of Carchi. Growing in wet mossy upper montane forests at elevations of 2750–2800 m, and flowering during July and August. According to Brad Boyle (pers. comm.), the paratype was collected in a sheltered forested cove between ridges. The canopy was 15–18 m tall and consisted of *Weinmannia* (Cunoniaceae), *Miconia* (Melastomataceae), *Clusia* (Clusiaceae), Myrsinaceae, and Lauraceae, while the shrub layer comprised a variety of Melastomataceae and Rubiaceae.

Etymology. The specific epithet alludes to the distinctive branched trichomes; from the Latin noun *arbusculae*, little trees, and the adjectival suffix *-fer*, to bear.

Relationships. Arbusculiform or dendritic hairs (i.e., trichomes irregularly branched above a stalked base) characterize *Centropogon* sect. *Siphocampyloides* and section *Niveopsis* (see below), and also occur in four species of *Siphocampylus* (one described herein) and one species of the endemic Hawaiian genus *Cyanea* Gaudichaud (Lammers, 1998a, 1998b). However, these unusual trichomes have not previously been reported from species currently assigned to *Burmeistera*. Although Wimmer's (1943) monograph did include three species of *Burmeistera* with arbusculiform hairs [*B. asteriscus* F. E. Wimmer, *B. macrocarpa* (Zahlbruckner) F. E. Wimmer, and *B. peruviana* F. E. Wimmer], McVaugh (1949) later transferred them to *Centropogon.*

On the basis of the pubescent apex of its ventral anthers, *B. arbusculifera* is assigned to *Burmeistera* sect. *Barbatae.* In Jeppesen's (1981) treatment of Ecuadorean *Burmeistera*, *B. arbusculifera* keys readily to *B. aspera* F. E. Wimmer, a poorly known species of that section that occurs in nearby Imbabura as well as in southern Colombia. The two species are similar in habit; size, shape, and other details of their leaves; length of pedicels; shape and margin of the calyx lobes; and pigmentation of the corolla. However, *B. aspera* differs from the new species in having the upper portions of the stem and the abaxial leaf surface pubescent with distally curved articulate hairs (vs. arbusculiform hairs in *B. arbusculifera*); hypanthium subglobose, 5–6 mm diam., truncate at base (vs. obconic, 3.5–5 mm diam., cuneate at base); calyx lobes 4–5 mm (vs. 7–11 mm) long; corolla 39 mm (vs. 30 mm) long, with tube 25 mm (vs. 15 mm) long and the lateral and ventral lobes 5–6 mm (vs. 10–11 mm) long; and dorsal anthers 6 mm (vs. 4.2 mm) long. Overall, on the basis of morphology and geographic proximity, *B. aspera* would appear to be the closest known relative of *B. arbusculifera*. The possibility of a developmental relationship between the articulate hairs of the former and the arbusculiform trichomes of the latter is intriguing and merits further study.

Paratypes. ECUADOR. **Carchi:** Cerro Golondrinas, valley bottom ca. 1.5 km NNE of summit, transect 2750–2, 00°51′N, 78°08′W, mossy upper montane forest, with tall trees to 30 m high near creek margin, stunted elfin forest on ridge crest, 2750 m, 25 July 1994, *B. Boyle, A. Boyle, J. Bradford & N. Skinner 3451* (MO, OSH, QCNE not seen).

2. Burmeistera brighamioides Lammers, sp. nov. TYPE: Ecuador. Carchi: further ascent of Río Verde past stream and waterfall entering from SW and continuing beyond principal drainage stream of large Cerro Golondrinas into drainage streams of medium Golondrinas mountains, 00°52′N, 78°07′W, forest area at stream embankment above stream and forest area, terminating at main stream division, 1200 m, 1 Dec. 1987, *W. S. Hoover 2182* (holotype, MO). Figure 2.

Species insignis egregie distincta ab omnibus caeteris speciebus *Burmeisterae* corolla longissima 78 mm longa duplo vel triplo longiore speciebus generis cognitis cum tubo gracili decemplo longiore quam latiore et calycis lobis ad marginem ciliatis cum trichomatibus isabellinis.

Suffruticose herb, 2 m tall; stems moderately leafy, 7 mm diam., the portions seen unbranched, glabrous; latex white. Lamina obovate, 10.5–21 × 5.2–11 cm, chartaceous; adaxial surface dull green, glabrous; abaxial surface dull white-green, pubescent along the veins with sordid yellow trichomes; margin minutely denticulate with remote dark callosities; apex rounded with a small acute tip; base cuneate; petiole 12–35 mm long, 1.5–3.5 mm diam., 1/5–1/10 as long as the lamina, glabrous. Flowers solitary in the upper leaf axils; pedicels straight, ascending, 62 mm long, 1.4 mm diam., ebracteolate, glabrous. Hypanthium oblate, 8 mm long, 9 mm diam., 1/10 as long as the corolla, glabrous; base truncate. Calyx lobes deltate, erect, 2.5–3 × 2.5 mm, ca. 1/3 as long as the hypanthium and 1/20 as long as the corolla tube; apex obtuse;

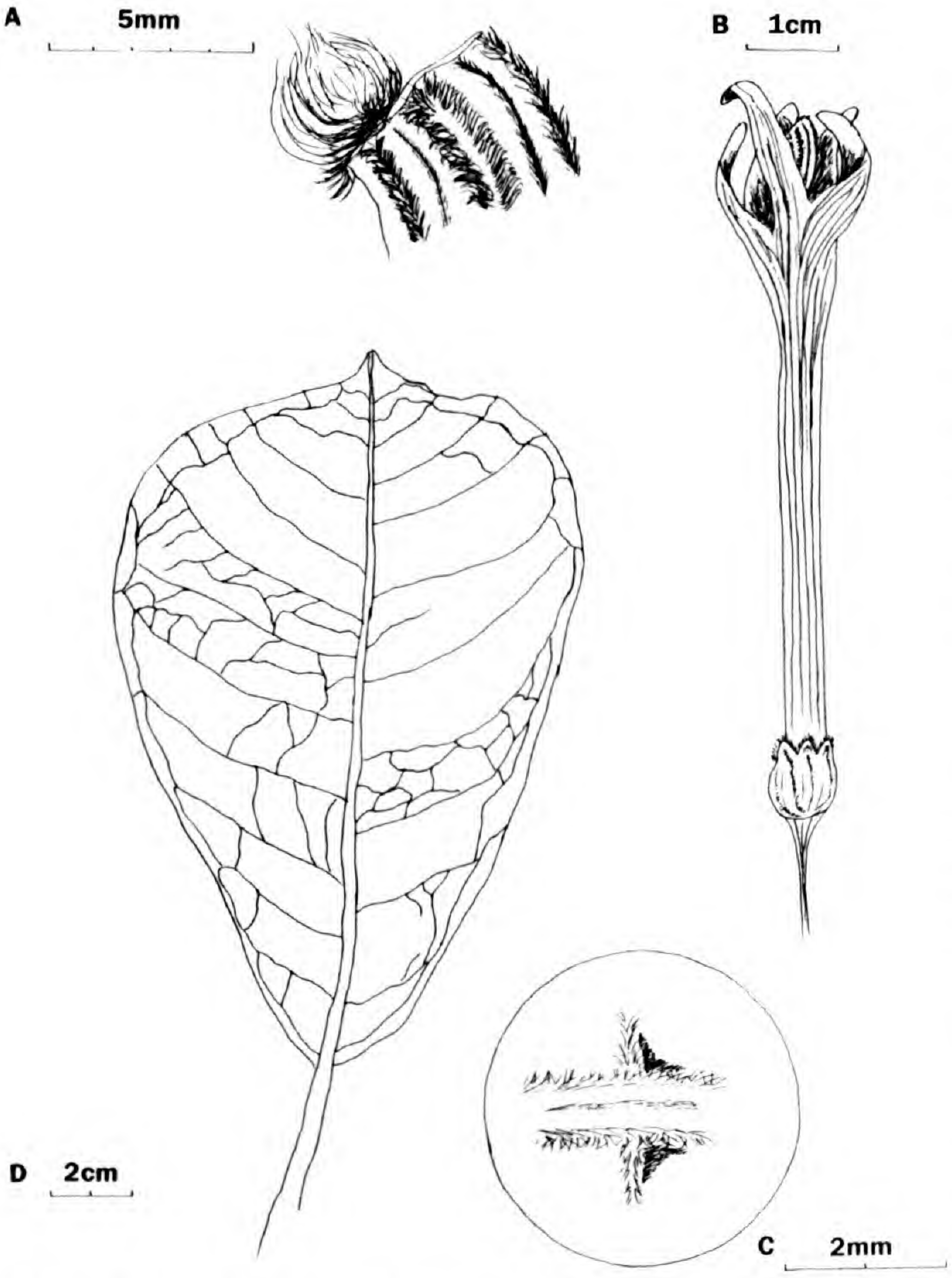

Figure 2. *Burmeistera brighamioides* Lammers. —A. Orifice of anther tube. —B. Flower. —C. Pubescence along abaxial midrib. —D. Leaf. (Drawn from the holotype, *Hoover 2182.*)

margin entire, densely ciliate with sordid yellow trichomes. Corolla tubular, bilabiate, green, 78 mm long, glabrous; tube suberect, 58 mm long, 5.5 mm diam. at base and middle, very gradually tapering to 8 mm diam. at mouth; dorsal lobes lanceolate, falcate, 20 × 4.5 mm, 1/3 as long as the tube, the apex acuminate; ventral lobes ovate, deflexed, 8 × 4 mm, the apex acuminate. Staminal column slightly exserted between the dorsal lobes; filament tube suberect, 64 mm long, 3 mm diam., glabrous; anther tube 4.5 mm diam., slightly deflexed, densely pubescent on the sutures with long spreading sordid yellow hairs; dorsal anthers 9 mm long, 1/7 as long as the filament tube; ventral anthers 7 mm long, with dense apical tufts of sordid yellow hairs 1.6–1.8 mm long. Fruit and seeds not seen, but apex of ovary flat.

Distribution, habitat, and phenology. Apparently endemic to northern Ecuador and known only from the type specimen.

Etymology. The specific epithet calls attention to the uncanny resemblance of the long slender flower and obovate leaf to those of the endemic Hawaiian genus *Brighamia* A. Gray (cf. Lammers, 1989).

Relationships. Burmeistera brighamioides differs from all previously known members of the genus in the incredible length of its corolla (but see below). Most congeners have corollas between 25 and 35 mm long; reported extremes are as little as 12 mm in *B. kirkbridei* Wilbur and as much as 45 mm in *B. utleyi* Wilbur. At 78 mm, the corolla of *B. brighamioides* is two to three times longer than the average congener. Furthermore, the tube of the corolla is extremely slender, about 10 times longer than broad, lacking basal or apical distensions, and is three times longer than the dorsal lobes; corolla tubes elsewhere in the genus are typically two to seven times longer than broad, distended at base and/or throat, and about as long as the dorsal lobes or up to twice as long. The dense edging of sordid yellow trichomes on the margin of the calyx lobes also appears to be unique within the genus.

On the basis of its densely bearded ventral anthers, *B. brighamioides* would be assigned to *Burmeistera* sect. *Barbatae.* Beyond that, it is not possible to infer a close relationship to any previously described species (but see below). In Jeppesen's (1981) treatment, it keys with difficulty to *B. ceratocarpa* H. Karsten of western Colombia and northern Ecuador (including Carchi), which shares with it an oblate, basally truncate hypanthium. However, that species differs in having leaves widest at or below the middle, longer (13–16 mm) linear glabrous calyx lobes, and shorter (5–6 mm) dorsal anthers, as well as by its far shorter (20–25 mm) corolla with basally distended tube 4–7 times longer than wide and about as long as the lobes.

3. Burmeistera fimbriata Lammers, sp. nov. TYPE: Colombia. Huila: W slope of Cordillera Oriental, 29 km above (SE of) Guadalupe on road to Florencia, ca. 1.5 km W of Caquetá Dept. limit, 01°55′N, 75°43′W, 2250–2350 m, 22 Mar. 1986, *B. A. Stein 3706* (holotype, MO). Figure 3.

Ab omnibus caeteris speciebus *Burmeisterae* foliorum marginibus fimbriatis differt; species sect. *Barbatarum* ob pedicellos bibracteolatos et calycis lobos basi connatos affinis *B. venezuelensi*, sed ab hac specie lamina elliptica basi attenuata, bracteolis longioribus 8–9 mm longis, hypanthio obconico, calycis lobis longioribus 26–30 mm longis distinguenda.

Fleshy herb to 1 m tall; stems moderately leafy, 6–6.5 mm diam., the portions seen unbranched, densely pubescent with long crisped septate trichomes; latex white. Lamina elliptic, 12–23 × 4.5–8.8 cm; adaxial surface dull green, sparsely pubescent with long crisped septate trichomes; abaxial surface dull white-green, sparsely pubescent with

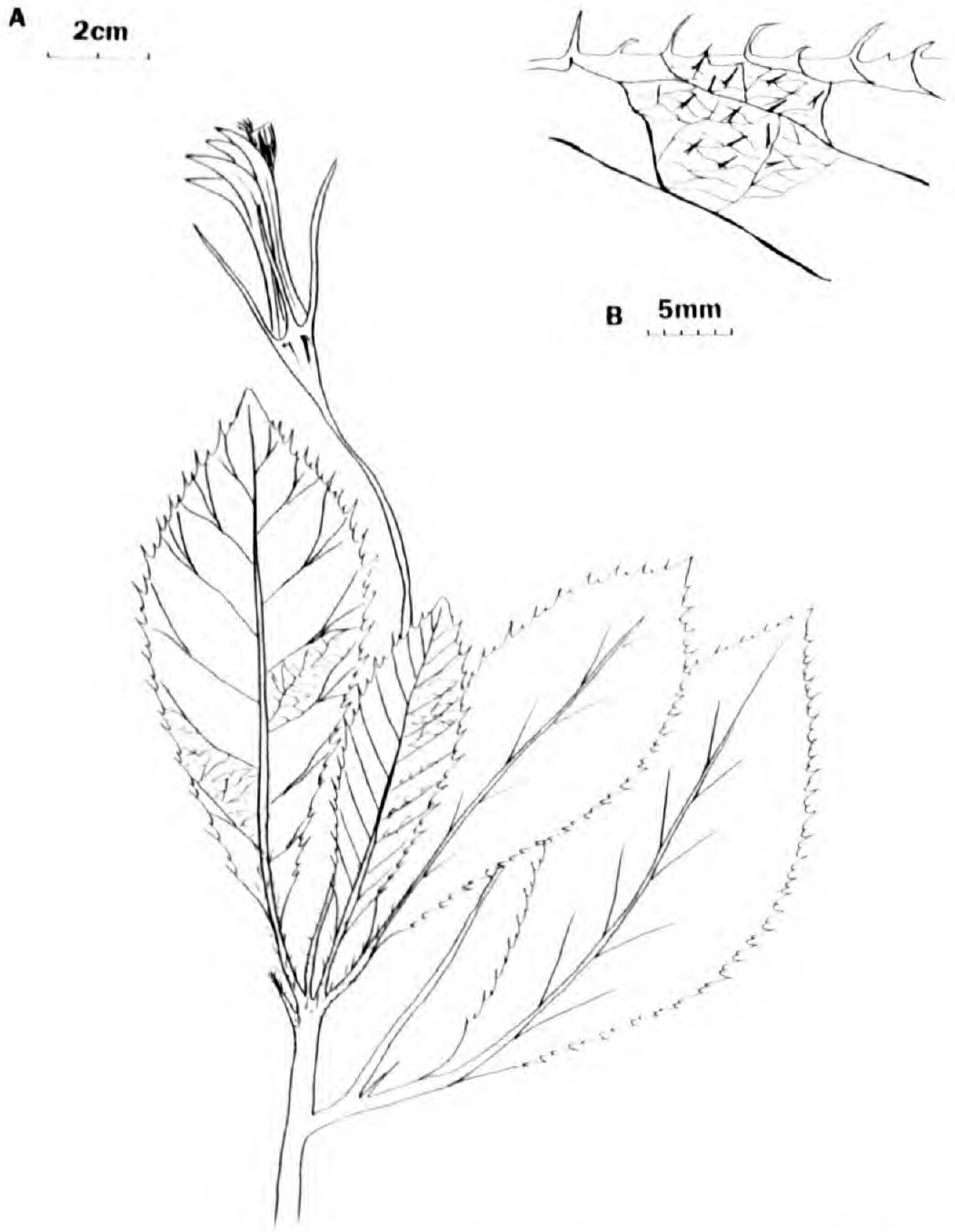

Figure 3. *Burmeistera fimbriata* Lammers. —A. Upper portion of stem with flower. —B. Leaf margin. (Drawn from the holotype, *Stein 3706*.)

long crisped septate trichomes; margin fimbriate with 4 to 8 fimbriae per cm, the fimbriae a mixture of short (0.8–1.5 mm long) and long (2.5–3.4 mm long) and each pubescent with long crisped septate trichomes; apex cuspidate; base attenuate; petiole 20–40 mm long, 1.8–2.2 mm diam., 1/5–1/8 as long as the lamina, pubescent with long crisped septate trichomes. Flowers solitary in the upper leaf axils; pedicels straight, ascending, 110–125 mm long, 1.2–1.3 mm diam., bibracteolate at base, pubescent with long crisped septate trichomes; bracteoles linear, 8–9 × 0.5 mm, the apex acuminate. Hypanthium obconic, 14 mm long, 9 mm diam., 1/3 as long as the corolla, pubescent with long crisped septate trichomes; base cuneate. Calyx lobes linear-triangular, erect or spreading slightly, 26–30 × 3 mm, about twice as long as the hypanthium and equaling the corolla tube, connate at base for 1–2 mm, pubescent with long crisped septate trichomes; apex acuminate; margin sparsely dentate with 6 to 10 long callosities on each side. Corolla bilabiate, green, 45 mm long, glabrous; tube suberect, 30 mm long, 9 mm diam. at base, gradually tapering to 4.5 mm diam. at middle before gradually increasing to 12 mm diam. at mouth; dorsal lobes triangular, falcate, 15 × 5 mm, half as long as the tube, the apex acuminate; lateral lobes triangular, deflexed, 13 × 6 mm, the apex acuminate. Staminal column slightly exserted between the dorsal lobes; filament tube suberect, 36 mm long; anther tube 5 mm diam., gently deflexed, its surfaces glabrous; dorsal anthers 10 mm long, ca. 1/4 as long as the filament tube; ventral anthers 8 mm long, their apex densely bearded with sordid hairs 1.5 mm long. Fruit and seeds not seen, but apex of ovary flat.

Distribution, habitat, and phenology. Apparently endemic to the western slope of the Cordillera Oriental in southwestern Colombia, and known only from the type specimen.

Etymology. The specific epithet alludes to the distinctive leaf margin; from the Latin adjective *fimbriatus*, fringed.

Relationships. On the basis of its densely bearded ventral anthers, *Burmeistera fimbriata* is referable to section *Barbatae*. Its fimbriate leaf margin is unique in the genus and thus not helpful in assessing relationships more precisely. However, its bibracteolate pedicels and basally connate calyx lobes, while unusual, are not unique. These features are found in two other members of section *Barbatae*: *B. caldasensis* (Gleason) F. E. Wimmer of west-central Colombia and *B. venezuelensis* Lammers of southwestern Venezuela. Like *B. fimbriata*, these two species are fleshy understory herbs up to 1 m tall with toothed calyx lobes equaling or exceeding the hypanthium. Based on these similarities, it seems clear that *B. caldasensis*, *B. fimbriata*, and *B. venezuelensis* form a close-knit if not monophyletic group of species.

Of the two previously described species, *B. venezuelensis* seems more similar to the novelty, resembling it in its septate trichomes, large leaves (lamina 8.5–11.5 × 4.5–6.8 cm), and long pedicels (80–135 mm). In contrast, the other previously described species, *B. caldasensis*, bears only unicellular trichomes and has smaller leaves (lamina 4.5–6.5 × 2–2.5 cm) and shorter pedicels (4 cm long). However, *B. caldasensis* does resemble the novelty in its longer bracteoles (8 mm long) and obconic hypanthium; *B. venezuelensis* has bracteoles just 2.7–4 mm long and an oblate hypanthium.

4\. **Burmeistera hippobromoides** Lammers, sp. nov. TYPE: Colombia. Valle: Yatacué, CVC camp at Anchicaya, 03°40′N, 76°50′W, mature premontane wet forest, 700–900 m, 25 Feb. 1983, *A. Gentry, A. Juncosa & F. Gomez 40746* (holotype, MO). Figure 4.

Species *Burmeisterae* sect. *Barbatarum* ob corollam gracilem longissimam affinis *B. brighamioidi*, sed ab hac specie laminis oblanceolatis angustioribus 3.8–4.4 cm latis, hypanthio obconico angustiore 5 mm diametro basi cu-

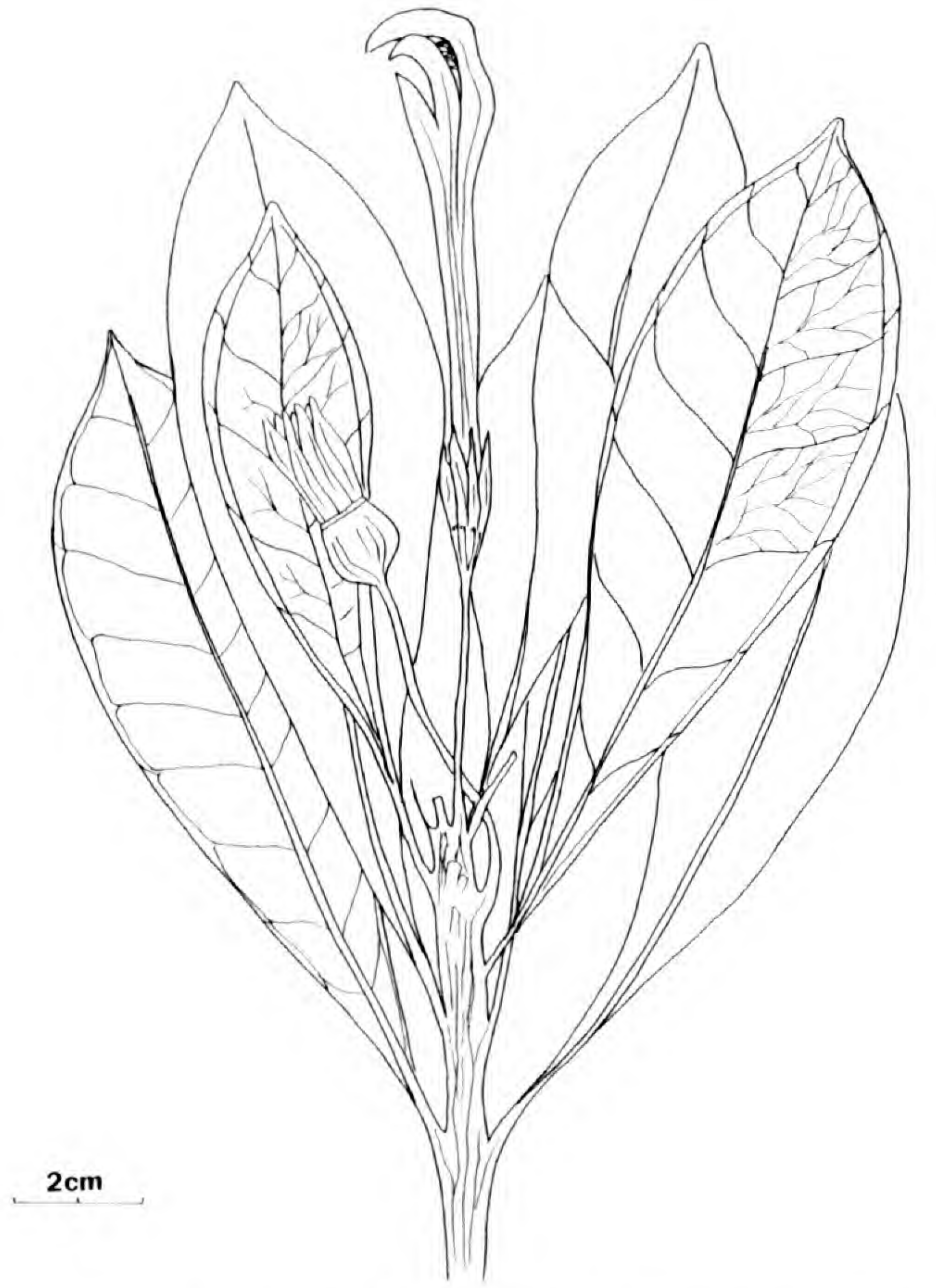

Figure 4. *Burmeistera hippobromoides* Lammers. (Drawn from the holotype, *Gentry et al. 40746*).

neato, calycis lobis lanceolatis vel anguste triangularis longioribus 13.5–16 mm longis ad marginem glabris, et corolla pubescenti longiore 92 mm longa statim distinguenda.

Shrub, 2 m tall; stems moderately leafy, 9 mm diam., the portions seen unbranched, sparsely short-pubescent. Lamina oblanceolate, 12–15 × 3.8–4.4 cm; adaxial surface dark green, glabrous; abaxial surface green, sparsely short-pubescent; margin subentire, somewhat sinuate; apex acute or cuspidate; base attenuate; petiole 10–18 mm long, 1.5–1.9 mm diam., 1/8–1/12 as long as the lamina, sparsely short-pubescent. Flowers solitary in the upper leaf axils; pedicels straight, ascending, 35–60 mm long, 1.4–1.5 mm diam., ebracteolate, sparsely short-pubescent. Hypanthium obconic, 9 mm long, 5 mm diam., 1/10 as long as the corolla, sparsely short-pubescent; base cuneate. Calyx lobes lanceolate or narrowly triangular, erect, 13.5–16 × 2–3.5 mm, ca. 1 1/2× as long as the hypanthium and 1/4–1/5 as long as the corolla tube; apex acuminate; margin entire. Corolla tubular, bilabiate, green, 92 mm long, densely short-pubescent; tube suberect, 67 mm long, 4.5 mm diam. at base and middle, very gradually tapering to 8 mm diam. at mouth; dorsal lobes lanceolate or narrowly triangular, falcate, 25 × 4–4.5 mm, ca. 1/3 as long as the tube, the apex acuminate; lateral lobes narrowly triangular, falcate, 18 × 3–3.5 mm, the apex acuminate; ventral lobe narrowly triangular, deflexed, 10 × 4.5 mm, the apex acuminate. Staminal column slightly exserted between the dorsal lobes; filament tube suberect, 77 mm long; anther tube 5 mm diam., slightly deflexed; dorsal anthers 9 mm long, ca. 1/8 as long as the filament tube; ventral anthers with dense apical tufts of white curly hairs 2 mm long. Berry globose, 12 mm diam.; seeds oblong, 0.8 mm long, 0.3 mm diam., honey brown, the testa minutely reticulate.

Distribution, habitat, and phenology. Apparently endemic to the Cordillera Occidental of southwestern Colombia and known only from the type specimen.

Etymology. It seems appropriate to christen the only two species of *Burmeistera* with long slender flowers with the names of the only two genera in the subfamily with long slender flowers. Just as *B. brighamioides* takes its name from the Hawaiian endemic *Brighamia*, this novelty takes its name from the Jamaican endemic *Hippobroma* G. Don.

Relationships. The discovery of one species of *Burmeistera* with inordinately long flowers, *B. brighamioides*, was quite remarkable. The discovery of a second species with such flowers taxes credulity. Like Ecuadorean *B. brighamioides* (see above), *B. hippobromoides* of Colombia differs from all other known members of the genus in bearing a corolla two to three times longer than the average congener, with a slender tube that is almost three times longer than the dorsal lobes and lacks basal or apical distensions. The two species are also similar in length and posture of their pedicels, diameter of the corolla tube, size and shape of the corolla lobes, and size and apical pubescence of the anther tube. Both are members of *Burmeistera* sect. *Barbatae*.

However, the Colombian novelty differs from *B. brighamioides* in a number of features. The leaves of *B. hippobromoides* are oblanceolate (vs. obovate in *B. brighamioides*) and narrower (3.8–4.4 cm wide vs. 5.2–11 cm). The hypanthium is obconic (vs. broadly ovoid) and narrower (5 mm diam. vs. 9 mm), with a cuneate (vs. truncate) base. The calyx lobes are lanceolate or narrowly triangular (vs. deltate) and far longer (13.5–16 mm vs. 2.5–3 mm), and the margin lacks the dense edging of sordid yellow trichomes seen in *B. brighamioides*. The corolla is even longer than that of *B. brighamioides* (92 mm vs. 78 mm), and densely short-pubescent (vs. glabrous).

In light of the unique corolla they share, it seems reasonable to regard *B. brighamioides* and *B. hippobromoides* as sister-species, i.e., to hypothesize that their unique floral morphology has evolved just

Figure 5. *Burmeistera knaphusii* Lammers. (Drawn from the holotype, *Hoover 2276*.)

once in the genus. One is further tempted to hypothesize that this extraordinary shift in corolla morphology is correlated with a shift in pollen vector. Unfortunately, almost nothing is known about pollination in *Burmeistera*. Vogel (1969) documented chiropterophily in *B. fuscoapicata* F. E. Wimmer, while Luteyn (1986) suggested that *B. pinnatisecta* Luteyn was hummingbird pollinated. Conceivably, the long slender straight corollas of *B. brighamioides* and *B. hippobromoides* could be an adaptation to pollination by hawkmoths (Lepidoptera: Sphingidae), a syndrome hypothesized for both *Brighamia* and *Hippobroma* (cf. Lammers, 1989).

5. Burmeistera knaphusii Lammers, sp. nov. TYPE: Ecuador. Carchi: mountain E & NE, forest area along slope of mountain ENE of Rafael Quindí's mountain *finca* and above Río Verde including top of mountain which is similar in geologic format to Golondrinas Mountains, 00°52′N, 78°07′W, 1870–2400 m, 3 Dec. 1987, *W. S. Hoover 2276* (holotype, MO). Figure 5.

Species *Burmeisterae* sect. *Barbatarum* affinis *B. huacamayensi*, sed ab hac specie septatis trichomatibus longiusculis patentibus in caulibus pedicellisque, laminis ovatis vel anguste ovatis brevioribus 2.5–5 cm longis apice acuminatis basi rotundis vel truncatis, pedicellis brevioribus 10–12 mm longis, et floribus parvioribus cum hypanthio 3.5–4 mm longo, corolla 29–32 mm longa, corollae tubo 3–3.8 mm basi diametro, et lobis ventralibus 4.5–6 mm longis distinguenda.

Hemiepiphytic liana to 4 m long; stems moderately leafy, 1.4–2.2 mm diam., the portions seen unbranched, pubescent with long spreading septate trichomes. Lamina ovate or narrowly ovate, 2.5–5 × 1.2–2.2 cm, subcoriaceous; adaxial surface dull green, glabrous; abaxial surface dull pale green, pubescent primarily on the veins with long spreading septate trichomes; margin minutely crenulate with remote callosities, a pair toward the apex especially prominent; apex acuminate; base rounded or truncate; petiole 2–3.5 mm long, 0.5 mm diam., 1/12–1/20 as long as the lamina, pubescent with long spreading septate trichomes. Flowers solitary in the upper leaf axils; pedicels straight or somewhat curved, ascending, 10–12 mm long, 0.5–0.6 mm diam., ebracteolate, pubescent with long spreading septate trichomes, at least at base. Hypanthium obconic, 3.5–4 mm long, 1.8–3 mm diam., 1/8 as long as the corolla, glabrous or with a few scattered long spreading septate trichomes; base cuneate, ± distinct from pedicel. Calyx lobes narrowly triangular or linear-triangular, reflexed, 4–6 × 0.7–1.3 mm, as long as the hypanthium up to half again as long, 1/5–1/3 as long as the corolla tube, glabrous or with a few scattered long spreading septate trichomes; apex acute; margin denticulate with 2–3 callosities on each side. Corolla bilabiate, pale green faintly suffused with lavender or red, 29–32 mm long, glabrous; tube suberect, 19–21 mm long, 3–3.8 mm diam. at base, gradually tapering to 2.2–3 mm diam. at middle and 2.8–3.6 mm diam. at mouth; dorsal lobes lanceolate, spreading, 10–12 × 3–3.7 mm, 1/2–3/5 as long as the tube, the apex acuminate; lateral lobes ovate, deflexed, 5–6 × 2.2–3.5 mm, the apex acuminate; ventral lobe 4.5–5 × 1.8–2.6 mm, the apex acuminate. Staminal column slightly exserted between the dorsal lobes; filament tube suberect, 24–28 mm long, 0.8–1.1 mm diam. at mouth of corolla, flaring to 1.3–1.5 mm diam. at base of anther tube, glabrous; anther tube 2.5–3 mm diam., deflexed, its surfaces glabrous; dorsal anthers 3.2–4.5 mm long, 1/5–1/10 as long as the filament tube; ventral anthers 2.2–3 mm long, their apex sparsely pubescent with soft wispy hairs 0.2–0.4 mm long. Fruit and seeds not seen, but apex of ovary flat.

Distribution, habitat, and phenology. Apparently endemic to northern Ecuador, collected twice in the Cerro Golondrinas of Carchi. Growing in montane forests at elevations of 1870–2430 m, and flowering during December.

Etymology. This species is respectfully dedicated to the memory of George Knaphus (1924–2000), botanist and educator extraordinaire. From

1965 until his death, "Dr. K." was professor of botany at Iowa State University. In classroom, laboratory, and field, he opened the eyes of thousands of undergraduate students to the marvels of the plant and fungal kingdoms. Furthermore, his personal approach to academic advising and genial sponsorship of Botany Club (with colleague Lois H. Tiffany) provided a level of support, guidance, and encouragement to young men and women that is rare indeed in today's academic world. The epithet coined here is in accordance with Recommendation 60C.2 of the *International Code of Botanical Nomenclature* (ICBN; Greuter et al., 2000). Although his surname resembles a second declension Latin noun, it is actually of Norwegian origin; the initial *k* is pronounced and *ph* is not a digraph.

Relationships. On the basis of its apically pubescent ventral anthers, *Burmeistera knaphusii* is assigned to section *Barbatae.* In Jeppesen's (1981) treatment, it keys with difficulty to *B. huacamayensis* Jeppesen, a member of that section endemic to the Cordillera de Huacamayos in the Ecuadorean province of Napo. The two species share a number of features, including habit; hypanthium shape; size, shape, and reflexion of the calyx lobes; color and shape of the corolla; and various aspects of the staminal column. However, *B. huacamayensis* differs from the novelty in its lack of hairs on stems and pedicels, longer (9–12 cm vs. 2.5–5 cm in *B. knaphusii*) lanceolate (vs. ovate or narrowly ovate) leaves that are cuspidate (vs. acuminate) at apex and cuneate or obtuse (vs. rounded or truncate) at base; longer (6–7 cm vs. 1–1.2 cm) pedicels; and generally larger flowers, with the hypanthium 5–6 mm long and corolla 37 mm long with the tube 6 mm in diameter at base and the ventral lobes 9 mm long. Overall, *B. huacamayensis* would appear to be the closest known relative of *B. knaphusii.*

Paratype. ECUADOR. **Carchi:** forest and ridge area above Río Verde and ridge flanking medium Cerro Golondrinas, 00°52′N, 78°07′W, 2070–2430 m, 4 Dec. 1987, *W. S. Hoover 2322* (MO).

6. Burmeistera smaragdi Lammers, sp. nov. TYPE: Ecuador. Esmeraldas: Quinindé, Bilsa Biological Station, Montañas de Mache, 35 km W of Quinindé, 5 km W of Santa Isabel, road between the station and the SE Ridge Trail, 00°21′N, 79°44′W, premontane wet forest, 400–600 m, 19 Sep. 1994, *M. S. Bass & N. Pittman 22* (holotype, OSH; isotypes, MO, QCNE not seen). Figure 6.

Species *Burmeisterae* sect. *Burmeisterae* affinis *B. glabratae* et *B. truncatae*, sed ab his speciebus petiolis brevioribus 3–7 mm longis, foliorum apice caudato, hypanthio anguste obconico basi attenuato, corolla breviore 24–30 mm longa, dorsalibus antheris brevioribus 6–7 mm longis basi crinito in suturis, et antheris omnibus ad apicem glabris distinguenda.

Figure 6. *Burmeistera smaragdi* Lammers. (Drawn from the holotype, *Bass & Pittman 22.*)

Scandent shrub, 0.5–1 m tall; stems moderately leafy, 1.3–2 mm diam., the portions seen unbranched, glabrous; latex white. Lamina narrowly elliptic or narrowly oblong, 6.5–12.5 × 2–4.2 cm, chartaceous; adaxial surface dull olive green, glabrous; abaxial surface dull white-green, the midrib pubescent with long septate hairs; margin subentire or minutely denticulate with remote tiny dark callosities; apex caudate; base cuneate; petiole 3–7 mm long, 0.6–0.8 mm diam., 1/12–1/20 as long as the lamina, pubescent with long septate hairs. Flowers solitary in the upper leaf axils; pedicels straight, ascending, 37–66 mm long, 0.8–1.4 mm diam., ebracteolate, glabrous. Hypanthium narrowly obconic, 6–11 mm long, 4.5–5.5 mm diam., 1/4–2/5 as long as the corolla, glabrous; base cuneate, tapering imperceptibly into the pedicel. Calyx lobes narrowly triangular or linear-triangular, straight, ascending or spreading, 12–19 × 1–2.5 mm, 2–3 times as long as the hypanthium, equaling to 3/4 again as long as the corolla tube, glabrous; apex acuminate; margin minutely denticulate with 3 to 5 tiny dark callosities on each side. Corolla bilabiate, green or cream-colored, often tinged or striate with maroon or purple, 24–30 mm long, glabrous; tube suberect, 11.5–13 mm long, 3.5–4 mm diam. at the abruptly inflated base, 2.3–2.5 mm diam. at middle, gradually flaring to 2.5–3.3 mm diam. at mouth; dorsal lobes lanceolate, falcate, 12–18.5 × 2.3–4 mm, about as long as the tube to 2/3 again as long, the apex acuminate; lateral lobes lanceolate, deflexed, 8–13 × 2.2–3 mm, the apex acuminate; ventral lobe 6.5–11.5 × 2.2–3 mm, the apex acuminate. Staminal column exserted between the dorsal lobes; filament tube suberect, 21–21.5 mm long, 1.2–1.3 mm diam. at mouth of corolla, flaring to 2.7–3 mm diam. at base of anther tube, glabrous; anther tube 3.5–4.5 mm diam., slightly deflexed, pubescent at the base of the dorsal sutures with long crisped hairs, the orifice glabrous; dorsal anthers 6–7 mm long, 1/5–3/10 as long as the filament tube; ventral anthers 3.5–4.5 mm long. Fruit and seeds not seen, but apex of ovary flat.

Distribution, habitat, and phenology. Apparently endemic to northern Ecuador, where it has been collected several times at the Bilsa Biological Station in the Mache Mountains of Esmeraldas. It grows in wet premontane forests at elevations of 400–600 m, and flowers during September.

Etymology. The specific epithet is the genitive of the Latin noun *smaragdus*, emerald, in reference to the Ecuadorean province to which the species is apparently endemic.

Relationships. With its glabrous anther tube orifice, *Burmeistera smaragdi* is referable to section *Burmeistera*. In Jeppesen's (1981) treatment, it keys to two species of that section: *B. glabrata* (Kunth) Bentham & Hooker ex B. D. Jackson, which is found from central Colombia to southeastern Ecuador; and *B. truncata* Zahlbruckner, endemic to the Ecuadorean province of Pichincha. These three species share a number of features, including general size and shape of their leaves, pedicels shorter than the subtending leaf, erect or spreading calyx lobes not overlapping at base and longer than both the hypanthium and corolla tube, and glabrous green corollas often suffused with darker hues. However, *B. glabrata* and *B. truncata* differ from *B. smaragdi* in their longer petioles (1–2 cm vs. 0.3–0.7 cm in *B. smaragdi*); acute or acuminate (vs. caudate) leaf apices; globose, urceolate, or semiovoid hypanthium rounded or obtuse at base (vs. narrowly obconic and attenuate at base); corolla 30–37 mm long (vs. 24–30 mm long); and anther tube glabrous on the surface (vs. pubescent at base of dorsal sutures) and villous at the apex (vs. glabrous), with the dorsal three 8–10 mm long (vs. 6–7 mm long). Overall, *B. smaragdi* seems most closely related to *B. glabrata* and *B. truncata*.

Paratypes. ECUADOR. **Esmeraldas:** Quinindé, Bilsa Biological Station, Montañas de Mache, 20 km NW of Quinindé and 3 km W of Santa Isabela, southern boundary, SW of cabin, 00°22′N, 79°45′W, premontane wet forest, open area, 600 m, 24 Sep. 1994, *J. R. Abbott 15243* (MO, QCNE not seen); Quinindé, Bilsa Biological Station, Mache Mountains, 35 km W of Quinindé, 5 km W of Santa Isabel, 00°21′N, 79°44′W, premontane wet forest, on edge of clear cut and mature forest, 400–600 m, 13 Sep. 1994, *J. L. Clark & B. Adnepos 27* (MO, OSH, QCNE not seen); Quinindé Cantón, Mache-Chindul Ecological Reserve, Bilsa Biological Station, Mache mountains, 35 km W of Quinindé, 5 km W of Santa Isabel, 00°21′N, 79°44′W, premontane wet forest, 500 m, 24 Sep. 1996, *J. L. Clark 2902* (MO, OSH, QCNE not seen).

II. Centropogon C. Presl, Prodr. Monogr. Lobel. 48. 1836. TYPE (lectotype, designated by Pfeiffer (1873: 650)): *Lobelia surinamensis* L. [= *Centropogon cornutus* (L.) Druce].

With the addition of the six novelties described here, *Centropogon* comprises 222 species, distributed from southern Mexico to Bolivia and Brazil and in the Lesser Antilles (Lammers, 1998a). The genus differs from *Burmeistera* and resembles *Siphocampylus* in its usually bibracteolate pedicels; commonly red, orange or yellow (sometimes green or white) corolla; the occluded orifice of the anther tube; and isodiametric seeds. *Centropogon* and *Siphocampylus* are distinguished on the basis of fruit type: baccate, from a flat-topped ovary, in *Centropogon*; capsular, from an ovary conical at apex, in *Siphocampylus*.

Centropogon has been divided (Lammers, 1998a) into five sections primarily on the basis of floral morphology and pubescence: *Centropogon*, *Siphocampyloides* Bentham (divided into subsects. *Brevilimbati* F. E. Wimmer and *Peruviani* McVaugh), *Wimmeriopsis* McVaugh (divided into subsects. *Falcati* McVaugh and *Colombiani* McVaugh), *Burmeisteroides* Gleason, and *Niveopsis* Lammers. A key to these taxa is provided by Lammers (1998a), and their salient features are summarized here.

Three major types of gross floral morphology may be recognized in *Centropogon*: (1) "short-lobed"—corolla tube 3–8 times longer than broad and 2–5 times longer than the triangular or oblong lobes; (2) "long-lobed"—corolla tube 3–8 times longer than broad and about as long as the triangular or oblong lobes; and (3) "stout"—corolla tube twice as long as broad and four times longer than the deltate lobes. The "short-lobed" corolla type characterizes section *Centropogon*, section *Wimmeriopsis*, and subsection *Brevilimbati*; the "long-lobed" corolla type characterizes section *Burmeisteroides* and subsection *Peruviani*; and the "stout" corolla type is unique to section *Niveopsis*.

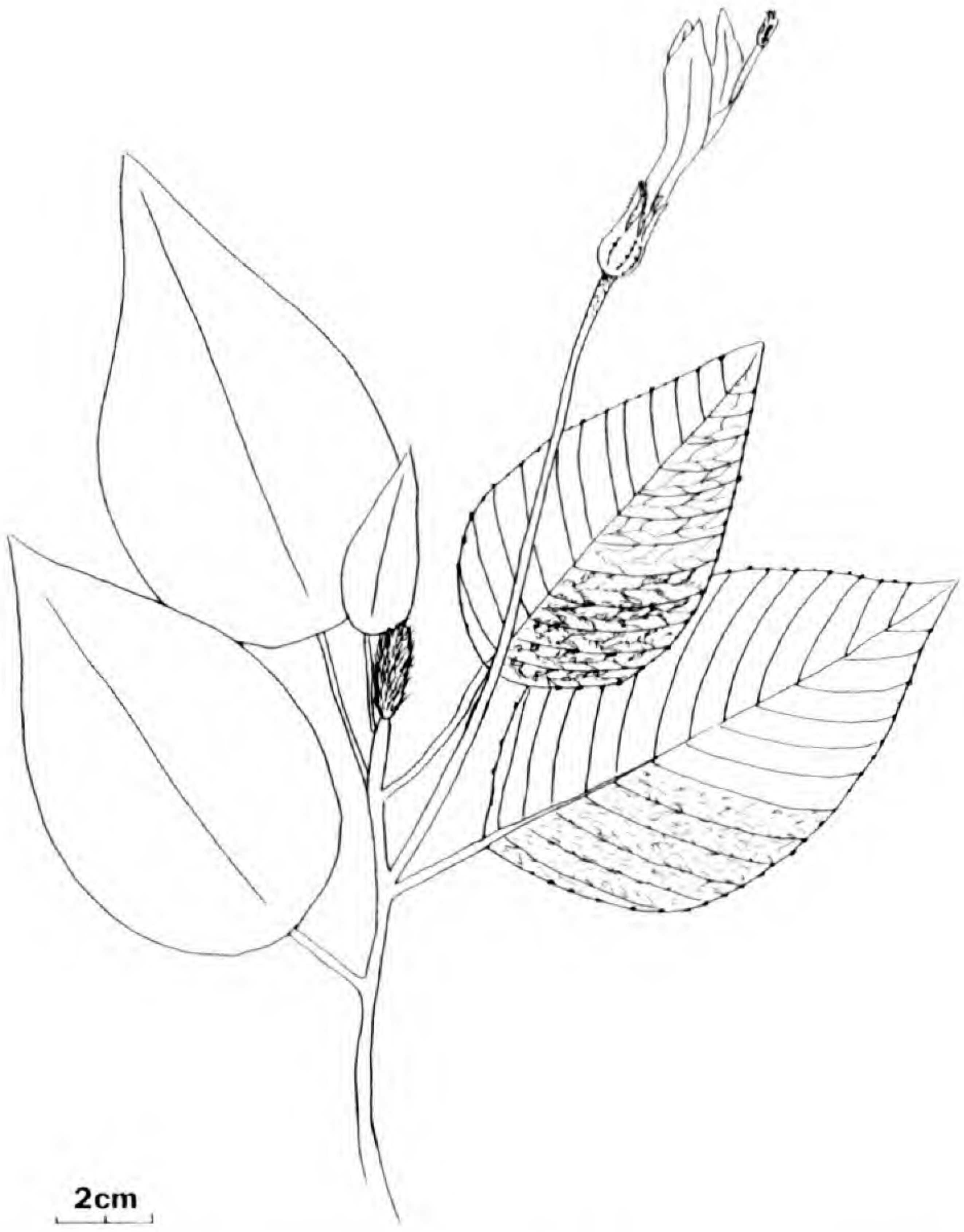

Figure 7. *Centropogon beniteziae* Lammers. (Drawn from the holotype, *Luteyn & Cotton 9709*.)

Two types of pubescence are important in the sectional classification of *Centropogon*: the tuft of trichomes at the apex of the ventral pair of anthers, and those forming the indumentum on stems, leaves, hypanthia, calyx lobes, and corollas. In the autonymic section, the apical anther trichomes are concrescent into a distinct triangular scale; these hairs are free and brush- or beard-like in the remaining sections. In section *Siphocampyloides* and section *Niveopsis*, the surface indumentum is composed primarily of arbusculiform (dendritic) trichomes; in the other sections, any hairs that occur are simple (with one exception, described below).

1. **Centropogon beniteziae** Lammers, sp. nov. TYPE: Venezuela. Trujillo: Dpto. Boconó, Páramo Guaramacál, 20–21 km beyond jct. with hwy. NE of Boconó, 09°13′N, 70°13′W, shaded very wet streambed with large boulders, infrequent, 2640–2700 m, 14 Mar. 1984, *J. L. Luteyn & E. Cotton 9709* (holotype, OSH; isotypes, NY, PORT not seen, VEN not seen). Figure 7.

Species *Centropogonis* subsect. *Brevilimbatorum* affinis *C. elmano* et *C. ewanio*, sed ab his speciebus lamina elliptica, pedicellis longioribus 5.8–12.5 cm longis, et floribus majoribus cum hypanthio 6–8 mm longo 8–10 mm diametro, calycis lobis 12–29 mm longis, corolla 48–60 mm longa tubo 35–45 mm longo ad constrictionem 3–3.8 mm diametro ad orem 7.7–10.5 mm diametro dorsalibus lobis 3–5 mm latis ventralibus lobis 2.8–3.5 mm latis, et tubo antherarum glabro distinguenda.

Erect or scandent suffruticose herb, 0.5–1.5 m tall; stems moderately leafy, 2–3.7 mm diam. above, up to 6 mm diam. below, branched, pubescent with arbusculiform hairs toward apex, glabrate below; latex white. Lamina elliptic or widely elliptic (rarely ovate), 5–15.5 × 2.5–7.7 cm, chartaceous; adaxial surface dull dark green, sparsely pubescent (densest on midrib) with simple or sparingly branched hairs; abaxial surface dull green often suffused with maroon, densely pubescent with arbusculiform hairs; margin denticulate or serrulate with dark callosities; apex acuminate; base cuneate; petiole 10–30 mm long, 0.9–1.5 mm diam., 1/4–1/8 as long as the lamina, pubescent with arbusculiform hairs. Flowers solitary in the upper leaf axils; pedicels ascending, 58–125 mm long, 0.9–1.4 mm diam., bibracteolate at or just above the base, pubescent with arbusculiform hairs. Hypanthium subglobose or very widely depressed globose, 6–8 mm long, 8–10 mm diam., 1/6–1/9 as long as the corolla, pubescent with arbusculiform hairs. Calyx lobes narrowly triangular or linear-triangular, ascending, 12–29 × 1.5–3 mm, half again as long to almost 4 times as long as the hypanthium, 1/3–1/2 as long as the corolla tube, pubescent with arbusculiform hairs; apex acuminate; margin entire or serrulate denticulate with 1 to 5 tiny curved teeth on each side. Corolla tubular, somewhat ventricose, orange, red, or dark red, paler or yellow within, 48–60 mm long, pubescent with arbusculiform hairs; tube suberect, 35–45 mm long, 5–7 mm diam. at the base, narrowing abruptly to 2.5–3.8 mm diam. just above the base, then flaring gradually to 7.5–10.5 mm diam. just below the mouth; dorsal lobes narrowly triangular, falcate, 13–17 × 3–5 mm, ca. 1/3–2/5 as long as the tube, the apex acuminate; ventral lobes lanceolate, deflexed, 9–12 × 2.8–3.5 mm, the apex acuminate. Staminal column somewhat exserted between the dorsal lobes; filament tube suberect, 43–54 mm long, 1–1.4 mm diam., glabrous or sparsely pubescent with simple white crisped hairs; anther tube 2–2.6 mm diam., suberect, its surfaces glabrous; dorsal anthers 7–9 mm long, 1/5–1/7 as long as the filament tube; ventral anthers 6–7 mm long, pubescent at apex with tufts of stiff yellow-white hairs 1.2–1.7 mm long. Berry very widely depressed globose, 8–12 mm long, 12–15 mm diam., the calyx lobes tardily deciduous; seeds ellipsoid, golden brown, 1.4 mm long, 0.4 mm diam., the testa minutely reticulate.

Distribution, habitat, and phenology. Apparently endemic to western Venezuela, where in recent years it has been collected frequently in wet rocky stream-beds, on steep roadside embankments, and in montane forest and subpáramo habitats in the area around Guaramacál and Boconó in the state of Trujillo, at elevations of 1600–3175 m. Plants flower from late October to July, and bear fruit from April to July.

Etymology. This species is named in honor of Carmen E. Benítez de Rojas (b. 1937) of the Universidad Central de Venezuela in Maracay, curator of the Herbario Victor Manuel Badillo (MY). Dra. Benítez is an authority on the Venezuelan flora, especially Solanaceae, and has been very helpful to me on several occasions in locating material of Venezuelan Lobelioideae. Earlier authors have referred to *C. beniteziae* as "Centropogon sp." (Ortega et al., 1987) and "Centropogon sp. A" (Dorr et al., 2000).

Relationships. With its arbusculiform trichomes and "short-lobed" corolla, *Centropogon beniteziae* is clearly a member of section *Siphocampyloides*, subsection *Brevilimbati*. However, it is unusual among the members of that subsection in having at least some simple hairs on the adaxial leaf surface. Most *Brevilimbati* bear only arbusculiform hairs on vegetative surfaces; just two previously known species bear simple hairs on the adaxial leaf surface: *C. ewanii* F. E. Wimmer of western Venezuela and *C. heteropilis* F. E. Wimmer of Colombia. In fact, many of the specimens of *C. beniteziae* cited here were originally identified as *C. ewanii* (cf. Dorr et al., 2000). However, in *C. ewanii* and *C. heteropilis*, all of the hairs on the adaxial surface are strictly simple, while *C. beniteziae* is variable, showing a continuum from simple to sparingly branched hairs, often on a single leaf. Furthermore, these two species collectively differ from *C. beniteziae* in their shorter pedicels (4–6 cm vs. 5.8–12.5 cm in *C. beniteziae*), shorter calyx lobes (4–7 mm vs. 12–29 mm), shorter corollas (35–44 mm vs. 48–60 mm), and pubescent (vs. glabrous) anthers.

Centropogon beniteziae is also quite similar to another western Venezuelan endemic, *C. elmanus* F. E. Wimmer. Both species are suffruticose plants with dark-callose leaf margins, denticulate linear calyx lobes 1.5 to 4 times longer than the depressed globose hypanthium, and constricted orange corollas. However, *C. elmanus* differs in its oblong leaves (vs. elliptic in *C. beniteziae*) bearing only arbusculiform trichomes (vs. some simple hairs adaxially), shorter pedicels (5 cm vs. 5.8–12.5 cm), and smaller flowers. Specifically, the hypanthium of *C. elmanus* is 5 mm long (vs. 6–8 mm in *C. beniteziae*) and 7 mm diam. (vs. 8–10 mm diam.), with calyx lobes 10 mm long (vs. 12–29 mm long) and 1 mm wide (vs. 1.5–3 mm). The corolla is 43–44 mm long (vs. 48–60 mm); its tube 30 mm long (vs. 35–45 mm), 2 mm diam. at the constriction (vs. 2.5–3.8 mm), and 5–6 mm at the mouth (vs. 7.5–10.5 mm); and its lobes 2 mm wide (vs. 3–5 mm in the dorsals, 2.8–3.5 mm in the ventrals). The staminal column is long exserted from the corolla (vs. scarcely exserted) and the anther tube long pilose on the dorsal sutures (vs. glabrous). On the basis of morphology and geography, *C. elmanus* and *C. ewanii* appear to be the closest known relatives of *C. beniteziae*.

Paratypes. VENEZUELA. **Trujillo:** Distr. Boconó, Páramo de Guaramacál, SE of television towers, 09°14′N, 70°11′W, along stream cascading over rocks, 2000 m, 28 Apr. 1988, *L. J. Dorr, L. C. Barnett, N. Cuello & G. M. Diggs, Jr. 4987* (PORT); Distr. Boconó, Páramo de Guaramacál, W of road summit, 09°14′N, 70°11′W, 2800–2900 m, 28 Apr. 1988, *L. J. Dorr, L. C. Barnett, N. Cuello & G. M. Diggs, Jr. 5015* (NY not seen, PORT); Mun. Boconó, Parque Nacional Guaramacál, road from Boconó to Guaramacál, SE of Boconó, N slope of mountain, 09°13′N, 70°12′W, montane forest, 2550 m, 7 July 1995, *L. J. Dorr & L. C. Barnett 8043* (PORT); Mun. Boconó, Parque Nacional Guaramacál, road from Boconó to Guaramacál, SE of Guaramacál, N slope of mountain, 09°13′N, 70°12′W, along stream, 2650 m, 20 July 1995, *L. J. Dorr & L. C. Barnett 8180* (F, NY not seen, PORT not seen, US); Mun. Boconó, Parque Nacional Guaramacál, road from Boconó to Guaramacál, SE of Boconó, S slope of mountain, 09°13′N, 70°12′W, montane forest, 2500 m, 22 July 1995, *L. J. Dorr & L. C. Barnett 8240* (F, NY not seen, PORT not seen, US); Dpto. Boconó, Parque Nacional Guaramacál, trail from La Laguna de las Aguas Negras to La Qda. Salvaje, N slope of mountain, 09°19′N, 70°11′W, 27 Oct. 1998, *L. J. Dorr, E. Briceño, G. Briceño & R. Cracas 8291* (PORT); Mun. Boconó, Parque Nacional Guaramacál, road from Boconó to Guaramacál, SE of Boconó, ca. 15 km from the post of the park guards, S slope of mountain, 09°13′N, 70°12′W, montane and lower montane forest, 3 Nov. 1998, *L. J. Dorr, E. Briceño, G. Briceño & R. Cracas 8436* (C not seen, COL not seen, CTES not seen, F, MO not seen, NY not seen, OSH, PORT not seen, US); Mun. Boconó, Parque Nacional Guaramacál, Boconó–caserío de Guaramacal road, S slope, (Qda. Jirajara) from turnoff to antennas to just above El Campamento, 15 June 2001, *L. J. Dorr, S. M. Niño & R. Caracas 9014* (OSH); 12 km ESE of Boconó, 1 km N to 4 km NNE of Guaramacál, 09°12′–13′N, 70°09′W, 1600–1900 m, 15 Mar. 1982, *R. Liesner, A. González, B. Stergios & G. Aymard 12954* (MO, PORT, VEN not seen); Boconó–Guaramacál road, kms 16–22 SSE of Boconó, subpáramo dominated by *Espeletia partoneoides* and *Neurolepis*, 2775–3175 m, 20 Jan. 1978, *J. L. Luteyn, M. Lebrón-Luteyn, L. Ruiz-Teran & J. A. Dugarte 5206* (NY not seen, MERF not seen, OSH, VEN not seen); Dpto. Boconó, Páramo Guaramacál, 12.2 km beyond jct. outside Boconó, 09°13′N, 70°12′W, steep roadside slopes dominated by *Clusia* and bamboo, ca. 2600 m, 19 Jan. 1984, *J. L. Luteyn & J. J. Pipoly 9296* (NY not seen, OSH, VEN not seen); Dpto. Boconó, Páramo Guaramacál, 20–21 km beyond jct. with hwy. NE of Boconó, 09°13′N, 70°13′W, shaded very wet streambed with large boulders, 2640–2700 m, 14 Mar. 1984, *J. L. Luteyn & E. Cotton 9710* (NY not seen, OSH, PORT not seen, VEN not seen), *J. L. Luteyn & E. Cotton 9711* (NY not seen, OSH, PORT not seen, US, VEN not seen); Dpto.

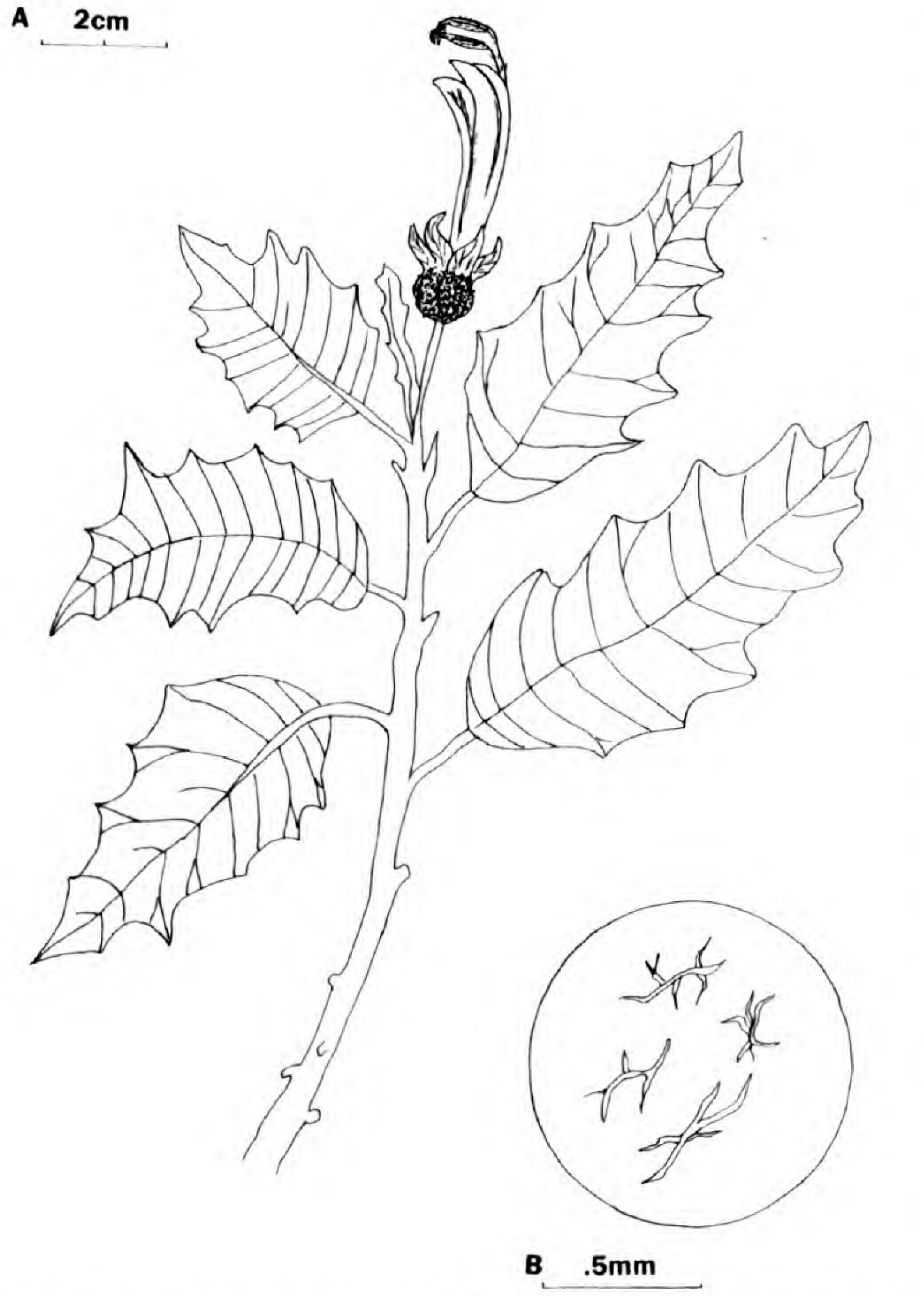

Figure 8. *Centropogon candidatus* Lammers. —A. Upper portion of stem with flower. —B. Arbusculiform trichomes on abaxial leaf surface. (Drawn from the holotype, *Bristol 1182*.)

Carache, via Páramo Cendé sitio denominado "Los Barreales," 9°32′N, 70°08′W, bosque subparameros, 2800–2900 m, 29 Feb. 1988, *R. Rivero & N. Rondón 1576* (MO, PORT not seen); Mun. Boconó, camino al Cerro Guaramacál via la laguna de "Los Cedros," bosque nublado, 21 Mar. 1981, *B. Stergios 2591* (PORT); Cerro Guaramacál, Boconó, bajando hacia el caserío de Guaramacál, selva húmeda montano alto, 25–26 Nov. 1982, *B. Stergios, G. Aymard & A. Smith 4726* (PORT); Mun. Boconó, Parque Nacional Guaramacál, camino Laguna de los Cedros, vertiente norte, 09°07′N, 70°16′W, bosque húmedo montano alto, cresta del páramo, 2000–2400 m, Jan. 1991, *B. Stergios 18643* (PORT not seen, US); Mun. Boconó, camino al Cerro Guaramacál via la laguna de "Los Cedros," bosque nublado, 21 Mar. 1981, *B. Stergios 2591* (PORT).

2. **Centropogon candidatus** Lammers, sp. nov. TYPE: Colombia. Nariño: E Aponte, Río Majinsanoy, forest trail, 2700 m, 29 June 1963, *M. L. Bristol 1182* (holotype, US). Figure 8.

Species insignis egregie distincta ab omnibus caeteris speciebus *Centropogonis* subsect. *Brevilimbatorum* trichomatibus arbusculiformibus candidis, laminis pinnatilobatis, et calycis lobis ellipticis erectis 13–15 mm longis 5–6 mm latis marginibus 1–3-spinulosis.

Shrub, 3 m tall; stems 2–2.6 mm diam., moderately leafy, densely pubescent with white arbusculiform hairs. Lamina ovate, 6.4–8 cm long, 2.5–3 cm wide between the lobes, 3–3.9 cm wide across the lobes, coriaceous; adaxial surface dull dark green, very sparsely pubescent with white arbusculiform hairs; abaxial surface dull green-white, very densely pubescent with white arbusculiform hairs, the surface almost wholly obscured; margin pinnately lobed, the segments 3 to 5 per side, triangular to deltate, 3–8 × 3–9 mm, acute and mucronate at apex; apex acuminate; base rounded; petiole 14–20 mm long, 1–1.5 mm diam., 1/4–1/5 as long as the lamina, very densely pubescent with white arbusculiform hairs. Flowers solitary in the upper leaf axils; pedicels ascending, 27–35 mm long, 0.8–0.9 mm diam., ebracteolate (or the bracteoles obscured by the indumentum?), very densely pubescent with white arbusculiform hairs. Hypanthium oblate, 6 mm long, 9–10 mm diam., 1/8 as long as the corolla, very densely pubescent with white arbusculiform hairs. Calyx lobes elliptic, erect, 13–15 × 5–6 mm, more than twice as long as the hypanthium, about half as long as the corolla tube, densely pubescent with white arbusculiform hairs toward base, becoming sparser toward apex; apex acuminate; margin denticulate with 1 to 3 spinulose teeth on each side. Corolla tubular, bilabiate, coral pink externally, yellow within, 46–48 mm long, pubescent with white arbusculiform hairs; tube gently curved, 31–32 mm long, 4–4.5 mm diam. at the base, not constricted, flaring gradually to 6.5–8 mm diam. at mouth; dorsal lobes narrowly triangular, falcate, 15–16 × 3.7–4 mm, half as long as the tube, the apex acuminate; ventral lobes narrowly triangular, deflexed, 8–10 × 2.5–3.5 mm, the apex acuminate. Staminal column exserted, emerging above the dorsal lobes; filament tube yellow, slightly curved, 45–47 mm long, 1 mm diam., densely pubescent with long spreading simple white hairs; anther tube gray-blue, 2.3–2.4 mm diam., slightly curved, sparsely pubescent on the connectives with long simple white hairs; dorsal anthers 7 mm long, 1/6 as long as the filament tube; ventral anthers 5 mm long, pubescent at apex with tufts of yellow-white hairs 1.5–2 mm long. Fruit and seeds not seen, but apex of ovary flat.

Distribution, habitat, and phenology. Apparently endemic to the Cordillera Central of southwestern Colombia, and known only from the type specimen.

Etymology. The specific epithet alludes to the plant's dense white indumentum; from the Latin adjective *candidatus*, clothed in white.

Relationships. Based on its arbusculiform trichomes and "short-lobed" corolla, *Centropogon candidatus* is a member of section *Siphocampyloides*, subsection *Brevilimbati*. Within that subsection, however, it is remarkable for its white (presumably unpigmented) indumentum. The arbusculiform hairs that characterize subsection *Brevilimbati* typically are darkly pigmented: yellow-brown, red-brown, chocolate-brown, purple, gray, or black. Only two other species of that subsection are characterized by white trichomes: *C. albostellatus* Jeppesen and *C. llanganatensis* Jeppesen, both of central Ecuador. Neither is very similar to *C. candidatus* in other features. Taken together, these two species differ from the novelty in their cuneate or attenuate leaf bases (vs. rounded in *C. candidatus*), entire or minutely toothed (vs. lobed) leaf margins, longer pedicels (40–80 mm vs. 27–35 mm), shorter calyx lobes (2–10 mm vs. 13–15 mm), shorter corollas (20–40 mm vs. 46–48 mm long) constricted toward base (vs. not constricted), and glabrous (vs. pubescent) staminal column.

As an aside, it should be noted that while color of the trichomes generally has been useful as a taxonomic character among subsection *Brevilimbati* (Jeppesen, 1981), variation within a species is possible. *Centropogon erythraeus* Drake of southern Ecuador typically has a dense indumentum that is purple or chocolate-brown. Recently, I examined a specimen (*Stein & D'Alessandro 2730*, MO) from a known locality of *C. erythraeus*, which conformed in every way to that species, except that the pubescence was pure white. Apparently, just as many plants produce occasional individuals with unpigmented flowers, so, too, do some members of subsection *Brevilimbati* occasionally produce individuals with unpigmented trichomes. For this reason, it would not be wise to distinguish a new species solely on an unusual indumentum color.

Fortunately, *Centropogon candidatus* is also remarkable for its pinnately lobed leaf margin. In most of subsection *Brevilimbati*, the margins are entire or minutely toothed (crenulate, denticulate, serrulate). Only one other species has leaves divided into definite lobes: *C. australis* (F. E. Wimmer) Gleason of Venezuela. This species does resemble *C. candidatus* in lamina size, petiole length, hypanthium shape, and pubescence of the staminal column. However, *C. australis* differs from *C. candidatus* in its brown (vs. white) indumentum; calyx lobes that are sublinear (vs. elliptic) and only 1–5 mm long (vs. 13–15 mm); and corolla that is purple (vs. coral externally and yellow internally), only 30–36 mm long (vs. 46–48 mm), and constricted (vs. not constricted) toward base. Overall, these two species do not seem closely related, and it may be hypothesized that leaf-lobing has evolved at least twice in this subsection.

In addition to the white indumentum and lobed leaves, *C. candidatus* is distinctive by virtue of its calyx lobes. In the majority of subsection *Brevilimbati*, calyx lobes are only 1–9 mm long (vs. 13–15 mm long in *C. candidatus*) and broadest at base (vs. above the base) with entire margins (vs. 1 to 3 spinulose denticulations per side). However, one known species possesses calyx lobes similar to those of *C. candidatus*: *C. karstenii* Zahlbruckner has calyx lobes that are 12–15 mm long and lanceolate (i.e., broadest above the base), with 3 denticulations on each margin. This species further resembles the novelty in size and general shape of the lamina; length of the pedicels; size and shape of the hypanthium; in the size, exsertion, and pubescence of the staminal column; and is likewise endemic to Nariño, growing in the vicinity of Pasto. It differs from the novelty only in its red-brown indumentum (vs. white in *C. candidatus*), shorter petioles (8–10 mm vs. 14–20 mm), denticulate (vs. pinnately lobed) lamina, narrower calyx lobes (2–4 mm vs. 5–6 mm) that are lanceolate (vs. elliptic), and red (vs. coral and yellow) corollas with shorter lobes (dorsal lobes 10 mm vs. 15–16 mm, ventral ones 5 vs. 8–10 mm). Overall, on the basis of morphology and geography, *C. karstenii* would appear to be the closest known relative of *C. candidatus.*

3. Centropogon eilersii Lammers & M. O. Dillon, sp. nov. TYPE: Peru. Cuzco: La Convencion, road from Cuzco to Quillabamba, after pass Abra Malaga and before Ipal, 13°04′S, 72°22′W, remnants of former cloud forest along the road, 2600–2900 m, 24 Feb. 2000, *M. Weigend & K. Weigend 2000/441* (holotype, NY; isotype, Herbario Universidad Nacional de San Augustin not seen). Figure 9.

Species *Centropogonis* sect. *Burmeisteroidis* affinis *C. david-smithio* et *C. isabellino*, sed ab his speciebus pedicellis longioribus 250 mm longis, calycis lobis longioribus 40 mm longis, corollis luteolis majoribus cum corolla 85 mm longa tubo 50 mm longo, et tubo filamentorum longiore 65 mm longo bene distinguenda.

Apparently an erect suffruticose herb or shrub; stems 8 mm diam., pubescent with brown arachnoid hairs. Lamina elliptic, 28–29 × 9–10.8 cm, chartaceous; adaxial surface dull dark green, pubescent with short stiff white hairs; abaxial surface dull light green, more densely pubescent with long stiff spreading brown hairs; margin minutely denticulate with yellow callosities; apex acute; base cuneate; petiole adaxially canaliculate, 25–38 mm long, 3–3.5 mm diam., 1/7–1/11 as long as the lamina, pubescent with brown arachnoid hairs. Flowers solitary in the upper leaf axils; pedicels ascending, curved, 250 mm long, 2.7 mm diam., bibracteolate at base, moderately pubescent with brown arachnoid hairs; bracteoles linear, 7 × 0.5 mm. Hypanthium narrowly campanulate, 18 mm long, 12 mm

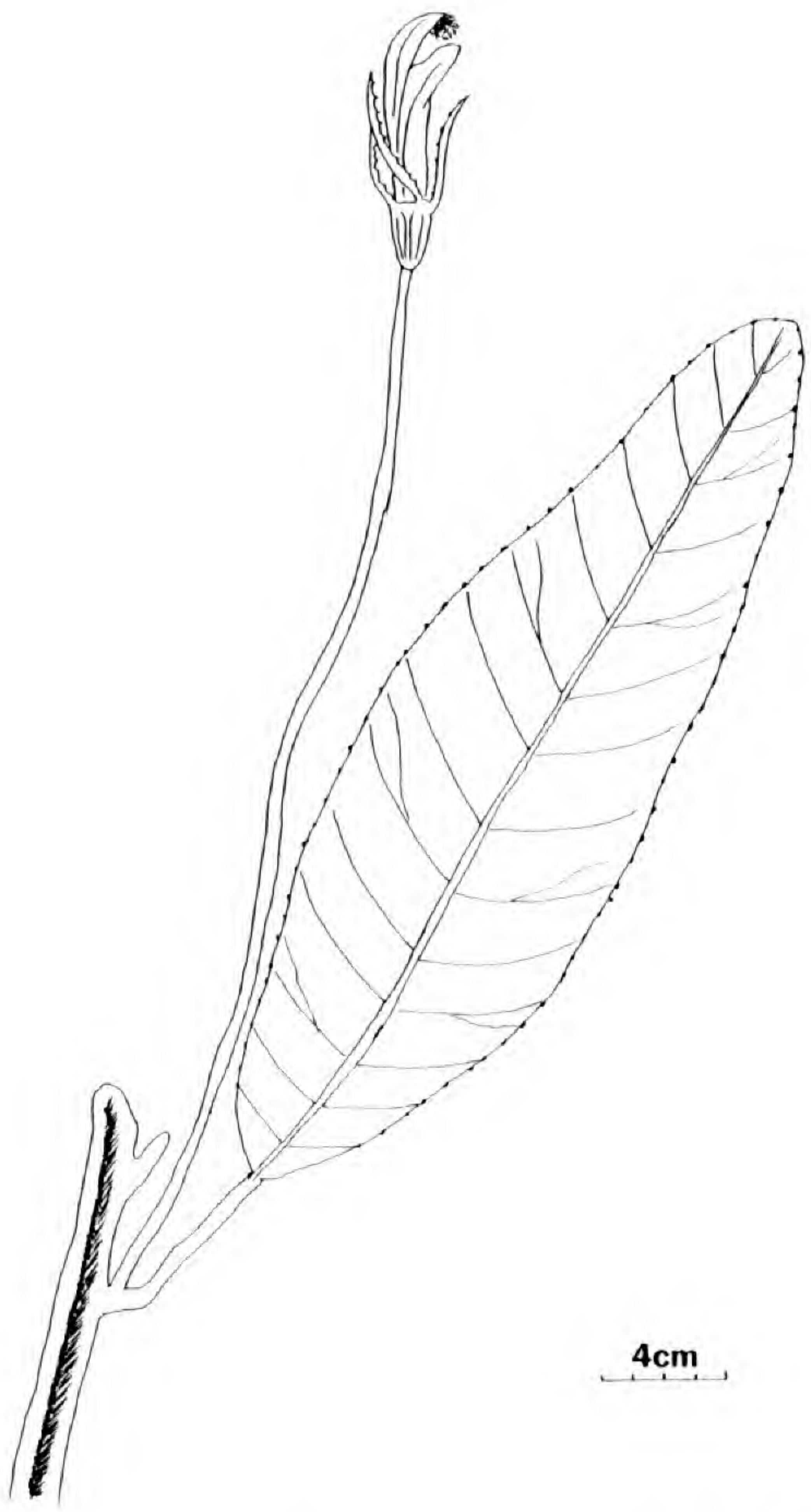

Figure 9. *Centropogon eilersii* Lammers & M. O. Dillon. (Drawn from the holotype, *Weigend & Weigend 2000/441*.)

diam., 1/5 as long as the corolla, pubescent with brown arachnoid hairs. Calyx lobes linear-triangular, erect, 40 × 3–5 mm, more than twice as long as the hypanthium, 4/5 as long as the corolla tube, pubescent with brown arachnoid hairs; apex acuminate; margin serrulate with 8 to 12 tiny curved teeth on each side. Corolla tubular, pale yellow, 85 mm long, pubescent with short stiff simple colorless hairs, these often clustered so as to appear stellate; tube slightly curved, 50 mm long, 12 mm diam. at the base, narrowing imperceptibly to 10 mm diam. at middle, then flaring gradually to 22 mm diam. at mouth; dorsal lobes narrowly triangular, falcate, 35 × 9 mm, 7/10 as long as the tube, the apex acute; ventral lobes narrowly triangular, deflexed, 23 × 9 mm, the apex acute. Staminal column apparently little exserted from the tube, the anthers positioned between the dorsal lobes; filament tube slightly curved, 65 mm long, 2 mm diam., pubescent with long soft spreading white hairs; anther tube 7 mm diam., curved, densely pubescent with long shaggy brown hairs; dorsal anthers 15 mm long, 1/4–1/5 as long as the filament tube; ventral anthers 13 mm long, pubescent at apex with tufts of soft brown hairs 3.5–4 mm long. Fruit and seeds not seen, but apex of ovary flat.

Distribution, habitat, and phenology. Apparently endemic to southern Peru, and known only from the type collection.

Etymology. This species is respectfully dedicated to the memory of Lawrence J. Eilers (1927–2000), plant taxonomist, ardent conservationist, and botanical educator. From 1968 to 1989, Larry was professor of biology at the University of Northern Iowa and curator of that school's herbarium (ISTC). His research program focused on the flora of Iowa, and culminated in the publication of *The Vascular Plants of Iowa* (Eilers & Roosa, 1994). As much as Larry enjoyed floristic research, it was as a teacher that he truly excelled. Students who were having trouble with academics or with life in general seemed especially to flourish and blossom under Larry's gentle tutelage. In addition to classroom teaching, he directed the master's theses of several future botanists, including the author and Michael O. Dillon of the Field Museum of Natural History (F), who joins me in naming this species in our professor's honor.

Relationships. On the basis of its simple trichomes and "long-lobed" corolla, *Centropogon eilersii* is a member of section *Burmeisteroides*. Within that section, it belongs to a group of four species characterized by denticulate leaves 2 to 6 times longer than wide; green or yellow corollas; and stiff persistent simple (often clustered) trichomes at least on the corolla (McVaugh, 1949; Lammers, 1998a): *C. altus* F. E. Wimmer of northern Peru, *C. ayavacensis* (Willdenow ex Schultes) Lammers of the Cordillera Central of Colombia (*C. willdenowianus* F. E. Wimmer, nom. superfl.; cf. Lammers, 1999), *C. david-smithii* Lammers of central Peru, and *C. isabellinus* F. E. Wimmer, also found in Cuzco. Among these species, the novelty seems most similar to the last two, particularly in size, shape, and pubescence of the hypanthium and anther tube. *Centropogon david-smithii* and *C. isabellinus* only differ from *C. eilersii* in their shorter pedicels (90–160 mm vs. 250 mm in *C. eilersii*); shorter calyx lobes (7–35 mm vs. 40 mm); green (vs. pale yellow) corollas that are shorter (56–64 mm vs. 85 mm) due to their shorter tube (20–33 mm vs. 50 mm); and shorter filament tube (46–50 mm vs. 65 mm) that is strongly (vs. scarcely) exserted.

4. **Centropogon joergensenii** Lammers, sp. nov. TYPE: Ecuador. Zamora–Chinchipe: Chinchipe, Parque Nacional Podocarpus, La Esmeralda (Cooperativa San Francisco de Numbala Alto), 04°22′S, 79°03′W, bosque primario alto, 2250 m, Jan. 1994, *W. Palacios & M. Tirado 13042* (holotype, OSH; isotypes, MO, QCNE not seen). Figure 10.

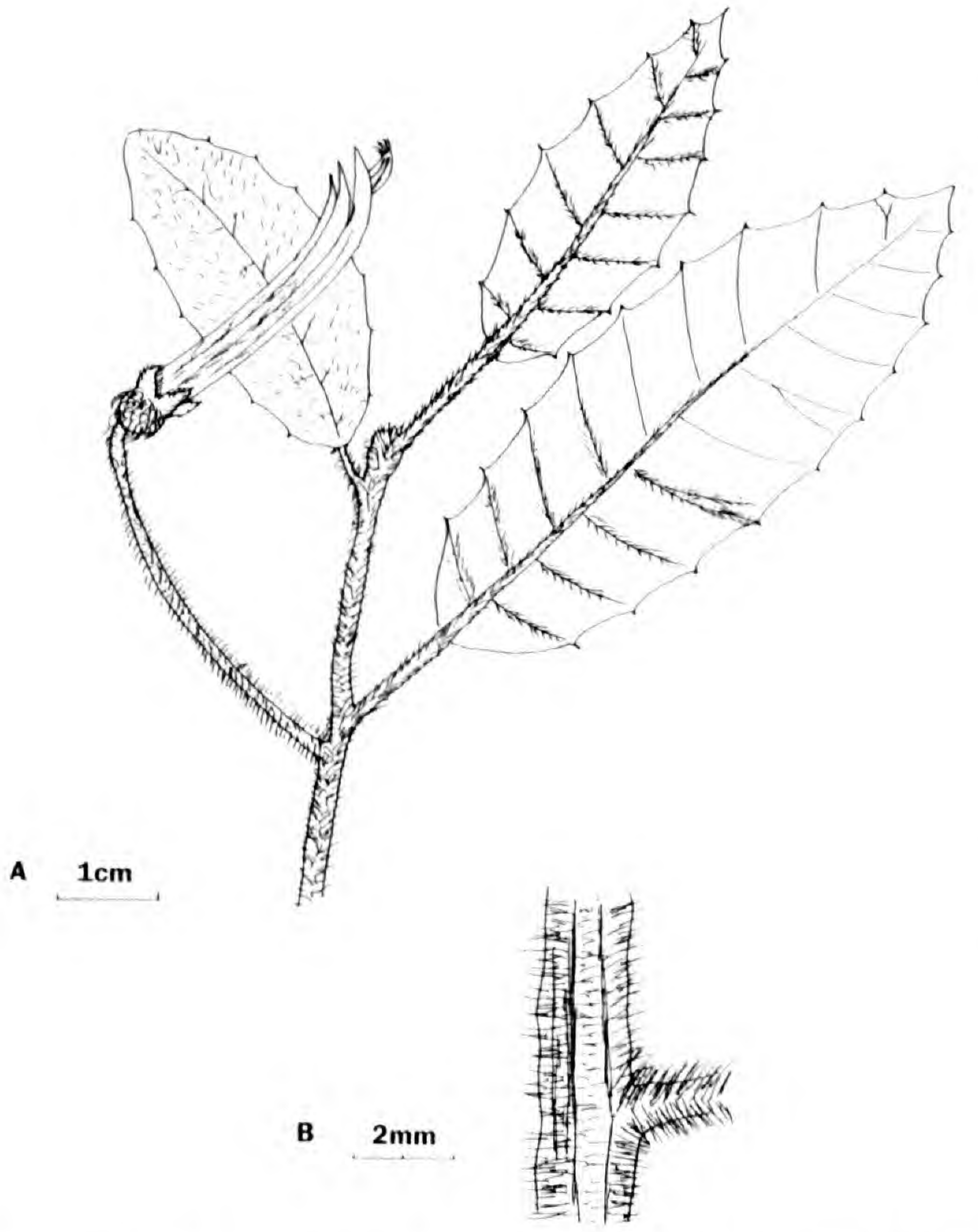

Figure 10. *Centropogon joergensenii* Lammers. —A. Upper portion of stem with flower. —B. Pubescence on stem and petiole. (Drawn from the holotype, *Palacios & Tirado 13042.*)

Species *Centropogonis* subsect. *Falcatorum* ob trichomata septata longa affinis *C. trichodi*, sed ab hac specie trichomatibus longioribus 2.5–3.5 mm longis, pedicellis longioribus 6.5–7.2 cm longis, calycis lobis parce pubescentibus brevioribus 6–7 mm longis, corolla majore 45–48 mm longa, columna staminali vix exserta, et tubo antherarum glabro statim distinguenda.

Scandent shrub; stems moderately leafy, 2–2.5 mm diam., branched, densely pubescent with stiff yellow spreading multicellular hairs 2.5–3.5 mm long. Lamina elliptic, 5.8–8 × 2.6–3.6 cm, chartaceous; adaxial surface dull dark green, moderately pubescent with long stiff yellow multicellular hairs; abaxial surface dull white-green, densely pubescent with long stiff yellow multicellular hairs; margin denticulate with dark callosities; apex acute; base obtuse; petiole 1.3–1.8 mm long, 0.8–1.2 mm diam., 1/4–1/6 as long as the lamina, densely pubescent with long stiff yellow multicellular hairs. Flowers solitary in the upper leaf axils; pedicels ascending, 65–72 mm long, 1–1.3 mm diam., bibracteolate at or just above the base, moderately pubescent with long stiff spreading yellow multicellular hairs. Hypanthium depressed hemispheric, 3–4 mm long, 7–8 mm diam., 1/10–1/15 as long as the corolla, densely pubescent with long stiff spreading yellow multicellular hairs. Calyx lobes triangular, erect, 6–7 × 2.5–3 mm, half again as long to almost 2 1/2× as long as the hypanthium, 1/5–1/6 as long as the corolla tube, moderately pubescent with long stiff spreading yellow multicellular hairs; apex acuminate; margin entire. Corolla tubular, slightly ventricose, red with yellow limb, 45–48 mm long, moderately pubescent with long stiff spreading yellow multicellular hairs; tube slightly curved, 40 mm long, 6 mm diam. at the base, narrowing abruptly to 2.5 mm diam. just above the base, then flaring gradually to 5.5 mm diam. just below the mouth; dorsal lobes narrowly triangular, falcate, 8 × 2.3 mm, 1/5 as long as the tube, the apex acuminate; ventral lobes narrowly triangular, deflexed, 7 × 1.8 mm, the apex acuminate. Staminal column slightly exserted between the dorsal lobes; filament tube slightly curved, 43 mm long, 1.5 mm diam., densely pubescent with long soft white hairs; anther tube 2 mm diam., slightly curved, gray, its surfaces glabrous; dorsal anthers 6 mm long, 1/7 as long as the filament tube; ventral anthers 4.5 mm long, pubescent at apex with tufts of stiff dirty-white hairs 0.8–1 mm long. Fruit and seeds not seen, but apex of ovary flat.

Distribution, habitat, and phenology. Apparently endemic to southern Ecuador and known only from the type collection.

Etymology. It is a pleasure to name this species for Peter Møller Jørgensen (b. 1958), from 1986 to 1989 director of the herbarium at Pontificia Universidad Católica del Ecuador (QCA) and since 1992 a member of the curatorial staff at the Missouri Botanical Garden (MO). Peter is actively engaged in studies of the flora and biogeography of the Andes, was co-editor of the encyclopedic *Catalogue of the Vascular Plants of Ecuador* (Jørgensen & León-Yánez, 1999), and, with his wife Carmen Ulloa Ulloa (see below), is a contributor to the *Flora of Ecuador* project. In forming the epithet, the spelling of his surname has been altered to comply with Article 60.6 of the ICBN (Greuter et al., 2000).

Relationships. On the basis of its simple trichomes and "short-lobed" corolla with deflexed falcate lobes, *Centropogon joergensenii* is a member of section *Wimmeriopsis*, subsection *Falcati*. Though I did not comment upon it in my earlier review of the genus (Lammers, 1998a), the species of subsection *Falcati* fall into two discrete geographic groups. The first includes four species endemic to Costa Rica [*C. irazuensis* Wilbur, *C. palmanus* (Donnell Smith) F. E. Wimmer, *C. valerii* Standley, and *C. wimmeri* Standley] plus a fifth one [*C. grandidentatus* (Schlechtendal) Zahlbruckner] that is distributed from southern Mexico to northern Colombia and western Venezuela. The second group includes 12 Ecuadorean endemics [*C. aequitorialis*

F. E. Wimmer, *C. brachysiphoniatus* Zahlbruckner, *C. calycinus* Bentham, *C. jeppesenii* Lammers, *C. phoeniceus* Jeppesen, *C. pilalensis* Jeppesen, *C. rimbachii* F. E. Wimmer, *C. rubrodentatus* Jeppesen, *C. sodiroanus* Zahlbruckner, *C. subandinus* Zahlbruckner, *C. trichodes* F. E. Wimmer, and *C. uncinatus* Zahlbruckner] plus one [*C. reticulatus* Drake] that occurs in both Ecuador and northern Peru.

The new species differs from all these in various features, most notably in the dense indumentum of very long stiff yellow multicellular trichomes; most of the species are glabrous or pubescent with shorter, softer, unicellular hairs. Only *C. trichodes* F. E. Wimmer, which is also endemic to Zamora–Chinchipe (valley of the Río Valladolid), bears trichomes at all similar to those of *C. joergensenii*; they are, however, only 1–1.5 mm long (vs. 2.5–3.5 mm long in *C. joergensenii*). While the two species are similar in size and shape of the leaves and general floral structure, *C. trichodes* differs in its shorter pedicels (4–6 cm vs. 6.5–7.2 cm in *C. joergensenii*), longer calyx lobes (8–15 mm vs. 6–7 mm) that are subglabrous (vs. moderately pubescent), shorter corolla (30–35 mm vs. 45–48 mm), strongly exserted (vs. scarcely exserted) staminal column, and anther tube pilose with purple-blue trichomes in the sutures (vs. glabrous). On the basis of morphology and geography, *C. trichodes* appears to be the closest known relative of *C. joergensenii*.

5. **Centropogon ulloae** Lammers, sp. nov.

TYPE: Ecuador. Napo: road from Tulcán to Santa Bárbara and La Bonita, 21 km below Santa Bárbara, 00°35–45′S, 77°30′W, cloud forest, 2400 m, 28 May 1985, *B. A. Stein 2875* (holotype, MO). Figure 11.

Ab omnibus caeteris speciebus *Centropogonis* sect. *Wimmeriopsidis* indumento sparso trichomatum arbusculiformium minimorum differt; species ob calycis lobos basi connatos hypanthio oblato longiores affinis *Centropogoni calycino* et speciebus similaribus, sed ab his speciebus lamina lanceolata vel anguste elliptica longiore 12.5–17.5 cm longa, calycis lobis connatis per dimidium longitudinis ad apicem obtusis vel rotundatis ad marginem integris, et corolla aurantiaco-rubra cum lobis luteis bene distinguenda.

Shrub forming thickets to 2.5 m tall; stems purple, somewhat densely leafy toward apex, 3 mm diam., subglabrous; latex white. Lamina lanceolate or narrowly elliptic, 12.5–17.5 × 4–4.6 cm, subcoriaceous; adaxial surface dull dark green, very sparsely scabrid with minute arbusculiform trichomes; abaxial surface dull white-green, sparsely scabrid with minute arbusculiform trichomes; margin minutely denticulate with dark intramarginal callosities; apex acuminate; base obtuse or cuneate; petiole 20–40 mm long, 1.1–1.6 mm diam., 1/4–1/6 as long as the lamina, subglabrous or sparsely scabrid with minute arbusculiform trichomes. Flowers solitary in the upper leaf axils; pedicels ascending, 55 mm long, 1 mm diam., bibracteolate just above the base, subglabrous or sparsely scabrid with minute arbusculiform trichomes; bracteoles linear, 5 × 0.3 mm. Hypanthium oblate, 8 mm long, 13 mm diam., 1/6 as long as the corolla, glabrous. Calyx lobes narrowly oblong, erect, 18–19 × 3.5–4.5 mm, connate for half their length, more than twice as long as the hypanthium, about half as long as the corolla tube, moderately scabrid with minute arbusculiform trichomes; apex rounded or obtuse; margin entire. Corolla tubular, bilabiate, orange-red with yellow limb, 50 mm long, moderately scabrid with minute arbusculiform trichomes; tube bent above the base, 38 mm long, 10 mm diam. at mouth; dorsal lobes narrowly triangular, falcate, 12 × 4 mm, 1/3 as long as the tube, the apex acuminate; lateral lobes narrowly triangular, falcate, 9 × 2.5 mm, the apex acuminate; ventral lobe narrowly triangular, deflexed, 8 × 2.2 mm, the apex acuminate. Staminal column somewhat exserted be-

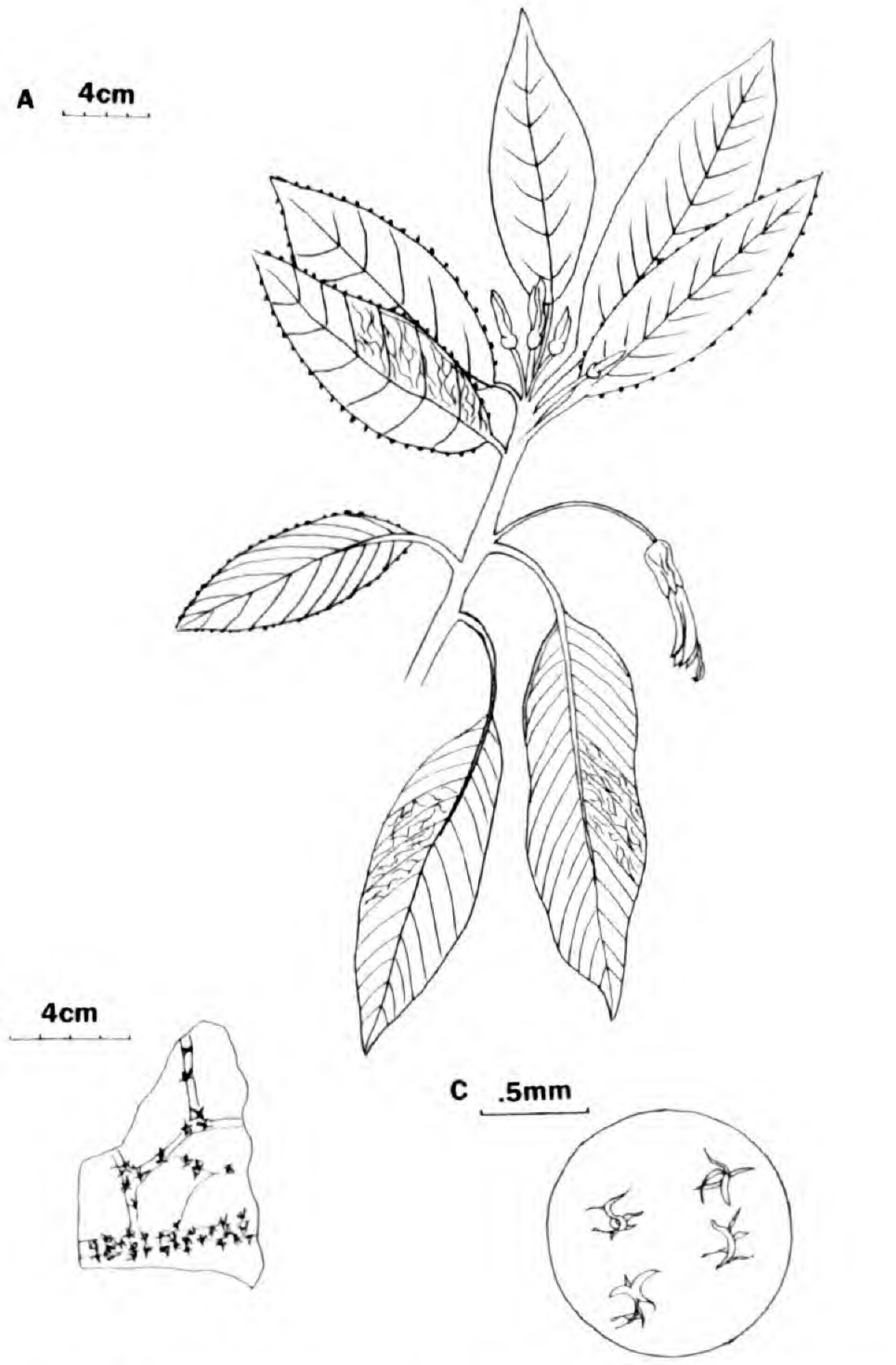

Figure 11. *Centropogon ulloae* Lammers. —A. Upper portion of stem with flower. —B, C. Arbusculiform trichomes on abaxial leaf surface. (Drawn from the holotype, *Stein 2875*.)

tween the dorsal lobes; filament tube suberect, 48 mm long, 1.9 mm diam., glabrous; anther tube 3 mm diam., suberect, gray, its surfaces glabrous; dorsal anthers 7 mm long, 1/7 as long as the filament tube; ventral anthers 5.3 mm long, pubescent at apex with tufts of stiff white hairs 1.3–1.5 mm long. Fruit and seeds not seen, but apex of ovary flat.

Distribution, habitat, and phenology. Apparently endemic to northern Ecuador and known only from the type specimen.

Etymology. It is a pleasure to name this species for Carmen Ulloa Ulloa (b. 1963), who served at the Pontificia Universidad Católica del Ecuador (QCA) as a research assistant (1986–1988) and *profesor agregado* (1990–1991) before joining the curatorial staff at Missouri Botanical Garden (MO) in 1992. Carmen is actively engaged in studies of the flora and biogeography of Andean forests and the *páramos* of Ecuador, co-edited *Flora de Nicaragua* (Stevens et al., 2001) and, with her husband Peter Møller Jørgensen (see above), is a contributor to the *Flora of Ecuador* project. It is an honor to commemorate this couple's many contributions to Latin American botany with a bouquet of *Centropogon.*

Relationships. *Centropogon ulloae* presents yet another challenge to McVaugh's (1949) classification of the genus. The combination of arbusculiform trichomes and "short-lobed" corolla would place this species in section *Siphocampyloides*, subsection *Brevilimbati.* However, the novelty shows little resemblance to any of those species. Its distinctive connate calyx lobes are almost unknown in section *Siphocampyloides*; within that group, only the recently described *C. connatilobatus* Lammers of Venezuela has basally connate calyx lobes. However, that species differs from *C. ulloae* in its much smaller leaves (2.6–6 × 0.6–1.9 cm vs. 12.5–17.5 × 4–4.6 cm in *C. ulloae*) with shorter petioles (4–17 mm vs. 20–40 mm); smaller hypanthium (3 mm vs. 8 mm long, 5 mm vs. 13 mm diam.) that is pubescent (vs. glabrous); shorter calyx lobes (12 mm vs. 18–19 mm long) that are acuminate at apex (vs. rounded or obtuse); and shorter corolla (42 mm vs. 50 mm long) with red limb (vs. yellow). Furthermore, the branched hairs of the novelty differ from those of section *Siphocampyloides* in their minuteness. The former are only 1/10 as long as those of the *Siphocampyloides*: 0.1–0.3 mm vs. 1–3 mm. Overall, it does not appear that *C. ulloae* is related to any member of section *Siphocampyloides.*

Though *C. ulloae* seems out of place in section *Siphocampyloides*, it does show great similarity to a group of four species within the Ecuadorean branch of section *Wimmeriopsis*, subsection *Falcati* (see above): *C. aequitorialis* F. E. Wimmer (Carchi and Pichincha), *C. brachysiphoniatus* Zahlbruckner (Pichincha), *C. calycinus* Bentham (Imbabura and Pichincha), and *C. phoeniceus* Jeppesen (Napo). Like *C. ulloae*, these species possess calyx lobes that are longer than the hypanthium and connate. They further resemble *C. ulloae* in their pedicels equaling or longer than the flower, relatively long subbasal bracteoles, hypanthia broader than long, "short-lobed" corolla morphology, and glabrous filaments. In an earlier classification of the genus, Wimmer (1931) applied the rankless infrasectional name "Caligati F. E. Wimmer" to these plants; that name (which was included in the synonymy of subsection *Falcati* by McVaugh [1949]) will be used here to informally designate this species group.

The sole impediment to the assignment of *C. ulloae* to section *Wimmeriopsis* is its indumentum of arbusculiform hairs. Throughout section *Wimmeriopsis*, any hairs that are present are unbranched (though sometimes multicellular). However, in light of the great overall similarity of *C. ulloae* to the "Caligati," and the pronounced size difference between its arbusculiform trichomes and those of section *Siphocampyloides*, it seems best to assign the novelty to *Centropogon* sect. *Wimmeriopsis*, subsect. *Falcati.* Its minute arbusculiform hairs are thus hypothesized to represent yet another independent origin of branched trichomes among the Lobelioideae.

In addition to its sparse indumentum of minute arbusculiform trichomes, the new species differs from the other "Caligati" in details of its connate calyx lobes. In *C. ulloae*, the lobes are connate for half their length (vs. 2/3 or more of their length in *C. aequitorialis* and *C. calycinus* or 1/3 or less of their length in *C. brachysiphoniatus* and *C. phoeniceus*), rounded or obtuse (vs. acute) at apex, with the free margins entire (vs. toothed). The new species further differs from the other four "Caligati" in its longer (12.5–17.5 cm vs. 3–13 cm long) lanceolate or narrowly elliptic (vs. ovate, elliptic, or widely elliptic) leaves and orange-red corolla with yellow lobes (vs. red or purple only occasionally with yellow or white lobes).

6. **Centropogon vitifolius** Lammers, sp. nov. TYPE: Peru. Amazonas: Condorcanqui Prov., Distr. El Cenepa, Región Nororiental del Marañon, comunidad de Kusu-kubaim, Río Comaina, 04°25′S, 78°16′W, bosque primario, 700 m, 17 Aug. 1994, *R. Vasquez, N. Jaramillo, R. Apanu & M. Ugkuch 18816* (holotype, OSH; isotypes, AMAZ not seen, MO). Figure 12.

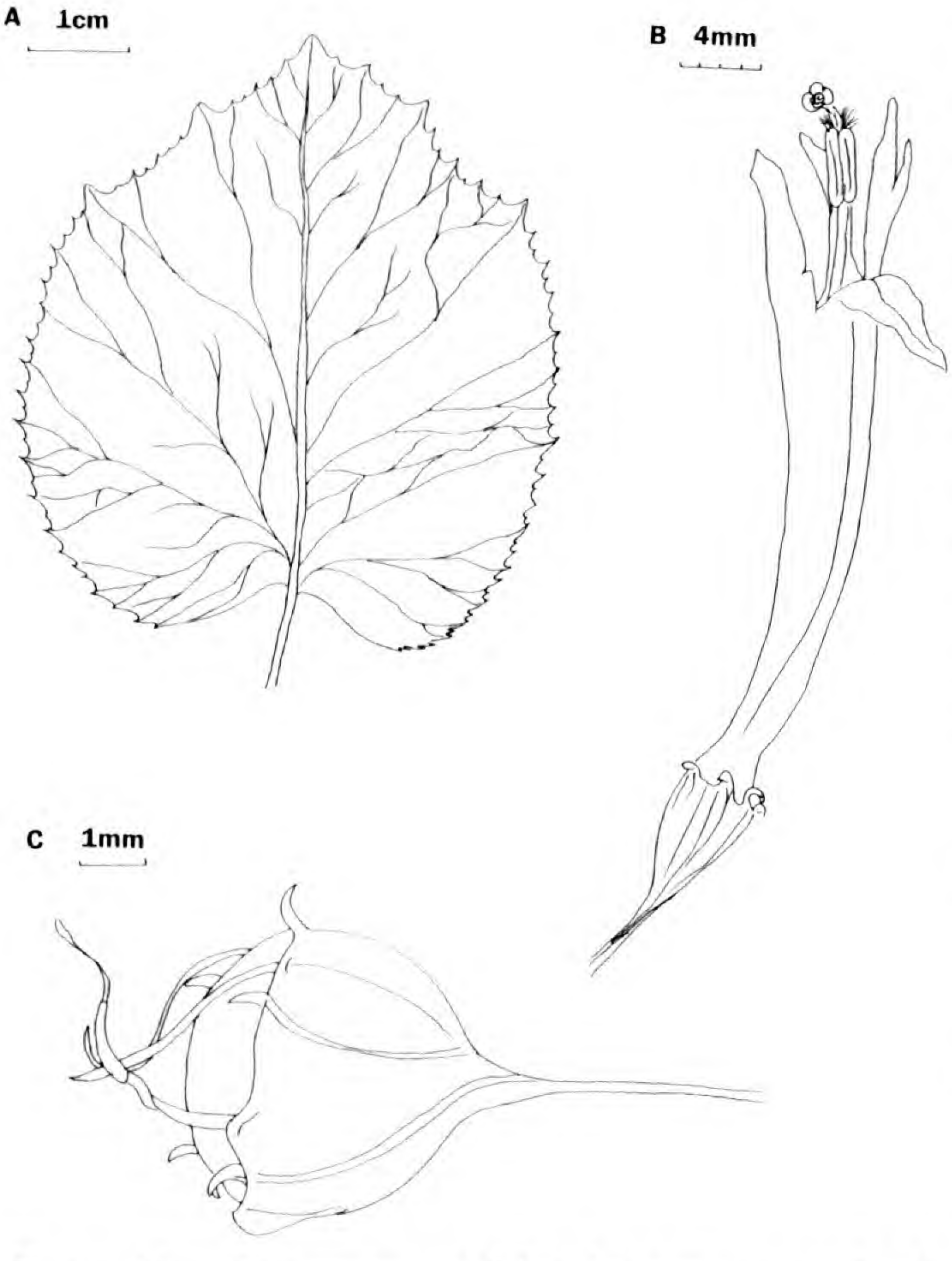

Figure 12. *Centropogon vitifolius* Lammers. —A. Leaf. —B. Flower. —C. Immature berry. (Drawn from the holotype, *Vasquez et al. 18816.*)

Species *Centropogonis* subsect. *Colombianorum* affinis *C. fimbriatulo* et *C. tessmanniis*, sed ab his speciebus absentia (praeter antheras) trichomatum longorum, lamina cordata interdum subtrilobata, et corollae lobis longioribus (dorsalibus 18 mm longis, ventralibus 13 mm longis) facile distinguenda.

Suffruticose herb; stems moderately leafy, 1.5–3 mm diam., glabrous; latex white. Lamina ovate or widely ovate, appearing vaguely 3-lobed, 5–7.5 × 3.5–6.5 cm, chartaceous, glabrous; adaxial surface dull light green, glabrous; abaxial surface dull white-green; margin coarsely dentate with 4 to 7 teeth per cm, some distinctly larger than the others; apex acuminate; base cordate; petiole 15–32 mm long, 0.5–1.2 mm diam., 1/4–1/2 as long as the lamina, glabrous. Flowers solitary in the upper leaf axils; pedicels ascending, recurved after anthesis, 38–50 mm long, 0.8–1.2 mm diam., ebracteolate, minutely puberulent. Hypanthium obovoid or obconic, 7–8 mm long, 6–7 mm diam., 1/8–1/9 as long as the corolla, minutely puberulent. Calyx lobes triangular, recurved at apex, 2–2.2 × 0.7–1 mm, 1/4–1/3 as long as the hypanthium, 1/25 as long as the corolla tube, minutely puberulent; apex acute; margin entire. Corolla tubular, rose-colored, 65–68 mm long, minutely puberulent; tube curved, 50 mm long, 5–6 mm diam. at the base, narrowing abruptly to 2.2–2.6 mm diam. above the base, then flaring gradually to 9–11 mm diam. just below the mouth; dorsal lobes linear-triangular, spreading, 18 × 2.5 mm, 1/3 as long as the tube, the apex acute; ventral lobes linear-triangular, deflexed, 13 × 2.5 mm, the apex acute. Staminal column slightly exserted between the dorsal lobes; filament tube curved, 58 mm long, 0.6 mm diam., glabrous; anther tube 2.2 mm diam., slightly curved, pubescent toward apex with long white hairs; dorsal anthers 7 mm long, 1/8 as long as the filament tube; ventral anthers 6.2 mm long, pubescent at apex with tufts of stiff dirty-white hairs 1 mm long. Fruit and seeds not seen, but apex of ovary flat.

Distribution, habitat, and phenology. Apparently endemic to northern Peru and known only from the type collection.

Etymology. The specific epithet is given in allusion to the resemblance of the leaves to those of certain species of grapes; from the genus *Vitis* L. (Vitaceae) and the Latin noun *folium*, leaf.

Relationships. On the basis of its simple trichomes and "short-lobed" corolla with spreading triangular lobes, *Centropogon vitifolius* is assigned to section *Wimmeriopsis*, subsection *Colombiani*. This group comprises 18 species distributed from southern Mexico to central Peru, plus an additional species endemic to Dominica and Guadeloupe in the Lesser Antilles (McVaugh, 1949; Lammers, 1998a). The new species is most similar to the only two members of the subsection found south of Colombia: *C. tessmannii* F. E. Wimmer (Amazonian lowlands of Ecuador and Peru) and *C. fimbriatulus* McVaugh (montane forests of southeastern Ecuador). These three species share a number of features, including habit, chartaceous ovate leaves with conspicuously toothed margins, ebracteolate pedicels, recurved calyx lobes, scarcely exserted staminal column, and pubescent anther tube. *Centropogon tessmannii* and *C. fimbriatulus* differ from the novelty in the increased pubescence of their vegetative organs (simple multicellular hairs up to 1.5 mm long vs. glabrous or minutely puberulent in *C. vitifolius*); cuneate, obtuse, or truncate (vs. cordate) leaf base; and shorter corolla lobes, both dorsal (6–11 mm vs. 18 mm) and ventral (6–9 mm vs. 13 mm). Neither species shows the tendency toward a trilobate leaf as seen in *C. vitifolius*.

Between *C. tessmannii* and *C. fimbriatulus*, the latter seems more similar to *C. vitifolius*, particularly in the length of its pedicels (4–7 cm), calyx lobes (2 mm), corolla (60–65 mm), and filament tube (45–55 mm). However, in addition to the features mentioned above, *C. fimbriatulus* further differs in its fimbriate leaf margin (vs. coarsely dentate in *C. vitifolius*) with 10 to 16 (vs. 4 to 7) teeth per cm, shorter (4–5 mm vs. 7–8 mm) hemispheric (vs. obconic or obovoid) hypanthium, pale lavender (vs. rose) corolla, and shorter (5–6 mm vs. 7 mm) dorsal anthers. *Centropogon tessmannii* does resemble *C. vitifolius* in its coarsely dentate leaf margin, longer obconic hypanthium, and longer dorsal anthers, but differs in its shorter (2–2.5 cm vs. 3.8–5 cm) pedicels, longer (3–10 mm vs. 2–2.2 mm) calyx lobes, shorter (46–60 mm vs. 65–68 mm) red (vs. rose-colored) corolla, and shorter (40–45 mm vs. 58 mm) filament tube. Overall, it seems best to regard the three species of *Centropogon* subsect. *Colombiani* occurring south of Colombia as a close-knit if not monophyletic group.

III. Siphocampylus Pohl, Pl. Bras. Icon. Descr. 2: 104. 1831. TYPE (lectotype, designated by McVaugh (1943: 100)): *Lobelia westiniana* Thunberg [= *Siphocampylus westinianus* (Thunberg) Pohl].

With the addition of the five novelties described here, *Siphocampylus* comprises 221 species, distributed from Costa Rica to Argentina, with several endemic to Cuba and Hispaniola (Lammers, 1998a). The genus resembles *Centropogon* overall, but differs in fruit type: baccate, from a flat-topped ovary, in *Centropogon*; capsular, from an ovary conical at apex, in *Siphocampylus*.

The most recent classification of *Siphocampylus* (Wimmer, 1953, 1968) is unsatisfactory for a variety of reasons (Pepper et al., 1997; Lammers, 1998a; also see below), but in the absence of an improved version, it must suffice here for purposes of discussion. In this classification, *Siphocampylus* was divided into into two sections: sect. *Siphocampylus* ("Macrosiphon," nom. invalid.) and sect. *Brachysiphon* F. E. Wimmer. The latter section was divided into four subsections: subsect. *Secundiflori* F. E. Wimmer, subsect. *Altofissi* F. E. Wimmer, subsect. *Megastomi* F. E. Wimmer, and subsect. *Megalandri* F. E. Wimmer. The autonymic section was divided into four subsections: subsect. *Hemisiphocampylus* (A. DC.) F. E. Wimmer, subsect. *Byrsanthes* (C. Presl) F. E. Wimmer, subsect. *Isochilus* F. E. Wimmer, and subsect. *Siphocampylus* ("Eusiphocampylus," nom. invalid.). This last subsection was then subdivided into five greges: grex *Ectropici* (F. E. Wimmer) F. E. Wimmer, grex *Siphocampylus* ("Verticillati," nom. invalid.), grex *Umbellati* F. E. Wimmer, grex *Botryoides* F. E. Wimmer, and grex *Dissitiflori* F. E. Wimmer. Several of the subsections and greges were further divided into subordinate taxa.

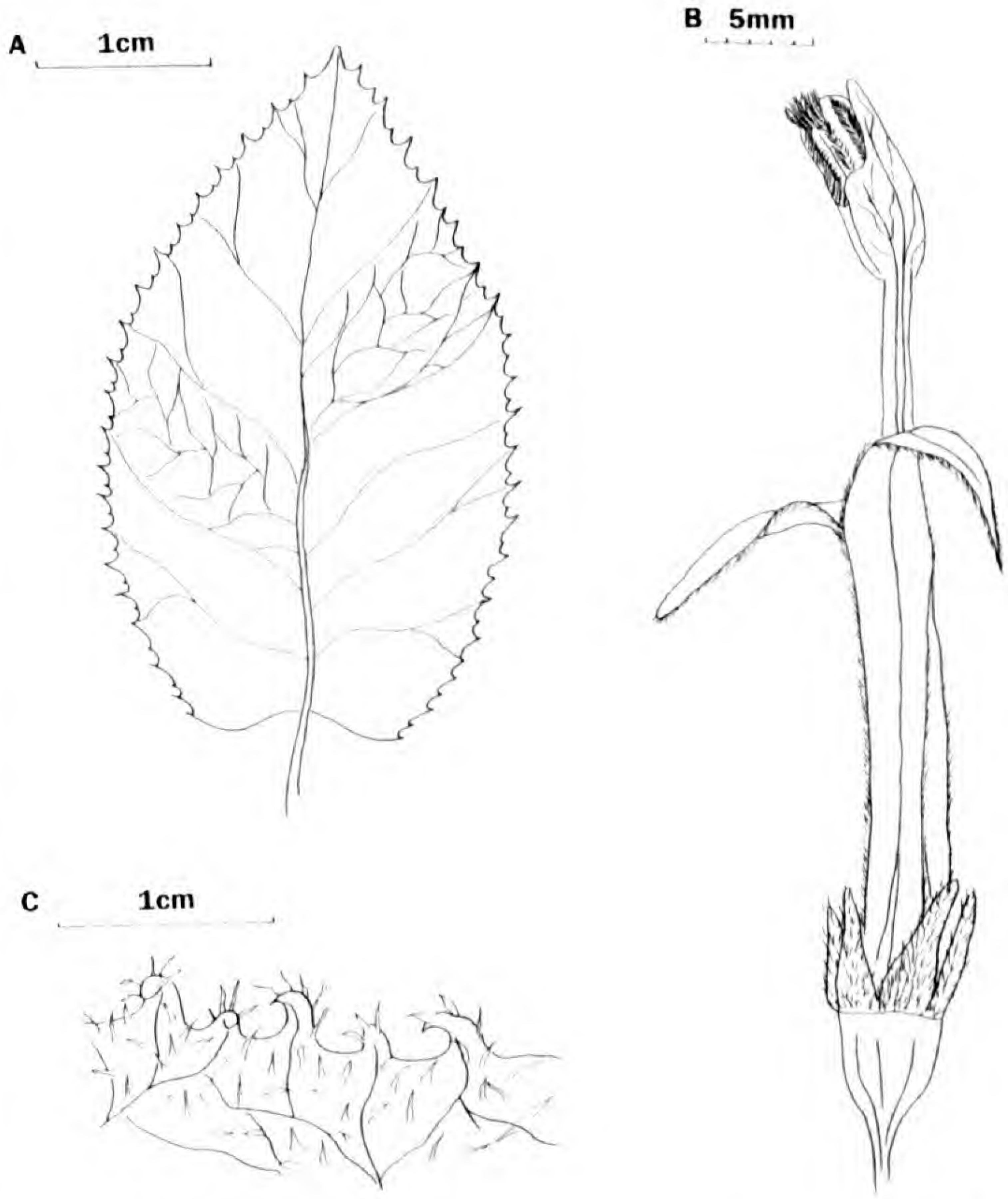

Figure 13. *Siphocampylus adhaerens* Lammers. —A. Leaf. —B. Flower. —C. Leaf margin. (Drawn from the holotype, *Luteyn et al. 5299*.)

1. Siphocampylus adhaerens Lammers, sp. nov. TYPE: Venezuela. Táchira: Hwy. 9, Quebrada de Cocoroco, 11 km S of Delicias, 1800 m, 28 Jan. 1978, *J. L. Luteyn, M. Lebron-Luteyn, L. Ruiz-Teran & J. A. Dugarte 5299* (holotype, OSH; isotype, MERF not seen, NY, VEN not seen). Figure 13.

Species ob corollam infundibularem et foliorum laminam cordatam vel subcordatam affinis *Siphocampylo megalantho* et speciebus similaribus, sed ab his speciebus pedicellis bibracteolatis brevioribus 1.9–2.8 cm longis, corollae tubo ad orem angustiore 4.6–6.7 mm diametro, antheris dorsalibus brevioribus 6–6.5 mm longis, et corollae lobis dorsalibus linearibus strictis longioribus 15–19 mm longis ventralibus dimidia parte longioribus sed dimidio latitudine adhaerentibus staminali columna statim distinguenda.

Suffrutescent herb; stems scandent, moderately leafy, 2.3–3 mm diam., moderately pubescent with long weak spreading white hairs; latex white. Lamina ovate, 4.5–9 × 3.5–5.5 cm, chartaceous; adaxial surface dull olive green, sparsely pubescent with short weak appressed white hairs; abaxial surface dull, paler, moderately pubescent (densest on the veins) with long weak spreading white or yellow hairs; margin conspicuously fimbriate with 7 to 10 teeth per cm, teeth 0.5–0.7 mm long alternating with teeth 1.3–1.5 mm long; apex acuminate; base cordate (often asymmetric), subcordate, or truncate; petiole 14–27 mm long, 0.7–0.9 mm diam., 1/3–1/5 as long as the lamina, densely pubescent with long weak spreading white or yellow hairs. Flowers solitary in distal leaf axils; pedicels straight (curved if scandent stem declinate), ascending, 19–28 mm long, 0.6–0.9 mm diam., bibracteolate at base, densely pubescent with long weak spreading yellow hairs; bracteoles subulate, 1.5–2 × 0.2–0.3 mm. Hypanthium turbinate, 5 mm long, 5–7 mm diam., ca. 1/10 as long as the corolla, densely pubescent with long weak spreading yellow hairs. Calyx lobes narrowly triangular, erect, 6.5–7.7 × 2.5–3 mm, 1/3–1/2 again as long as the hypanthium, ca. 1/5 as long as the corolla tube, densely pubescent with long weak spreading yellow hairs; apex acuminate; margin entire. Corolla bilabiate, infundibular, dark pink outside, paler within, 50–55 mm long, sparsely pubescent along the five major veins with long weak spreading white hairs; tube slightly curved, 33–37 mm long, 3.8–4 mm diam. at base, abruptly narrowing to an isthmus 1.9–2.4 mm diam. just above base, then gradually expanding to 4.6–6.7 mm diam. at mouth; dorsal lobes linear, strictly erect, closely adherent to the staminal column, 15–19 × 0.9–1.2 mm, 2/5–1/2 as long as the tube, the apex acuminate; ventral lobes narrowly triangular, recurved, 9–12 × 1.8–2.5 mm, the apex acuminate. Staminal column exserted between the adherent dorsal lobes; filament tube slightly curved, 45–52 mm long, 0.9–1 mm diam., glabrous; anther tube 2–2.3 mm diam., slightly curved, sparsely pubescent along the connectives with long weak appressed white hairs; dorsal anthers 6–6.5 mm long, 1/7–1/8 as long as the filament tube; ventral anthers 4–4.5 mm long, their apex pubescent with tufts of stiff white hairs 1.5–2 mm long. Capsule rhomboid, 12 mm long, 9 mm diam., half-inferior; seeds broadly ellipsoid, light brown, 0.6 mm long, 0.4 mm diam., the testa minutely reticulate.

Distribution, habitat, and phenology. Apparently endemic to western Venezuela and known only from the type collection.

Etymology. The specific epithet is the Latin participle *adhaerens,* adherent, given in reference to the unusual adherence of the dorsal corolla lobes to the staminal column.

Relationships. In Wimmer's (1953, 1968) treatment of *Siphocampylus, S. adhaerens* keys to a group of six Colombian species in section *Siphocampylus,* subsection *Siphocampylus,* grex *Dissitiflori* F. E. Wimmer, subgrex *Pyriformes* F. E. Wimmer: *S. coronatus* Gleason, *S. hypsophilus* F. E. Wimmer, *S. lecomtei* F. E. Wimmer, *S. megalanthus* Zahlbruckner, *S. sissii* F. E. Wimmer, and *S. venosus* Gleason. These plants share with the novelty a pink, red, or red-purple distinctly infundibular corolla (vs. subcylindric in other species of subgrex *Pyriformes*) 50–62 mm long, and ovate laminas cordate or subcordate at base, and are likely its closest relatives.

Siphocampylus adhaerens may be distinguished from these six species by several characters. The pedicels of all six lack bracteoles and are longer (3–15 cm vs. 1.9–2.8 cm in *S. adhaerens*); their corolla tubes are broader in diameter at the mouth (9–12 mm vs. 4.6–6.7 mm); and their dorsal anthers are longer (7–10 mm vs. 6–6.5 mm). However, the most conspicuous characters distinguishing *S. adhaerens* from its allies involve the dorsal lobes of the corolla.

First, the dorsal corolla lobes of *S. megalanthus* and its allies are shorter than those of *S. adhaerens*: 9–15 mm vs. 15–19 mm. Second, they are similar to the ventral lobes in size, shape, and posture. *Siphocampylus adhaerens,* in contrast, has distinctly dimorphic corolla lobes: the dorsal pair are broadly linear, the ventral narrowly triangular. Furthermore, the dorsal pair are more than half again as long as the ventral three (15–19 mm vs. 9–12 mm) but only half as wide (0.9–1.2 mm vs. 1.8–2.5 mm). In almost all other species of the genus, the dorsal and ventral corolla lobes are of approximately equal width. Three species have dorsal lobes wider than the ventral: *S. planchonis* F. E. Wimmer, *S. polyanthus* F. E. Wimmer, *S. quetamensis* F. E. Wimmer. Only in *S. isochilus* F. E. Wimmer and *S. sceptrum* Decaisne [which comprise *Siphocampylus* sect. *Siphocampylus,* subsect. *Isochilus* F. E. Wimmer (Wimmer, 1968)] are the ventral corolla lobes wider than the dorsal. However, these two species differ from *S. adhaerens* in numerous features (including the open orifice of their *Burmeistera*-like anther tube; cf. Stein, 1987; Lammers, 1998a), and are not closely related to the new species.

Finally, whereas all five corolla lobes have a spreading or recurved posture in *S. megalanthus* and its allies, this is true for only the ventral three in *S. adhaerens.* The dorsal pair are strictly erect and adhere closely to the exserted staminal column, hiding it from sight. This close adherence of the dorsal corolla lobes to the staminal column appears to be unique in the genus, and perhaps in the subfamily.

Figure 14. *Siphocampylus ambivalens* Lammers. (Drawn from the holotype, *Vargas 5061*.)

2. Siphocampylus ambivalens Lammers, sp. nov. TYPE: Bolivia. Florida: Bermejo, 5 km al E subiendo hacia el sillar Tres Cruces, camino del gaseoducto y zona de la antena, 18°08′S, 63°35.5′W, bosque alto en laderas y ondonadas con *Cariniana estrellensis, Pachistroma longifolia* y *Myroxylom peruiferum*, ca. 500 m, 2 Aug. 1996, *I. G. Vargas C. 5061* (holotype, OSH; isotypes, NY, USZ not seen). Figure 14.

Species *Siphocampyli* positione ambivalente umbellam apicalem gregis *Umbellatorum* et folia verticillata gregis *Siphocampyli* combinans.

Shrub, 2–3 m tall; stems scandent, moderately leafy, branched from the base, 3 cm diam. at base, 2.7–5 mm diam. toward apex, moderately pubescent with short scurfy brown hairs; latex white. Leaves whorled, 3 per node, gradually decreasing in size toward apex; lamina narrowly ovate, 6.5–11 × 2.2–4.8 cm, subcoriaceous; adaxial surface dull dark green, sparsely pubescent on the midrib with short scurfy brown hairs; abaxial surface dull light green, moderately pubescent with longer crisped white or brown hairs; margin doubly serrate; apex acuminate; base rounded or subcordate; petiole 5–7 mm long, 1–1.5 mm diam., 1/10–1/20 as long as the lamina, densely pubescent with short scurfy brown hairs. Flowers 7 to 10 in a terminal sessile umbel subtended by a whorl of 3 foliage leaves; bracts linear, 14–15 mm long, 1 mm diam., the apex acuminate; pedicels straight, ascending, 18–22 mm long, 0.5–0.6 mm diam., ebracteolate, densely pubescent with short scurfy brown hairs. Hypanthium broadly obconic or hemispheric, 3–4 mm long, 5 mm diam., 1/12–1/20 as long as the corolla, moderately pubescent with short scurfy brown hairs. Calyx lobes linear-triangular, erect or slightly spreading, 10–12 × 0.7–1 mm, 3–3× as long as the hypanthium, 1/3–1/4 as long as the corolla tube, densely pubescent with short scurfy brown hairs; apex acuminate; margin entire. Corolla tubular, bilabiate, pink-purple with green-yellow limb, 52–56 mm long, densely pubescent with short stiff pale hairs; tube suberect, 38–43 mm long, 5–5.5 mm diam. at base, narrowing to an isthmus 3–4 mm diam. just above base, then gradually expanding to 6.5–8 mm diam. at mouth; dorsal lobes linear-triangular, 13–14 × 1.3–2.3 mm, ca. 1/3 as long as the tube, the apex acuminate; lateral lobes linear-triangular, 11–13 × 2–2.5 mm, the apex acuminate; ventral lobe linear-triangular, 15–16 × 2.5–2.8 mm, the apex acuminate. Staminal column somewhat exserted between the dorsal lobes; filament tube suberect, 47–50 mm long, 1 mm diam., glabrous; anther tube 2–2.1 mm diam., gently curved, with a few long weak white hairs dorsally; dorsal anthers 9–10 mm long, ca. 1/5 as long as the filament tube; ventral anthers 6–7 mm long, their apex pubescent with tufts of stiff white hairs 1.5–2 mm long. Fruit and seeds not seen, but apex of ovary conic, pubescent.

Distribution, habitat, and phenology. Apparently endemic to central Bolivia and known only from the type collection.

Etymology. The specific epithet refers to the species' equivocal taxonomic position in Wimmer's (1953, 1968) classification; from the Latin participle *ambivalens*, ambivalent.

Relationships. *Siphocampylus ambivalens* clearly is referable to section *Siphocampylus*, subsection *Siphocampylus* in Wimmer's (1953, 1968) classification. Within that subsection, however, it combines features of two of the five greges recognized by Wimmer (1953): the terminal umbellate inflorescence of grex *Umbellati* and the whorled leaves of grex *Siphocampylus*. *Siphocampylus* grex *Umbellati* comprises nine species endemic to Colombia [*S. amalfiensis* F. E. Wimmer, *S. densiflorus* Planchon, *S. glareosus* Zahlbruckner, *S. lindleyi* Lemaire, *S. longibracteolatus* F. E. Wimmer, *S. lucifer* F. E. Wimmer, *S. microstoma* Hooker] or Venezuela [*S. moritzianus* F. E. Wimmer, *S. reticulatus* (Willdenow ex Schultes) Klotzsch & H. Karsten ex Vatke], plus one additional species [*S. corymbiferus* Pohl] distributed in Peru, Bolivia, and Brazil (Wimmer, 1953). *Siphocampylus* grex *Siphocampylus* comprises seven species endemic to southern Brazil [*S. duploserratus* Pohl, *S. fluminensis* (Vellozo) F. E. Wimmer, *S. psilophyllus* Pohl, *S. sulfureus* F. E. Wimmer, and *S. westinianus* (Thunberg) Pohl] or Bolivia [*S. orbignianus* A. DC., *S. tenuisepalus* F. E. Wimmer], plus one [*S. verticillatus* (Chamisso) G. Don] distributed in Brazil, Paraguay, Uruguay, and Argentina.

All known species of *Siphocampylus* grex *Umbellati* have alternate leaves. If one ignores its verticillate leaves, *S. ambivalens* will key to *S. reticulatus* of western Venezuela in Wimmer's (1953) treatment of grex *Umbellati.* The two species are similar in a number of features, including size and shape of their leaves, their linear bracts, ebracteolate pedicels, pubescent corollas, and glabrous staminal columns. However, *S. reticulatus* differs in its shorter (1–1.8 m vs. 2–3 m) stature, turbinate (vs. broadly obconic or hemispheric) hypanthium, shorter (35–40 mm vs. 52–56 mm) corolla, and shorter anthers (dorsal pair 5 mm vs. 9–10 mm).

The only species of *Siphocampylus* grex *Umbellati* known from Bolivia is *S. corymbiferus,* whose range extends into Peru and Brazil. This species likewise shows some similarity to *S. ambivalens* in size and shape of its leaves, its ebracteolate pedicels, and glabrous staminal column. However, *S. corymbiferus* differs in its shorter stature (0.6–1.5 m vs. 2–3 m in *S. ambivalens*), longer (8–15 mm vs. 5–7 mm) petioles, ovate or lanceolate (vs. linear) bracts, longer (30–45 mm vs. 18–22 mm) pedicels, short turbinate (vs. broadly obconic or hemispheric) hypanthium, shorter (4–6 mm vs. 10–12 mm) calyx lobes, and shorter (40–50 mm vs. 52–56 mm) glabrous (vs. pubescent) corolla.

All known species of *Siphocampylus* grex *Siphocampylus* have flowers solitary in leaf axils. If one ignores its umbellate inflorescence, *S. ambivalens* will key to *S. westinianus* of southern Brazil in Wimmer's (1953) treatment of grex *Siphocampylus.* The two are similar in a number of features, including size and shape of their leaves, size and color of their corollas, and glabrous staminal columns. However, *S. westinianus* differs in its shorter stature (0.6–0.8 m vs. 2–3 m in *S. ambivalens*), bibracteolate (vs. ebracteolate) pedicels, turbinate (vs. broadly obconic or hemispheric) hypanthium, and shorter (3–4 mm vs. 10–12 mm) calyx lobes.

Two other verticillate-leaved species are endemic to Bolivia: *S. orbignianus* and *S. tenuisepalus.* Both share a number of characters with the new species, e.g., leaf size and shape and corolla size and color are similar in *S. ambivalens* and *S. orbignianus,* hypanthium shape and pedicel length in *S. ambivalens* and *S. tenuisepalus.* However, *S. orbignianus* differs from *S. ambivalens* in its longer (35–40 mm vs. 18–22 mm in *S. ambivalens*) divergent (vs. ascending) bibracteolate (vs. ebracteolate) pedicels, broadly turbinate (vs. broadly obconic or hemispheric) hypanthium, and spreading or reflexed (vs. erect or slightly spreading) calyx lobes. *Siphocampylus tenuisepalus* differs from *S. ambivalens* in its glabrous (vs. pubescent) stems, narrower (2 cm vs. 2.2–4.8 cm) lanceolate (vs. narrowly ovate) laminas cuneate (vs. rounded or subcordate) at base, longer (10 mm vs. 5–7 mm) glabrous (vs. pubescent) petioles, longer (12–17 mm vs. 10–12 mm) spreading or reflexed (vs. erect or slightly spreading) calyx lobes, and longer (65 mm vs. 52–56 mm) corolla.

After careful comparison, it is concluded that despite its umbellate inflorescence, *S. ambivalens* is most likely allied to the verticillate-leaved species that make up *Siphocampylus* grex *Siphocampylus.* Geographic relationships support this view: all but one of the species of grex *Umbellati* are endemic to Colombia or Venezuela while all but one of the species of grex *Siphocampylus* are endemic to Brazil or Bolivia. Further, condensation of stem apices to form corymbiform or umbellate inflorescences appears to have occurred independently in several genera of Lobelioideae (*Burmeistera, Centropogon, Lobelia*) while the sole occurrence of verticillate leaves in the subfamily is in the species of grex *Siphocampylus.* It is thus more parsimonious to hypothesize that *S. ambivalens* is a member of *Siphocampylus* grex *Siphocampylus* that has evolved an umbellate inflorescence from solitary axillary flowers, rather than a member of grex *Umbellati* that has evolved whorled leaves from alternate.

3. Siphocampylus longior Lammers, sp. nov. TYPE: Peru. San Martín: Prov. Rioja, Buenos Aires, along road Pedro Ruiz–Rioja, 05°42′09″S, 77°53′06″W, wet cloud forest, ca. 2000 m, 21 Mar. 1998, *H. van der Werff, B. Gray, R. Vasquez & R. Rojas 15376* (holotype, OSH; isotype, MO). Figure 15.

Species *Siphocampyli* subsect. *Secundiflorum* ab omnibus caeteris speciebus hujus subsectionis petiolis longioribus 15–23 mm longis, pedicellis longioribus 40–65 mm longis, calycis lobis longioribus 7–10 mm longis, et antheris dorsalibus longioribus 11–14 mm longis facile distinguenda.

Suffrutescent liana; stems scandent, often horizontal or pendent, branched, moderately leafy, 2–5 mm diam., minutely scabrid; latex white. Leaves secund; lamina ovate or oblong, 3.5–6 × 2.2–3.2 cm, chartaceous; adaxial surface dull olive green, glabrous; abaxial surface dull, paler, minutely scabrid on the veins; margin minutely serrulate; apex acute or obtuse; base rounded, truncate, or subcordate, and sometimes asymmetric; petiole 15–23

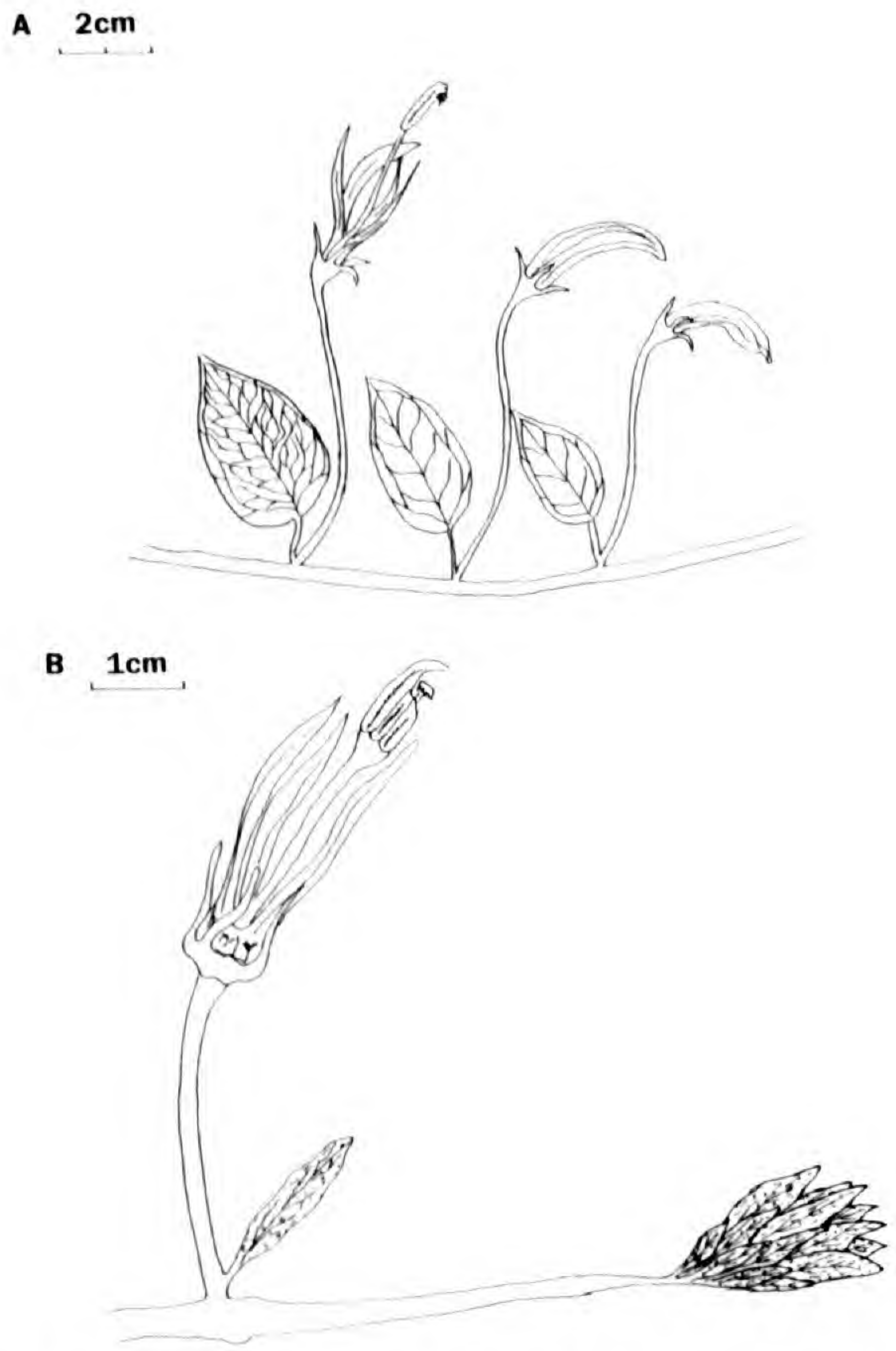

Figure 15. *Siphocampylus longior* Lammers. —A. Upper portion of stem with flowers. (Drawn from the holotype, *van der Werff et al. 15376.*) —B. Flower. (Drawn from the paratype, *van der Werff et al. 15746.*)

mm long, 0.8–1 mm diam., 1/2–1/3 as long as the lamina, minutely scabrid. Flowers in a secund terminal bracteate raceme or sometimes in the axils of unreduced leaves; bracts elliptic, 1.4–1.9 × 0.4–0.7 cm, minutely scabrid, acute or acuminate at apex, attenuate at base, the margin minutely serrulate, on petioles 6–7 mm long; pedicels ascending, curved toward apex, 40–65 mm long, 1.2–1.8 mm diam., ebracteolate, minutely scabrid. Hypanthium turbinate, 5–8 mm long, 7–8 mm diam., 1/5–1/7 as long as the corolla, minutely puberulent. Calyx lobes subulate, ascending, sometimes recurved toward apex, 7–10 × 0.8–1.2 mm above the base, slightly longer than the hypanthium, minutely scabrid; apex acuminate; margin entire. Corolla (imperfect in the material seen) green or maroon, 35–40 mm long, puberulent, more densely so toward base. Filament tube suberect, 32 mm long, 1 mm diam., glabrous; anther tube 3 mm diam., slightly curved, its surfaces glabrous; dorsal anthers 11–14 mm long, 1/3 as long as the filament tube; ventral anthers 8–10 mm long, their apex pubescent with tufts of stiff white hairs 2.5–3 mm long. Fruit and seeds not seen, but apex of ovary conic.

Distribution, habitat, and phenology. Apparently endemic to northern Peru, with both known collections obtained along the road between Pedro Ruiz and Rioja in Departamento de San Martín. Growing in wet cloud forest at 1900–2000 m and flowering in March.

Etymology. The specific epithet is the comparative of the Latin adjective *longus*, i.e., longer, in reference to the fact that this species' petioles, pedicels, calyx lobes, and anthers are longer than those of any other member of the subsection.

Relationships. With its secund terminal bracteate raceme of relatively short-pedicelled flowers, *Siphocampylus longior* is clearly a member of section *Brachysiphon*, subsection *Secundiflori*. This subsection comprises nine species: *S. purdieanus* Planchon is endemic to Colombia, *S. ayersiae* Lammers to Bolivia, and the remainder are distributed in Peru and southern Ecuador (Wimmer, 1953; Lammers, 1998a).

Although the specimens at hand are imperfect, with flowers either in bud or past anthesis, it is clear that they cannot be equated with any previously described member of subsection *Secundiflori*, as their petioles, pedicels, calyx lobes, and anthers are all significantly longer. In the other species of the subsection, petioles are 4–15 mm long (vs. 15–23 mm in *S. longior*), pedicels 8–42 long (vs. 40–65 mm), calyx lobes 1–5 mm long (vs. 7–10 mm), and dorsal anthers 7–11 mm long (vs. 11–14 mm).

Paratypes. PERU. **San Martín:** Prov. Rioja, along road Rioja–Pedro Ruiz, El Mirador, 1900 m, 26 Mar. 1998, *H. van der Werff, B. Gray, R. Vasquez & R. Rojas 15746* (MO, OSH).

4. **Siphocampylus plegmatocaulis** Lammers, sp. nov. TYPE: Peru. San Martín: Prov. Rioja, along road Rioja–Pedro Ruiz, ceja de la montaña, El Mirador, 05°40′29″S, 77°46′25″W, 1850 m, 25 Mar. 1998, *H. van der Werff, B. Gray, R. Vasquez & R. Rojas 15628* (holotype, OSH; isotype, MO). Figure 16.

Species *Siphocampyli* subgregis *Pyriformium* ob caules dimorphos et trichomata dimorpha ad orificium tubi antherarum insignis; caules primageni horizontales 1.2–1.8 mm diametro volubiles dextrorsum (externe visus) sparsim foliacei vel demum nudi, sed rami erecti 0.8–1 mm diametro confertim foliacei basin versus et remote foliacei flagelliformes apicem versus; trichomata ad apicem antherarum dorsalium 0.1–0.3 mm longa, sed haec antherarum ventralium 1–1.4 mm longa.

Vine with dimorphic stems; main stems horizontal, elongate, dextrorsely twining (in external view), 1.2–1.8 mm diam., sparsely leafy or eventually leafless, minutely scabrid; branches erect, 0.8–1 mm diam., highly condensed and densely leafy at base, whip-like and sparsely leafy distally. Lamina narrowly elliptic (sometimes lanceolate on the elongate portions of branches), 1.9–4 × 0.5–1.3 cm, char-

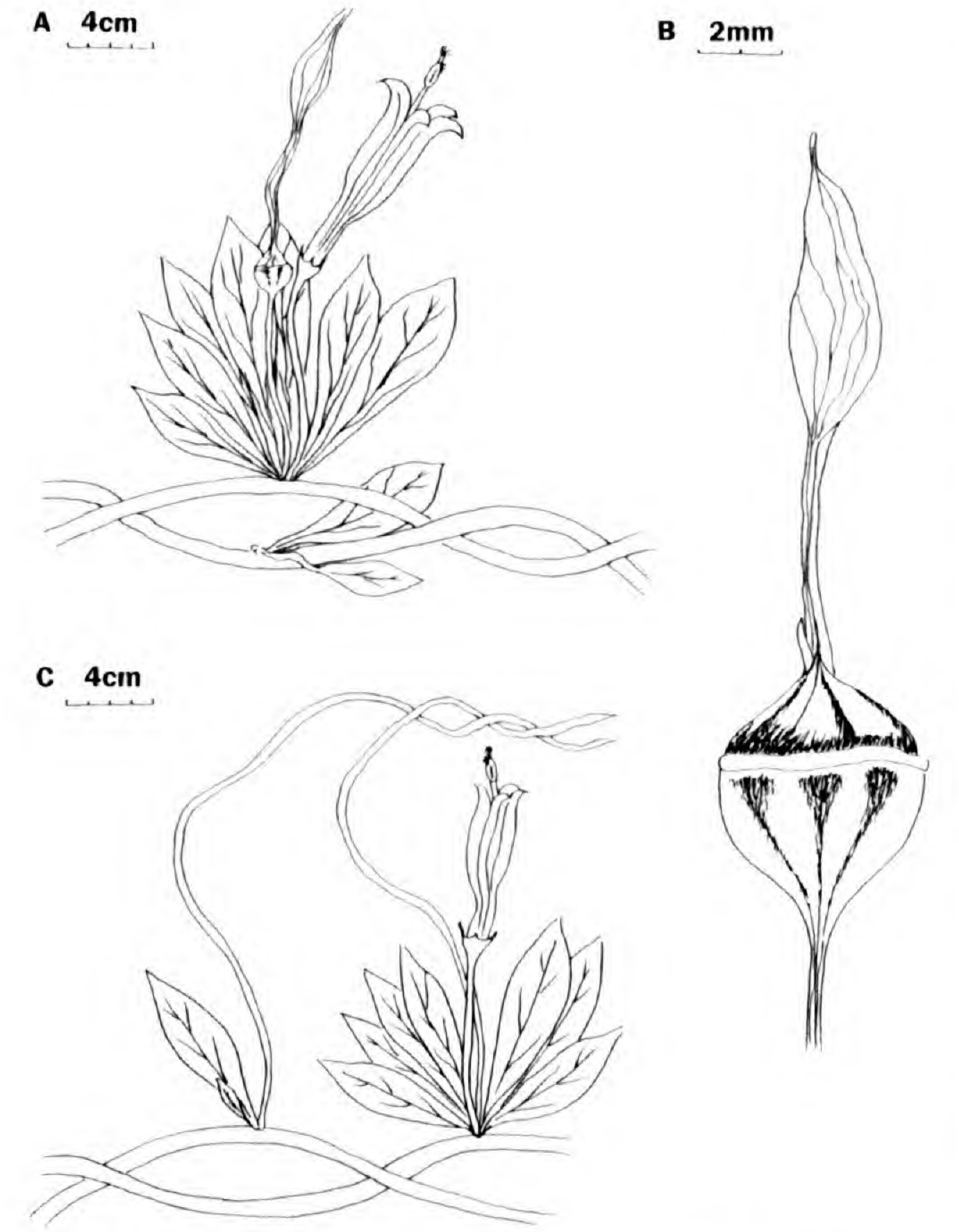

Figure 16. *Siphocampylus plegmatocaulis* Lammers. —A. Portion of horizontal twining main stem with condensed young branch. —B. Young capsule, topped by marcescent corolla. —C. Portion of main stem with erect branches older, elongated, whip-like. (Drawn from the holotype, *van der Werff et al. 15628*.)

taceous; adaxial surface dull olive green, glabrous; abaxial surface dull, paler, sparsely scabrid with minute dark antrorse trichomes; margin minutely serrulate or crenulate with 1 to 4 exserted dark callosities per side; apex acute (sometimes acuminate on the elongate portions of branches), mucronate; base cuneate; petiole 3–7 mm long, 0.6–0.8 mm diam., 1/4–1/10 as long as the lamina, minutely scabrid. Flowers solitary in axils of leaves on the branches; pedicels ascending, 15–38 mm long, 0.5–0.7 mm diam., ebracteolate, hispidulous or minutely scabrid. Hypanthium broadly obconic or turbinate, 2.5–3.5 mm long, 3.1–3.6 mm diam., ca. 1/10 as long as the corolla, hispidulous. Calyx lobes narrowly triangular, erect, slightly recurved at tips, 0.8–1.5 × 0.5–0.7 mm, 3/10–2/5 as long as the hypanthium, ca. 1/20 as long as the corolla tube, hispidulous at base; apex acuminate; margin entire. Corolla deep pink, red, or red-purple, tubular, bilabiate, 27–32 mm long, sparsely hispidulous; tube comprising a proximal isthmus ca. 8 mm long, 2.5–3.4 mm diam. at base and 1.5–2.2 mm diam. at apex, which bends and flares abruptly into an expanded distal portion 8–16 mm long and 4.5–5.5 mm diam. at mouth; dorsal lobes linear-triangular, 7–10 × 1.5–2 mm, spreading, 1/2–1/3 as long as the tube, acuminate at apex; ventral lobes linear-triangular, 7–9 × 1.5–1.9 mm, spreading, acuminate at apex. Staminal column slightly exserted; filament tube suberect, 23–26 mm long, 1 mm diam., glabrous; anther tube 1.6–1.7 mm diam., suberect, its surfaces glabrous; dorsal anthers 4.5–5 mm long, 1/5 as long as the filament tube, their apex pubescent with tufts of stiff white hairs 0.1–0.3 mm long; ventral anthers 3.5–4 mm long, their apex pubescent with tufts of stiff white hairs 1–1.4 mm long. Capsule obovoid, 8–9 mm long, 5.5–6 mm diam., 2/3–3/4-inferior; mature seeds not seen.

Distribution, habitat, and phenology. Apparently endemic to northern Peru, collected a few times in the vinity of Pedro Ruiz in Departamento de San Martín. Growing in *pajonal* vegetation on exposed ridges and in shrubs bordering cloud forest, 1850–2200 m. Flowering from February to August; fruit maturing from March to August.

Etymology. The specific epithet refers to the dextrorsely twining stems; from the Greek nouns πλεγμα, twist, and καυλος, stem.

Relationships. Though many species of *Siphocampylus* are scandent, a truly twining habit is rare in the genus, known from only *S. convolvulaceus* (Chamisso) G. Don of Brazil and *S. cordatus* (Willdenow ex Schultes) F. E. Wimmer of Venezuela and Colombia. These two species are referable to *Siphocampylus* sect. *Siphocampylus*, subsect. *Siphocampylus*, grex *Dissitiflori*, subgrex *Pyriformes*, as is the new species. These three species further share ebracteolate pedicels, obconic or turbinate hypanthia, and glabrous filament tubes. However, *S. convolvulaceus* and *S. cordatus* differ from *S. plegmatocaulis* in their longer petioles (5–20 mm vs. 3–7 mm in *S. plegmatocaulis*); larger laminas (4–9 × 1.2–3 cm vs. 1.9–4 × 0.5–1.3 cm) that are rounded, truncate, or subcordate (vs. cuneate) at base; longer calyx lobes (2–7 mm vs. 0.8–1.5 mm); corollas that are longer (45–60 mm long vs. 27–32 mm long) and broader (2–3 mm at isthmus vs. 1.5–2 mm, 5–9 mm at mouth vs. 4.5–5.5 mm); longer dorsal anthers (6–7 mm vs. 4.5–5 mm) that are glabrous (vs. bearded) at apex; and longer capsules (1.5–2 cm vs. 0.8–0.9 cm).

Though *S. convolvulaceus* and *S. cordatus* are twining vines, neither produces the unique dimorphic stems of *S. plegmatocaulis*. For this reason, it seems unlikely that the new species is closely related to either of the other two twiners. Instead, *S. plegmatocaulis* may represent an independent origin of the twining habit, perhaps as an adaptation to life in exposed, nutrient-poor *pajonal*, an unusual habitat for the genus.

In addition to the dimorphic twining stems, the dimorphic pubescence surrounding the orifice of the anther tube in *S. plegmatocaulis* is unique in *Siphocampylus*. Most members of the genus only have apical tufts of trichomes on the ventral pair of anthers. Just five species bear tufts of trichomes at the apex of all five anthers: *S. isochilus*, *S. oscitans* B. A. Stein, *S. sceptrum* (sometimes all five glabrous), *S. rusbyanus* Britton, and *S. splendens* (F. E. Wimmer) Jeppesen ex B. A. Stein. However, in these five species, the hairs of the dorsal and ventral anthers are similar in size, while those of *S. plegmatocaulis* differ significantly: 0.1–0.3 mm on the three dorsal anthers, 1–1.4 mm long on the ventral pair. Furthermore, these five species all have a *Burmeistera*-like anther tube with a wide open orifice (cf. Stein, 1987; Lammers, 1998a). In *S. plegmatocaulis*, the orifice of the anther tube is occluded, as is typical for *Siphocampylus* and most genera of Lobelioideae. None of these five species is referable to *Siphocampylus* subsect. *Siphocampylus*, and none is believed to be related to *S. plegmatocaulis*. In summary, the affinities of this new species remain obscure.

Paratypes. PERU. **San Martín:** Prov. Rioja, Pedro Ruiz–Moyobamba road, km 368, Campamento García, 05°45′S, 77°43′W, *pajonal* vegetation, a vegetation type developing due to exposure and poor soil, here found on ridges, 1900 m, 14 Aug. 1983, *D. N. Smith 4803* (MO, OSH); Prov. Rioja, Río Nieva valley, ca. 100 km W of Rioja on road to Pedro Ruiz, 1 km E of Puente Río Nieva, 05°47′S, 77°40′W, twining through shrubs along road in low cloud forest, 2000 m, 16 Feb. 1985, *B. Stein & C. Todzia 2204* (MO).

5. **Siphocampylus praevaricator** Lammers, sp. nov. TYPE: Venezuela. Mérida: Páramo de los Colorados, road to San Isidro Alto, 4 km from junction with Estanques–Páramo del Molino road, 2600 m, 3 Feb. 1978, *J. L. Luteyn, M. Lebron-Luteyn & L. Ruiz-Teran 5408* (holotype, OSH; isotypes, MERF not seen, NY, VEN not seen). Figure 17.

Species ob trichomata arbusculiformia *Centropogonem* subsect. *Brevilimbatos* (praecipue *C. acrodentatum* et *C. alatum*) simulans sed ovarii apice conico et floribus in racemo terminali subumbellato, ergo in *Siphocampylum* gregem *Umbellatos* disposita; in hoc grege *S. reticulato* et *S. moritziano* affinis, sed ab his speciebus trichomatibus arbusculiformibus in caule foliis inflorescentia corollaque, calycis lobis triangularis erectis 3–4 mm longis, filamentorum tubo minute puberulo, et antherarum tubo apicem versus hirto statim distinguenda. Ab omnibus caeteris speciebus *Siphocampyli* cum trichomatibus arbusculiformibus racemo terminali subumbellato differt.

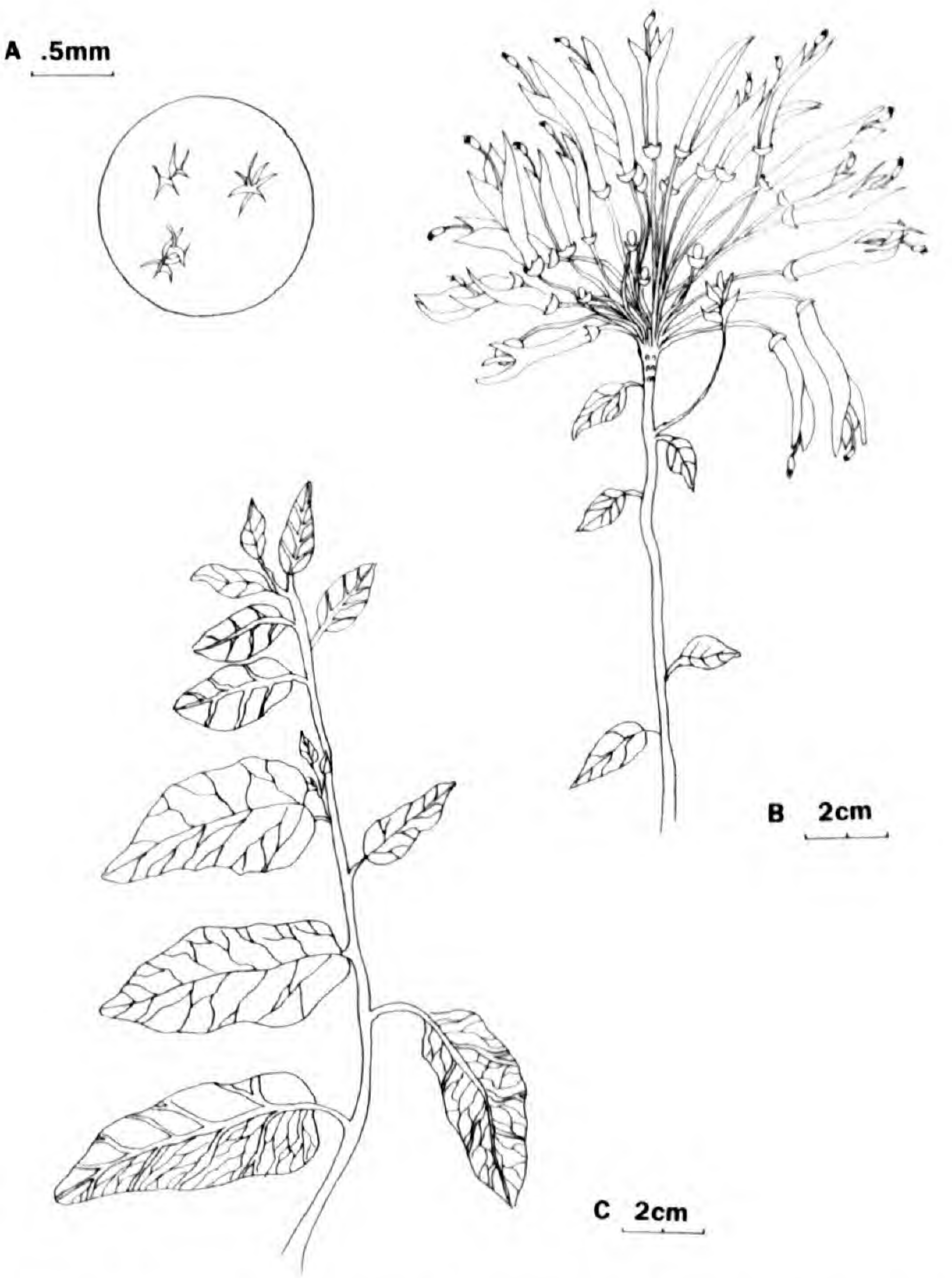

Figure 17. *Siphocampylus praevaricator* Lammers. —A. Arbusculiform trichomes on abaxial leaf surface. —B. Upper portion of fertile stem. —C. Upper portion of sterile stem. (Drawn from the holotype, *Luteyn et al. 5408*.)

Suffrutescent herb; stems scandent, moderately leafy, 2–2.5 mm diam., densely pubescent with arbusculiform trichomes; latex white. Lamina ovate or narrowly ovate, 4.5–6.5 × 2.8–3.5 cm, coriaceous, those on the stem below the inflorescence smaller; adaxial surface shiny olive green, glabrous or with a few arbusculiform hairs along the midrib; abaxial surface dull ochreous, densely pubescent with arbusculiform trichomes; margin irregularly dentate with smaller and larger teeth alternating; apex acute or acuminate; base cordate; petiole 14–18 mm long, 1.3–1.5 mm diam., 1/3–1/4 as long as the lamina, sparsely pubescent with arbusculiform trichomes. Flowers 30 to 35 in a terminal subumbellate raceme; rachis congested, condensed, 25 mm long; bracts linear, 4–6 × 0.2–0.3 mm, the apex acuminate; pedicels straight or somewhat curved, ascending, 22–27 mm long, 0.7–1 mm diam., ebracteolate, densely pubescent with arbusculiform trichomes. Hypanthium turbinate, 5 mm long, 5 mm diam., 1/8–1/10 as long as the corolla, densely pubescent with arbusculiform trichomes. Calyx lobes triangular, erect, 3–4 × 1.5–2 mm, 3/5–4/5 as long as the hypanthium, 1/8–1/10 as long as the corolla tube, densely pubescent with arbusculiform trichomes; apex acuminate; margin entire. Corolla bilabiate, deep violet outside, paler within, 42–47 mm long, moderately pubescent with arbusculiform trichomes; tube suberect, 30–34 mm long, 4.5–4.8 mm diam. at base, abruptly narrowing to an isthmus 2.2–2.3 mm diam. just above base, then gradually expanding to 6.7–7.5 mm diam. at mouth; dorsal lobes narrowly triangular, erect, 12–13 × 2.3–3.5 mm, 2/5 as long as the tube, the apex acuminate; ventral lobes narrowly triangular, spreading, 7–10 × 2–2.8 mm, the apex acuminate. Staminal column exserted between the dorsal lobes; filament tube suberect, pale violet, 43–45 mm long, 0.7–1 mm diam., minutely puberulous; anther tube gray, 2–2.2 mm diam., suberect, sparsely pubescent with straight simple white hairs; dorsal anthers 6 mm long, 1/7–1/8 as long as the filament tube; ventral anthers 4.5–5 mm long, their apex pubescent with tufts of stiff white hairs 0.8–1 mm long. Fruit and seeds not seen, but apex of ovary conic.

Distribution, habitat, and phenology. Apparently endemic to western Venezuela and known only from the type collection.

Etymology. The specific epithet is the Latin noun *praevaricator*, one who speaks or behaves in a deceitful, ambiguous, or equivocal fashion. While the new species belongs to *Siphocampylus*, its arbusculiform trichomes might mislead one into assuming that it is a member of *Centropogon*.

Relationships. As noted under *Burmeistera arbusculifera*, arbusculiform hairs are common in *Centropogon* but very rare in other genera of Lobelioideae. Just three species of *Siphocampylus* have been reported to bear such trichomes (McVaugh, 1949; Lammers, 1998a): *S. columnae* (L. f.) G. Don and *S. furax* F. E. Wimmer of northern Ecuador, and *S. fallax* Lammers of northern Peru. All are referable to *Siphocampylus* sect. *Siphocampylus*, subsect. *Siphocampylus*, grex *Dissitiflori*, a group that is characterized in part by flowers solitary in the upper leaf axils (Wimmer, 1953). *Siphocampylus praevaricator*, on the other hand, bears its flowers in a congested terminal subumbellate raceme, and so is referable to a different element of subsection *Siphocampylus*, grex *Umbellati* (described above under *S. ambivalens*).

In Wimmer's (1953) treatment of *Siphocampylus* grex *Umbellati*, *S. praevaricator* would key with difficulty to *S. moritzianus* and *S. reticulatus*. Both these species are endemic to Venezuela and occur in Mérida; the former species is endemic to that state, the latter more widely distributed. However, these species differ from *S. praevaricator* in their simple (vs. arbusculiform) trichomes on stems, leaves, and inflorescences; filiform or sublinear (vs. triangular) calyx lobes which are longer (6–10 mm vs. 3–4 mm) in *S. reticulatus* and recurved at apex (vs. erect) in *S. moritzianus*; glabrous (vs. minutely puberulent) filaments; and glabrous (vs. pubescent) anther tubes.

Because arbusculiform hairs are so much more common in *Centropogon* than in *Siphocampylus*, one must consider the possibility that this anomalous *Siphocampylus* has been described already as a species of *Centropogon*. An author who did not have mature fruit or did not dissect a flower to examine the ovary might well be led to assign this plant to *Centropogon*. The two genera clearly are closely related (Pepper et al., 1997; Lammers, 1998a; Buss et al., 2001), and there are many examples of species of one genus being described under the other.

Siphocampylus praevaricator does indeed show some resemblance in general size and shape of the leaves and flowers to two species of *Centropogon* subsect. *Brevilimbati* endemic to high-elevation *páramo* habitats in Mérida: *C. acrodentatus* F. E. Wimmer and *C. alatus* Gleason. However, both these species (as well as all other species of subsect. *Brevilimbati*) bear solitary axillary flowers rather than terminal subumbellate racemes. Furthermore, these two species of *Centropogon* have longer pedicels (8 cm in *C. acrodentatus*, 5–6 cm in *C. alatus*, vs. 2.2–2.7 cm in *S. praevaricator*), which are bibracteolate toward the base (vs. ebracteolate). Thus it does not appear that *S. praevaricator* has been described already under the genus *Centropogon*.

One last hypothesis to consider is that *S. praevaricator*, with the terminal subumbellate raceme characteristic of *Siphocampylus* grex *Umbellati* and the arbusculiform hairs characteristic of *Centropogon* subsect. *Brevilimbati*, is the result of hybridization between *S. moritzianus* or *S. reticulatus* on the one hand and *C. acrodentatus* or *C. alatus* on the other. The co-occurrence of all four species in Mérida certainly makes this possibility tempting. However, this seems unlikely. Neither of the salient characters of *S. praevaricator* is intermediate between the hypothesized parents. The inflorescence is as tight and congested as that of any member of *Siphocampylus* grex *Umbellati*, with highly reduced bracts; there is no tendency whatsoever toward the production of flowers in the axils of unreduced foliage leaves. Similarly, the hairs are fully as dense and arbusculiform as any member of subsection *Brevilimbati*, showing no tendency toward reduction in branching or density. It thus seems best to hypothesize that in *S. praevaricator*, the presence of these unusual trichomes is not due to gene flow from a species of *Centropogon* but rather is the result of yet another independent evolutionary origin of these structures.

ADDENDUM

In addition to the new species described here, the 400 specimens of neotropical Lobelioideae identified over the past four years have included some additional collections of species described as new in a previous paper (Lammers, 1998a), most of which were based solely on the type gathering.

Burmeistera racemiflora Lammers, Brittonia 50: 258. 1998.

COLOMBIA. **Nariño:** en la vía Tumaco–Pasto, km 105, a 7 km de el Diviso, 850 m, en bosque, 12 June 1986, *H. León & P. Maas 1622* (U). The species was described solely from the type, collected in Carchi, Ecuador. This second collection, made five years earlier, extends the species' range across the border into adjacent Colombia.

Centropogon dianae Lammers, Brittonia 50: 257. 1998.

PERU. **Cuzco:** kms. 143–152, Ollantaytambo–Alfamayo Rd., 58–67 km NW of Ollantaytambo, 3110–3415 m, montane cloud forest, infrequent, 11 Dec. 1978, *J. L. Luteyn & M. Lebrón-Luteyn 6456* (F). The species was described solely on the basis of the type. This second gathering was collected five years earlier in the same general region.

Centropogon jeppesenii Lammers, Brittonia 50: 252. 1998.

ECUADOR. **Napo:** trail to La Bonita ca. 1–2 km from end of Tulcán–Sta. Bárbara rd., ca. 25 km below Sta. Bárbara, 2100–2150 m, 0°35′N, 77°30′W, cloud forest & clearings above Río Chingual, 28 May 1985, *B. A. Stein 2871* (MO). The species was described solely on the basis of the type gathering. This second collection was made three years later at or near the type locality.

Siphocampylus smilax Lammers, Brittonia 50: 240. 1998.

BOLIVIA. **Santa Cruz:** Prov. Ichilo, Parque Nacional Amboró, ca. 15 km (SE) up the Río Pitasama from the Río Surutú, moist tropical forest on lower montane slopes, sandstone, 700 m, 17°44′S, 63°40′W, 26 Aug 1985, *J. C. Solomon & S. Urcullo 14074* (MO). This collection extends the species' distribution to a fourth province in Depto. Santa Cruz; it was previously reported from localities in Prov. Andrés Ibanez, Cordillera, and Florida.

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Dyckia delicata (Bromeliaceae), a New Species from Rio Grande do Sul, Brazil

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ABSTRACT. *Dyckia delicata*, a narrow-endemic bromeliad from basaltic outcrops in the state of Rio Grande do Sul, Brazil, is described and illustrated. It is similar to *Dyckia hebdingii*, from which it is distinguished by its leaves with soft, non-injurious spines, glabrous and few-branched or unbranched inflorescences, and triangular-shaped seeds.

RESUMEN. Se describe e ilustra *Dyckia delicata*, una Bromeliácea endémica restringida a los afloramientos basálticos del estado de Rio Grande do Sul, Brasil. La especie se parece a *Dyckia hebdingii*, de la cual se diferencia por las hojas con espinos suaves, no punzantes, por la inflorescencia glabra y poco o no ramificada y por las semillas triangulares.

Key words: Brazil, Bromeliaceae, *Dyckia*.

The first thorough study of Bromeliaceae in Rio Grande do Sul (Winkler, 1982), the southernmost Brazilian state, listed 15 native species of *Dyckia*, 8 of which are endemic. Since then, 4 more were described (Irgang & Sobral, 1987; Smith, 1988, 1989; Strehl, 1998), so that now there are 12 endemic species, at least half of which are known from only one collection site—that is, can be considered as narrow endemics. This relatively high rate of endemism could be due to the occurrence of pluvial forests on about half of the state, resulting in the isolation of some mountain tops and rocky outcrops; this, in turn, may have caused some isolated populations of plants to evolve as species of their own.

During collecting trips to the hinterland of Rio Grande do Sul, a geographically restricted, small, and soft-spined species of *Dyckia* growing in isolated basaltic outcrops came to our attention and is herein described as new.

Dyckia delicata Larocca & Sobral, sp. nov. TYPE: Brazil. Rio Grande do Sul: Barros Cassal, Linha Pessegueiro, ca. 5 km da sede do município, 29°07′S, 52°35′W, 350 m s.m., Dec. 1996, *J. Larocca, A. D. Nilson & M. Sobral 96/001* (holotype, ICN; isotypes, MBM, US, ZSS). Figures 1, 2.

[Live specimens at Porto Alegre Botanical Garden and Fundação Gaia at Pantano Grande.]

Species *D. hebdingi* proxima, a qua spinis foliorum papyraceis, non pungentibus, inflorescentiis pauciramosis glabrisque et seminibus triangularibus recedit.

Rosetted herb, 0.2–0.6 m diam. Leaves succulent, cinereous to reddish-cinereous, eventually curled toward the soil in some isolated individuals, densely covered on both faces with pale scales up to 1 mm long; leaf sheaths wide-triangular; blades linear-triangular, 5–20 cm long and 0.7–2 cm wide; apex forming a rigid spine; margin undulate with soft, flexible spines 5–7 × 1–1.5 mm, straight, retrorse or antrorse, spaced 3–5 mm from each other. Inflorescences 80–150-flowered, erect, simple or compound spikes, glabrous, with the axis softly ridged longitudinally, to 1.2 m long, the main inflorescence axis up to 5 mm diam. at the base; secondary branches when present 1–9, to 35 cm long. Scape bracts linear-lanceolate, papyraceous, soft to the touch, with 10–20 parallel nerves, glabrous, longer than the internodes in the lower half of the axis and shorter in the upper one, 30–55 × 6–10 mm, with spines up to 3 mm long in the upper portion. Floral bracts elliptic-ovate, rounded or acute at apex, glabrous, 5.5–8 × 5–6 mm. Calyx green, the sepals ovate-oblong, rounded at apex, 6–7 × 3.5–4 mm, the margins hyaline for about 1 mm. Corolla campanulate or urceolate, yellow, the petals lanceolate-spathulate to oblanceolate, 10–13 mm long, 3–4 mm wide. Stamens 6, 9–10 mm, the antisepalous and epipetalous somewhat unequally

Figure 1. Flowering individuals of *Dyckia delicata* (*Larocca et al. 96/01*). Scale bar = 100 mm. Photograph J. Larocca.

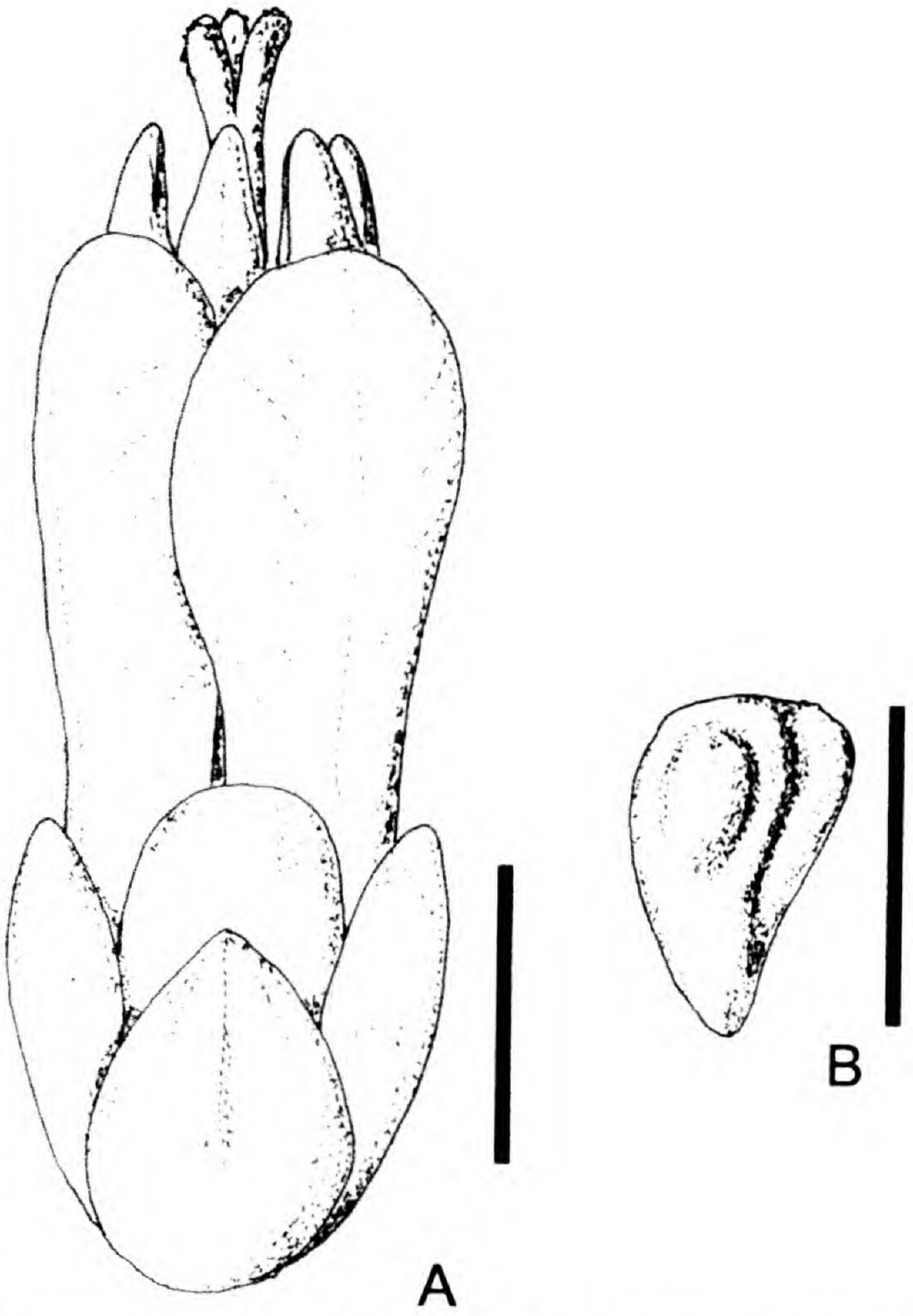

Figure 2. *Dyckia delicata.* —A. Schematic drawing of flower in abaxial view (*Sobral et al. 9204*). —B. Seed (*Larocca & Záchia 95/025*). Scales: A: 3 mm; B: 1 mm.

fused with the base of the corolla; anthers lanceolate-ovate, ca. 2 × 1 mm. Style 7–10 × 0.2 mm; stigmatic lobes 3, papillose. Ovary triquetrous, oblong-acute, 7 mm long and 2.5–3 mm diam., trilocular with numerous ovules centrally attached in two longitudinal rows per locule. Capsules elliptic, 9–12 × 3–5 mm. Seeds triangular-shaped, 1.2–1.7 × 0.5–1 mm, with a reduced wing 0.1–0.2 mm wide along the longitudinal axis.

Habitat, distribution, and phenology. Rupicolous, collected on steep, 60°–90° basaltic cliffs with northeastern exposure, where it occurs with *Parodia haselbergii* (Rümpler) F. H. Brandt (Cactaceae), *Sinningia macrostachya* (Lindley) Chautems (Gesneriaceae), and *Tillandsia recurvata* (L.) L. (Bromeliaceae). This species is known only from the type locality, and appears to be a narrow endemic of basaltic outcrops in Rio Grande do Sul. The collection site at Linha Pessegueiro consists of two small mountains with basaltic outcrops some 100 m apart. We have found the species growing on both outcrops, and we think it is probable that it also grows on other near outcrops, although we were not able to verify this. Flowers were observed in November, December, and January, and fruits in January and February (pers. obs. from the field and cultivated material).

Etymology. The species was named after the Latin word "delicata," delicate, in allusion to its soft, non-injurious spines, the most evident and readily verifiable character of the species.

Affinities. *Dyckia delicata* is apparently related to *D. hebdingii* L. B. Smith (Smith & Downs, 1974; Winkler, 1982), another narrow endemic known from only one locality on the southern slopes of the southern Brazilian plateau known as Serra Geral, 250 km southeast of the collection site of *D. delicata.* The two species can be set apart by the following characters:

1a. Leaves with rigid spines, injurious to the touch; inflorescences profusely branched, with ramifications up to third degree; scape bracts reddish and divergent from the axis; scapes lepidote; flowers pilose; floral bracts always shorter than the sepals; seeds linear-shaped . . *Dyckia hebdingii*

1b. Leaves with soft spines, not injurious to the touch (except the apical spine); inflorescences simple or with ramifications up to second degree, in this case with fewer than 10 branches; scape bracts green, not divergent from the axis; scapes and flowers glabrous; floral bracts varying from shorter than to longer than sepals; seeds triangular-shaped . . . . *Dyckia delicata*

Paratype. BRAZIL. **Rio Grande do Sul:** Barros Cassal, Linha Pessegueiro, ca. 5 km da sede do município, 29°07′S, 52°35′W, 350 m s.m., Dec. 1995, *Larocca & Záchia 95/025* (ICN).

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Notes on the Species of *Cycas* (Cycadaceae) from Sri Lanka and Islands of the Andaman Sea

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ABSTRACT. Two cycad species, *Cycas nathorstii* endemic to Sri Lanka and *Cycas zeylanica* native to Sri Lanka and islands of the Andaman Sea, are discussed. A new combination, *Cycas zeylanica* (J. Schuster) Lindstrom & K. D. Hill, is established, elevating this taxon from subspecies status on the basis of cataphyll and leaflet characters. Both *Cycas* species are lectotypified. Distribution of the two species is investigated, and a key to the species is provided.

Key words: Andamans, Cycadaceae, *Cycas*, Sri Lanka.

The identity of the cycads native to Sri Lanka has never been clearly understood from the earliest recording of these plants in the region. The first record for this country was in *Flora Zeylanica*, published by Linnaeus in 1747. Linnaeus (1753) later treated this as one element of *Cycas circinalis* L. Schuster (1932) separated the Sri Lankan material as *C. nathorstii* J. Schuster, and de Laubenfels and Adema (1998) included some but not all Sri Lankan material in *C. sphaerica* Roxburgh.

Cycas sphaerica is endemic to southeastern India, and only *C. nathorstii* and *C. zeylanica* are therefore here recognized as being native to Sri Lanka. The latter also occurs in the Andamans and Nicobar Islands where its populations are considered vulnerable.

About 90 species are recorded for the genus *Cycas* L. worldwide. Of these, 27 species are Australian and about 35 are Indo-Chinese. *Cycas* also occurs in the Malesian region, Japan, India, and Sri Lanka extending to Micronesia and Polynesia, Madagascar, and East Africa. Plants are commonly understory shrubs in forest, woodland, or savanna habitats. Four sections have been recognized (Hill, 1995), but only one of these sections with two subsections occurs naturally in Sri Lanka. Three subsections are recognized, circumscription following Hill (1995), with two occurring in Sri Lanka: subsection *Cycas* and subsection *Rumphiae*. The full range of the section is from India and southern Indochina south to Australia, and from East Africa east to Tonga.

KEY TO THE SPECIES OF *CYCAS* IN SRI LANKA

1a. Lateral spines on megasporophylls distinct; cataphylls thinly sericeous or glabrous with age, not pungent, 50–60 mm long; midrib of median leaflets raised above and below; 6–10 ovules; no spongy layer . . . . *C. nathorstii*

1b. Lateral spines on megasporophylls indistinct; cataphylls pilose, pungent, 100–120 mm long; midrib of median leaflets raised above and flat below; 2–5 ovules; spongy layer present . . . . *C. zeylanica*

Cycas subsect. *Cycas* (approx. 5 species) is defined by the absence of a spongy endocarp, the presence of fibers in the sarcotesta, and a narrow megasporophyll lamina. It ranges from India to Sri Lanka. A single endemic species is found in Sri Lanka.

Cycas nathorstii J. Schuster, Pflanzenr. 99: 76, fig. 10E. 1932. TYPE: Sri Lanka. Central and northern parts of the isle, 1866, *G. Thwaites 3689 in Herb. Barbey-Boisser* (lectotype, designated here, G; isolectotypes, A, K, LE, P).

Stems arborescent, 1–4.5 m tall. Leaves bright green, semiglossy, 160–180 cm long, flat (not keeled) in cross section (opposing pinnae inserted at 180° on rachis), with 140 to 170 leaflets, tomentum shedding as leaf expands. Petiole 45–55 cm long (25–30% of total leaf), petiole glabrous, spinescent for 90–95% of length. Basal leaflets not gradually reducing to spines. Median leaflets simple, weakly discolorous, 190–310 × 9–14 mm, narrowed to 3–4 mm at base (to 25–35% of maximum width), 17–20 mm apart on rachis; median leaflets flat; margins flat; apex softly acuminate, not spinescent; midrib raised above, raised below. Cataphylls narrowly triangular, soft, sparsely sericeous or lacking tomentum, 50–60 mm long, persistent. Pollen cones narrowly ovoid, orange; microsporophyll lamina firm, not dorsiventrally thickened, 30–40 × 15–22 mm, apical spine prominent, gradually raised, 10 mm long. Megasporophylls 15–30 cm long; ovules 6 to 10, glabrous; lamina lanceolate, 40–65 × 18–25 mm, shortly dentate with 26 to 40 lateral spines 1–4 mm long; apical spine distinct from lateral spines, 10–14 mm long. Seeds flattened-ovoid; sarcotesta yellow; fibrous layer present; sclerotesta smooth; spongy layer absent.

Historical notes. This upland cycad from Sri Lanka has been generally known as *C. circinalis* (Trimen, 1898) and was in fact one element of the protologue of the latter (Linnaeus, 1747). German historian and sometime botanist Julius Schuster distinguished *C. nathorstii* from *C. circinalis* in 1932 on the basis of specimens collected by George Thwaites and distributed to European herbaria by Swiss botanist and philanthropist William Barbey-Boissier (1842–1914). Thwaites (1812–1882) was superintendent of the Royal Botanic Garden at Peradeniya in Ceylon from 1849 to 1880. Collection detail cited (Schuster, 1932: 76) was "Ceylon: Thwaites 1866 n. 3689 in Herb. Barbey-Boissier." The Barbey-Boissier herbarium and types are in G, including Thwaites's specimen. This may not have been the specimen examined by Schuster, as it has no annotation by him and was filed as undetermined. Schuster's types were mainly in B and were destroyed during World War II. This sheet at G includes both leaflets and megasporophylls, and is here designated the lectotype. De Laubenfels and Adema (1998) included *C. nathorstii* in the synonymy of *C. sphaerica*, but also placed some Sri Lankan collections of the same taxon in *C. circinalis*.

Distinguishing features. *Cycas nathorstii* is distinguished from *C. circinalis* and *C. sphaerica* of the Indian mainland by its more robust habit, wider leaflets, and larger male cones with longer and more curved apical spines on microsporophylls. Megasporophyll apices of *C. nathorstii* are narrowly triangular with numerous fine lateral spines extending almost to the very tip, whereas the Indian species possess broader apices with a distinct extended apical spine that is free from lateral teeth. *Cycas nathorstii* is distinguished from *C. zeylanica* by the more closely spaced and more chartaceous leaflets, the shorter, softer and less pubescent cataphylls, and lack of a spongy layer in the seeds.

Distribution and habitat. Known only from Sri Lanka, where it occurs in inland and upland forests in the north of the island, usually in somewhat dry sites.

Reproductive biology. No confirmed or potential pollinator has been recorded for *Cycas nathorstii*.

Conservation status. Still locally frequent, although not in great numbers, this species is regarded as vulnerable (IUCN, 1998, Red List category VU).

Vernacular. Madu.

Etymology. Honoring Swedish palaeobotanist Alfred Gabriel Nathorst (1850–1921), professor at the Natural History Museum in Stockholm.

Specimens examined. SRI LANKA. Ceylon, *herb. P. Herm. s.n.* (L); hort. Kew. ex Ceylon, 1875, *Thwaites 4230* (K); between Kuda Patessa and Maha Patessa, 15 July 1969, *Cooray & Wirawan 1145* (A, K, L, NY); ridge S of Na-Ulpota, 8 Aug. 1973, *Jayasuriya 1278* (K); Manerangata district, Bibile, 18 July 1972, *Hepper & de Silva 4723* (K); Manerangata district, 3.2 km E of Bibile, 28 Nov. 1970, *Fosberg & Sachet 53148* (K, NY); Mandae, *Oldmanas 53* (L); Moraragale district, Nilgala, Gal Oya National park, 1 May 1975, *Jayasuriya 1951* (L); NW Province, Puttalam district, Wilpattu National Park, Kudu patassa, 1 Nov. 1974, *Davidse 8237 & Sumithraarachi* (BRI, K, L).

Cycas subsect. *Rumphiae* K. D. Hill is uniquely defined by the presence of a layer of spongy tissue within the seed. Its distribution is very wide, extending from Africa to Fiji and Tonga, and from New Guinea north to southern coastal Indochina. One species, *Cycas zeylanica*, occurs in Sri Lanka and islands in the Andaman Sea. This subsection contains approximately 11 species, but the taxonomy of the group is difficult and unclear. All species in the *C. rumphii* complex have appeared in the literature erroneously as *C. circinalis* at some stage (see Hill, 1994). A spongy layer causes seeds to be buoyant, and this has been proposed as a dispersal mechanism (Dehgan & Yuen, 1983). This dispersal mode has been interpreted as a cause of the taxonomic complexity of this group (for discussion, see Hill, 1994; Fosberg & Sachet, 1975).

Cycas zeylanica (J. Schuster) A. Lindstrom & K. D. Hill, comb. et stat. nov. Basionym: *Cycas rumphii* subsp. *zeylanica* J. Schuster, Pflanzenr. 99: 75, figs. 10C–D, 11K–M. 1932. TYPE: Sri Lanka. 1866, *Thwaites 3862 in Herb. Barbey-Boissier* (lectotype, designated here, G; isolectotypes, A, K, LE).

Stems arborescent, to 3 m tall. Leaves bright to deep green, semiglossy, 140–190 cm long, flat (not keeled) in cross section (opposing pinnae inserted at 180° on rachis), 70 to 100 leaflets, with white or orange tomentum shedding as leaf expands; rachis consistently terminated by paired leaflets. Petiole 50–70 cm long (30–40% of total leaf), petiole glabrous, spinescent for 30–100% of length. Basal leaflets not gradually reducing to spines. Median leaflets simple, strongly discolorous, 180–300 × 12–15 mm, narrowed to 6–7 mm at base (to 40–50% of maximum width), 22–27 mm apart on rachis; median leaflets flat; margins slightly recurved; apex acute, not spinescent; midrib raised above, flat below. Cataphylls linear, pungent, pilose, 100–120 mm long, persistent. Pollen cones fusiform; microsporophyll lamina firm, not dorsiventrally thickened, 35–45 × 17–19 mm, apical spine prominent, sharply upturned, 3–10 mm long. Megasporophylls 17–30 cm long; ovules 2 to 5, glabrous; lamina lanceolate, 60–120 × 10–17 mm, obscurely dentate with 6 to 12 lateral bumps or short spines to 2 mm long; apical spine distinct from lateral spines, 40–60 mm long. Seeds flattened-ovoid; sarcotesta orange-brown; fibrous layer absent; sclerotesta smooth; spongy layer present.

Historical notes. Collection detail cited (Schuster, 1932: 75) was "Ceylon: Thwaites 1866 n. 3862 in Herbar. Barbey-Boissier." Schuster's herbarium and types were in B, and were destroyed in World War II. The Barbey-Boissier herbarium and types are in G, including this collection. Three sheets exist, with microsporophylls, megasporophylls, and leaflets, each on a separate sheet. More than one plant is clearly involved, and it is impossible at this stage to associate the leaf specimen with either of the fertile specimens. These may not have been the specimens examined by Schuster, as they have no annotations. The sheet bearing the megasporophylls is here designated the lectotype.

Distinguishing features. *Cycas zeylanica* is allied to both *C. thouarsii* Desfontaines ex Gaudichaud and *C. edentata* de Laubenfels, sharing the character lacking an apical wing and microsporophylls with an apical spine. The numerous, long and pungent cataphylls, an exceptionally long and drawn out megasporophyll tip, and the widely spaced leaflets distinguish *C. zeylanica*.

Distribution and habitat. Known from Sri Lanka, in southern coastal regions, and the Andamans and Nicobar Island group. The habitat is in littoral forest near the sea in sandy soil.

Reproductive biology. Surprisingly little is known about the pollinators of *Cycas* subsect. *Rumphiae*. Weevils (*Curculionidae, Tychiodes*) have been found in male cones both in the Andamans and Nicobar Islands (Tang et al., 1999). Two male cones collected in the South Andamans were found full of these weevils (*Lindstrom 357, Lindstrom 358*), but they are apparently of a different species than those found on *Cycas edentata* on the eastern coast of peninsular Thailand (Tang et al., 1999).

Conservation status. SRI LANKA. Populations have been totally decimated, and a survey done by the first author failed to find any viable regenerating populations. Only widely scattered, large, old specimens remain. No plants were found within any protected areas. The correct IUCN Red List category for the species on Sri Lanka should be Critically Endangered (CR) (IUCN, 1998). INDIA. The species is widespread and common on the Andamans and Nicobar Islands. However, although still growing in large populations at several locations, severe damage has been done by repeated strong cyclones. The recent development of seaside resorts on the islands has also had an impact on some populations, and several previously large populations have been eradicated to make space for tourist accommodations. There are populations within protected areas as well as in off-limit, military areas. The recommended IUCN Red List category would be Vulnerable (VU) (IUCN, 1998).

Vernacular. Maha-madu (Sri Lanka).

Etymology. From Zeylona, the Latinized rendering of Ceylon (Sri Lanka), from where the type of this species was collected.

Specimens examined. INDIA. **South Andamans:** *Kurz s.n.* (K, P); Havelock Island, E coast, beach No. 5, 2 m ASL, tall evergreen littoral forest, app. 50 m from the beach, 2 Dec. 2000, *Lindstrom 357* (NSW, SING); cult. near the jetty, 5 m ASL, 2 Dec. 2000, *Lindstrom 359* (NSW, SING); W coast, beach No. 7, 3 m ASL, tall secondary evergreen littoral forest, 3 Dec. 2000, *Lindstrom 365* (NSW, SING); Kodiaghat, beach vegetation, sandy soil, sea level, few plants, 25 Sep. 1973, *Balakrishnan 382* (SING); hort. Kew, raised from seed coll. Nicobars by Col. Nan in 1875, 1881 *leg. ign.* (K). SRI LANKA. Araiya Mawtha, Maddawattha, Mataya, wild near the seashore along a stream, 27 m ASL, 10 June 2000, *Lindstrom 287* (NSW, SING); cultivated along the road, 31 m ASL, 10 June 2000, *Lindstrom 288* (NSW, SING); Hikkaduwa, Dewadalla, Wauleguda, cult. 11 June 2000, *Lindstrom 289* (NSW, SING); Wtage, Alangama, cult., 11 June 2000, *Lindstrom 290* (NSW, SING).

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A New Species of *Holomitrium* (Musci: Dicranaceae) from South America, and a Key to *Holomitrium* in the Northern and Central Andes of South America

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ABSTRACT. *Holomitrium azuayensis* differs from all other species of *Holomitrium* known from South America, Central America, and the Caribbean by its completely entire leaf margins. *Holomitrium xolocotzianum* H. A. Crum from Mexico is a similar species that has entire leaf margins below, but the leaves are toothed at the apex. It is a much smaller plant with shorter leaves that have a cucullate apex. Also similar is *H. pulchellum* Mitten from Central America and northern South America. It has subentire or weakly crenulate to sometimes serrate leaf margins, but it has more slender and erect leaves than *H. azuayensis*. The alar region in *H. pulchellum* is only weakly differentiated, and often fugacious, which also distinguishes it from *H. azuayensis*. This new moss species is currently known from Ecuador.

Key words: Dicranaceae, Ecuador, *Holomitrium*, Neotropics.

With around 30 species *Holomitrium* Bridel is one of the largest and most morphologically diverse of the epiphytic genera in the Dicranaceae. This moss genus is characterized by differentiated alar regions; strong, single costae with central guide cells; long, sheathing perichaetial leaves; cucullate calyptrae; long-rostrate opercula; erect, cylindrical capsules; weakly divided to entire peristome teeth that are fenestrate and papillose; and 2 to 3 rows of cell development above the capsule mouth constituting a persistent annulus. The genus has been recently treated from Mexico (Ireland, 1994), Central America (Allen, 1990, 1994), the Caribbean (Hegewald, 1978), and Colombia (Churchill & Linares, 1995). There are currently 15 species of *Holomitrium* in the Neotropics, 7 of which are known from the northern and central Andes. In this region of South America *Holomitrium* species are generally robust plants, predominantly epiphytic, and found at mid to high elevations. They tend to form cushions on tree trunks and branches in montane woodlands. During recent revisionary studies of the genus a new species was discovered from Ecuador. This new species, *H. azuayensis*, is distinct from all the other species in this region by its completely entire leaf margins. It also has peristome teeth that are sometimes joined at the tips, a feature that has not previously been recorded for *Holomitrium*.

Holomitrium azuayensis M. J. Price, sp. nov. TYPE: Ecuador. Azuay: El Cajas National Recreation Park, 30 km W of Cuenca, in *Polylepis* woodlands on N facing slope of E-W valley to the N of Lake Toreadora, 3600–4000 m, 02°54′S, 79°17′W, 16 Sep. 1995, *M. J. Price 7* (holotype, MO; isotypes, BM, G, QCNE). Figure 1.

A *H. xolocotziano* statura grandi, foliis lanceolatis et grandioribus, marginibusque integris omnino differt.

Plants medium in size, light green-yellow above, brown-green to brown below, glossy, growing in tufts. Stems erect, 2.5–5.5 cm tall, radiculose throughout; branches irregularly bi-pinnate; tomentum dark red-orange, rhizoids hyaline at tips, smooth; stem cross section with sclerodern, outer cells small and thick-walled, inner cells large and thin-walled, central strand small; axillary hairs 2 to 4 per axil, 6 to 8 cells long, cells elongate, hyaline throughout. Leaves moderately spaced, erect at base, crisped above, secund or somewhat erect when dry, secund to erect-spreading when wet, lanceolate, 3–6 × 0.5–1.1 mm, tubulose throughout, unistratose; base short-decurrent; apex gradually acuminate; margins plane below, broadly incurved above, sometimes slightly undulate, entire throughout; costae single, slender, strong, subpercurrent, smooth at back, in cross section at mid-leaf with 4 central guide cells, dense dorsal and ventral stereid bands; median leaf cells below shoulder rectangular to oblate, incrassate, not to weakly porose, 15–53 × 7–10 μm, becoming longer toward costae; cells above shoulder rounded, quadrate, oblate or sometimes short-rectangular, incrassate, not porose,

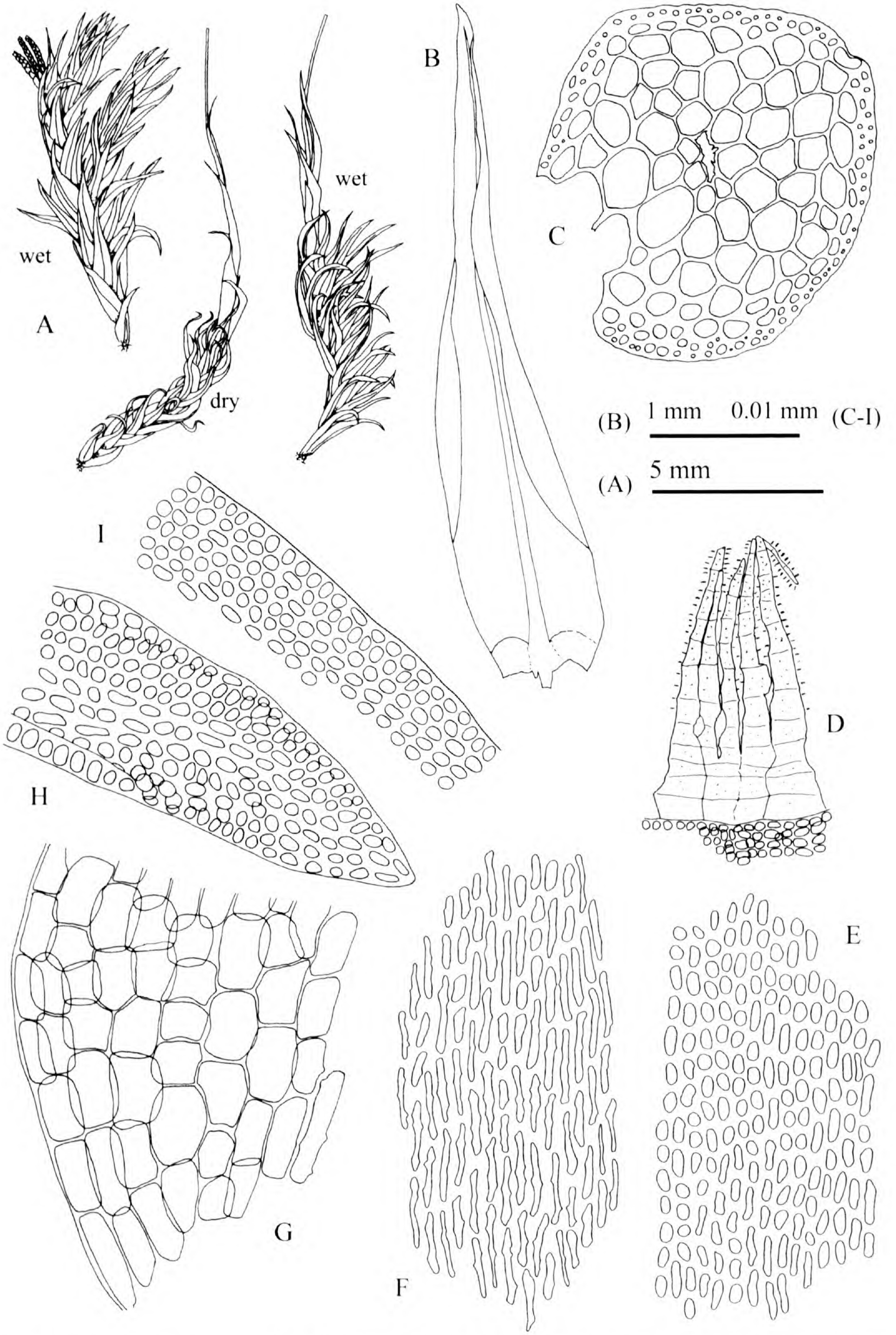

Figure 1. *Holomitrium azuayensis* M. J. Price. —A. Plants wet and dry. —B. Leaf. —C. Stem cross section. —D. Peristome teeth (external surface). —E. Cells at leaf shoulder. —F. Basal leaf cells. —G. Alar cells. —H. Cells at leaf apex. —I. Leaf margin and upper leaf cells. All from *Price 7* (MO).

12–27 × 7–13 μm, becoming smaller and quadrate toward apex; basal cells long-rectangular to rectangular, incrassate, porose, 32–113 × 13–20 μm; alar cells distinct, reddish orange, rectangular to subrectangular, 25–68 × 22–38 μm, persistent, incrassate, non-porose; marginal cells undifferentiated. Asexual reproduction by fragile flagellate branches, 5–12 mm long, clustered at stem apex or in branch axils, leaves to 1 mm long, costae subpercurrent. Pseudautoicous. Perigonia on dwarf males, growing on stem tomentum, in leaf axils or perichaetial bracts of female plants, plants 1–7 mm long, often with two antheridial bracts, leaves lanceolate, 1.5–1.7 mm long. Perichaetia terminal becoming lateral by subperichaetial branching, outer leaves erect below, erect to erect-spreading above, lanceolate to linear-lanceolate; inner perichaetial leaves long-sheathing, linear-lanceolate, 6–12 mm long; margins entire throughout, sometimes weakly crenulate at apex; costae subpercurrent; cells similar to vegetative leaves. Setae single, light yellow, erect, 20–25 mm long, twisted counterclockwise just below capsule, smooth. Capsules long-exserted, erect; urn long-cylindrical, symmetric, 2.0–3.5 mm long, to 1 mm diam., smooth; neck short; mouth slightly constricted; exothecial cells irregularly rectangular, thin-walled, yellow tinged with several rows of small red, incrassate cells at mouth. Stomata 6 to 10 per capsule, superficial, at base of capsule. Annuli persistent, as 2 to 3 rows of cells developed above the capsule mouth, cells homogeneous, quadrate to triangular. Opercula long-rostrate, 2.5 mm long. Peristome teeth 16, irregular, inserted at mouth, weakly divided or entire, teeth sometimes united at tips by inner peristomial layer deposition, fenestrate, irregularly thickened on outer surface, dark orange-red at base, fragile and hyaline above, narrowly triangular, 137–175 μm long without hyaline tips, when hyaline tips present 237–250 μm long, finely papillose below, papillose above. Calyptrae cucullate, smooth, 3–4 mm long, base entire. Spores spherical, 10–13 μm diam., lightly roughened.

Etymology. The specific epithet *azuayensis* was derived from the province Azuay, in Ecuador.

Distribution. Known from Ecuador.

Habitat. On trunks and branches of *Polylepis* in montane woodlands, growing as cushions mixed with *Chorisodontium* between 3600 and 4200 m.

Holomitrium azuayensis is a medium-sized plant, growing to 5.5 cm in height, with lanceolate leaves that are somewhat secund, moderately spaced, and crisped when dry. The leaf margins in this species are broadly incurved above, and completely entire throughout. Its alar cells are well developed and persistent, forming a distinct colored group at the basal angles of the leaf. The median cells near the leaf shoulders are rectangular to oblate, incrassate, and not to weakly porose. Its upper leaf cells are small, rounded, and quadrate to oblate or sometimes short-rectangular. These cells are incrassate, non-porose, becoming smaller and more regularly quadrate toward the leaf apex. The peristome morphology of this species is unusual within *Holomitrium.* A peristome tooth in *H. azuayensis* is split from one-third to one-half of its length, forming two hyaline filaments above. Some of these filaments are joined at the tips, to an adjacent tooth, by their ventral (inner) surfaces. So far, this feature has been observed in only a couple of other species of *Holomitrium* (*H. flexuosum* Mitten and *H. olfersianum* Hornschuch), and has not previously been documented for the genus. This peristome morphology is more typical for the genus *Dicnemon* Schwägrichen, where it is known in all species except one, namely *D. calycinum* (Hooker) Schwägrichen (Allen, 1987).

In overall aspect this new species most closely resembles the Mexican species *H. xolocotzianum*, described by Crum (1952). Both have secund, lanceolate leaves, similar upper leaf cell areolation, subpercurrent costae, and flagellate branches. However, *H. xolocotzianum* is a much smaller plant, growing only to 2.5 cm in height. It also has shorter, more sheathing leaves with a more pronounced shoulder than the new species. Leaf cells at the leaf shoulder in *H. xolocotzianum* are more uniform in shape, and are smaller than those in *H. azuayensis.* The cucullate leaf apices and apical teeth of *H. xolocotzianum* also distinguish this species from *H. azuayensis.* Capsule and peristome morphology of these two species differ. In *H. xolocotzianum* the persistent annulus consists of 6 to 8 rows of cells, compared with 2 to 3 rows of cells in *H. azuayensis.* The peristome teeth are densely papillose throughout and are not joined at their tips in *H. xolocotzianum.*

Holomitrium pulchellum and the closely related species *H. hawkinsii* B. H. Allen, from Central America (Allen, 1997), are similar to *H. azuayensis* in their leaf cell areolation, and in having nearly entire leaf margins. In *H. pulchellum* and *H. hawkinsii* leaf margins can vary from crenulate to serrulate or almost entire and toothed only at the very apex; they are never completely entire. *Holomitrium azuayensis* is distinguished from these two species by its lanceolate leaves with a completely entire leaf apex; well-developed, persistent alar regions; subpercurrent costae; and the presence of flagellate branches. The Central American species *H. williamsii* E. B. Bartram shares with *H. azuayensis* the presence of flagellate branches, but it has serrate, irregularly bistratose leaf margins. All other species from the northern and central Andes are distinct from *H. azuayensis* by their serrulate to serrate or dentate leaf margins, while some others differ by their elongate cells throughout the lamina.

When *H. azuayensis* is found fertile the rather striking long, sheathing perichaetial leaves and crisped stem leaves when dry confirm that it belongs to *Holomitrium*. Two other genera in the Dicranaceae that are found in this region, *Eucamptodontopsis* Brotherus and *Schliephackea* Carl Müller, also have long and sheathing perichaetial leaves. *Schliephackea* is a pendent moss, with stems to 30 cm in length, and it has wide-spreading somewhat distant leaves that distinguish it immediately from *H. azuayensis*. *Eucamptodontopsis* is predominantly a Central American-Caribbean-Guyana Shield genus. It contains species with subentire, crenulate or serrate leaf margins, but the genus is characterized by leaves that are weakly spirally twisted or contorted when dry, and elongate, rectangular leaf cells throughout. The new species *H. azuayensis* can be distinguished from members of *Eucamptodontopsis* by its entire leaf margins, and by its small, rounded, and quadrate to oblate or sometimes short-rectangular upper leaf cells. When the new species is lacking perichaetia, the crisped leaves when dry, the differentiated and colored alar region, and differentiated lower and upper leaf cells (basal cells rectangular and upper leaf cells small and rounded to quadrate or oblate) can be used to identify it as belonging to *Holomitrium*.

Paratypes. ECUADOR. **Imbabura:** on old trail to Intag, 11,000 ft., 24 Nov. 1943, *W. C. Steere 9224* (MO, NY).

KEY TO THE SPECIES OF *HOLOMITRIUM* IN THE NORTHERN AND CENTRAL ANDEAN REGION OF SOUTH AMERICA

1a. Leaf margins entire throughout . . . . *H. azuayensis*
1b. Leaf margins subentire, crenulate, serrate, serrulate, or toothed above leaf shoulder 2
  2a. Cell walls of upper leaf porose or sinuose 3
  2b. Cell walls of upper leaf straight-walled . . . 4
3a. Cell walls strongly sinuose from just above alar region . . . . *H. sinuosum*
3b. Cell walls straight to leaf shoulder, mostly weakly sinuose above . . . . *H. flexuosum*
  4a. Leaf margins and/or lamina irregularly bistratose 5
  4b. Leaf unistratose throughout 6
5a. Leaves bistratose at margins and in patches across lamina . . . . *H. crispulum*
5b. Leaves bistratose only at margins . . . *H. arboreum*
  6a. Leaf margins subentire, crenulate or serrulate, serrate at apex . . . . *H. pulchellum*
  6b. Leaf margins serrate or dentate 7
7a. Leaves over 9 mm long . . . . *H. moritzianum*
7b. Leaves under 9 mm long . . . . *H. arboreum*

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Lycianthes manantlanensis (Solanaceae), a New Species from Mexico

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ABSTRACT. *Lycianthes manantlanensis* is described as a new species from Mexico. *Lycianthes manantlanensis* is recognized by its glabrous, coriaceous, and shiny leaves, long slender pedicels at anthesis and in fruit, and minute calyx appendages. It is morphologically similar to *L. barbatula*, *L. geminiflora*, and *L. orogenes* and is here compared with them.

RESUMEN. Se describe e ilustra a *Lycianthes manantlanensis* como una especie nueva que crece en México. *Lycianthes manantlanensis* se reconoce por sus hojas glabras, coriáceas y brillosas; pedicelos largos y delgados en la antesis y fructificación y cáliz con pequeños apéndices. El taxón propuesto es morfológicamente similar a *L. barbatula*, *L. geminiflora* y *L. orogenes* con las cuales se compara.

Key words: Jalisco, *Lycianthes*, Mexico, Solanaceae.

An inventory of the family Solanaceae for the flora of Jalisco, in western Mexico, is under way (Rodríguez & Vargas, 1994; Vargas & Rodríguez, 1993, 1995). In the process, we found some morphologically unfamiliar specimens that we describe as a new species.

Lycianthes manantlanensis A. Rodríguez & O. Vargas, sp. nov. TYPE: Mexico. Jalisco: Mpio. Cuautitlán de García Barragán, Majada de las Avellanas, comunidad indígena de Cuzalapa, 3–4 km al NNW de El Durazno, 800–1000 m, 6 Nov. 1995 (fl), *R. Cuevas, E. Sánchez & F. J. Santana 5009* (holotype, IBUG; isotypes, ENCB, MEXU, MO, WIS, ZEA). Figure 1.

Frutex vel arbor parva 1–6 m alta, caulibus teretibus glabris; sympodia bifoliata geminata anisophylla; lamina foliorum maximorum coriacea glabra obovata vel elliptica 4.2–12 cm longa 2.4–4.2 cm lata, apice acuto vel acuminato, basi oblique cuneata vel cuneata interdum decurrenti, petiolo gracili glabro 0.7–2 cm longo; folia minora coriacea, glabra, obovata vel elliptica 2.5–6 cm longa 1.3–2.7 cm lata, apice acuto vel acuminato, basi oblique cuneata vel cuneata interdum decurrenti, petiolo gracili glabro 2–4 mm longo; inflorescentia axillaris fasciculata, 3–5 floribus; gemmae globosae vel ovoideae, 2–4 mm latae; pedicellus sub anthesi gracillimus deflexus vel erectus 2–3.5 cm longus glaber; calyx campanulatus 2 mm longus glaber truncatus prope apicem 5 minutis appendicibus < 0.5 mm longis instructus; corolla late campanulata alba 1.2–2 cm diametro, lobis sub anthesi reflexis; stamina subaequalia, filamentis glabris 0.5–1 mm longis, antheris 2.5–3 mm longis oblongis; ovarium glabrum; stylus glaber 6–8 mm longus; stigma clavatum; bacca globosa, viridis 5 mm diametro; pedicellus fructifer lignosus erectus 2–3.5 cm longus.

Shrub or small tree, 1–6 m tall; stems terete, glabrous. Sympodia bifoliate, geminate, the leaf pair markedly anisophyllous. Branches glabrous or with some simple uniseriate trichomes less than 0.5 mm long. Leaves coriaceous, flat, glabrous and shiny on both sides; major leaves 4.2–12 × 2.4–4.2 cm; lamina obovate to elliptic, the apex acute or acuminate, the base cuneate, sometimes oblique; petioles 0.7–2 cm long; minor leaves not differing from the major ones in shape, 2.5–6 × 1.3–2.7 cm; petioles 2–4 mm long. Inflorescences axillary, fasciculate, 3–5-flowered. Pedicels slender, glabrous, erect or deflexed at anthesis, 2–3.5 cm long. Buds globose to ovoid, 2–4 mm wide. Calyx campanulate, truncate, glabrous, 2 mm long, with five minute knob-like appendages below the erose margin, less than 0.5 mm long. Corolla white, campanulate, 1.2–2 cm diam., the lobes minutely pilose at the tips and along margins. Stamens subequal in length; filaments 0.5–1 mm long, glabrous; anthers 2.5–3 mm long. Ovary glabrous. Style glabrous, 6–8 mm long. Stigma clavate. Fruit globose, green, 5 mm diam.

Distribution. *Lycianthes manantlanensis* has been collected in the Sierra de Cacoma, Jalisco, at the western end of the Trans-Mexican Volcanic Belt. It is also known from the Sierras de Manantlán and Coalcomán in the Sierra Madre del Sur, as well as the states of Oaxaca and Chiapas in southern Mexico.

Etymology. The name of the species refers to the Sierra de Manantlán, where this species is common.

Habitat. *Lycianthes manantlanensis* grows in the transition zone between the tropical subdeci-

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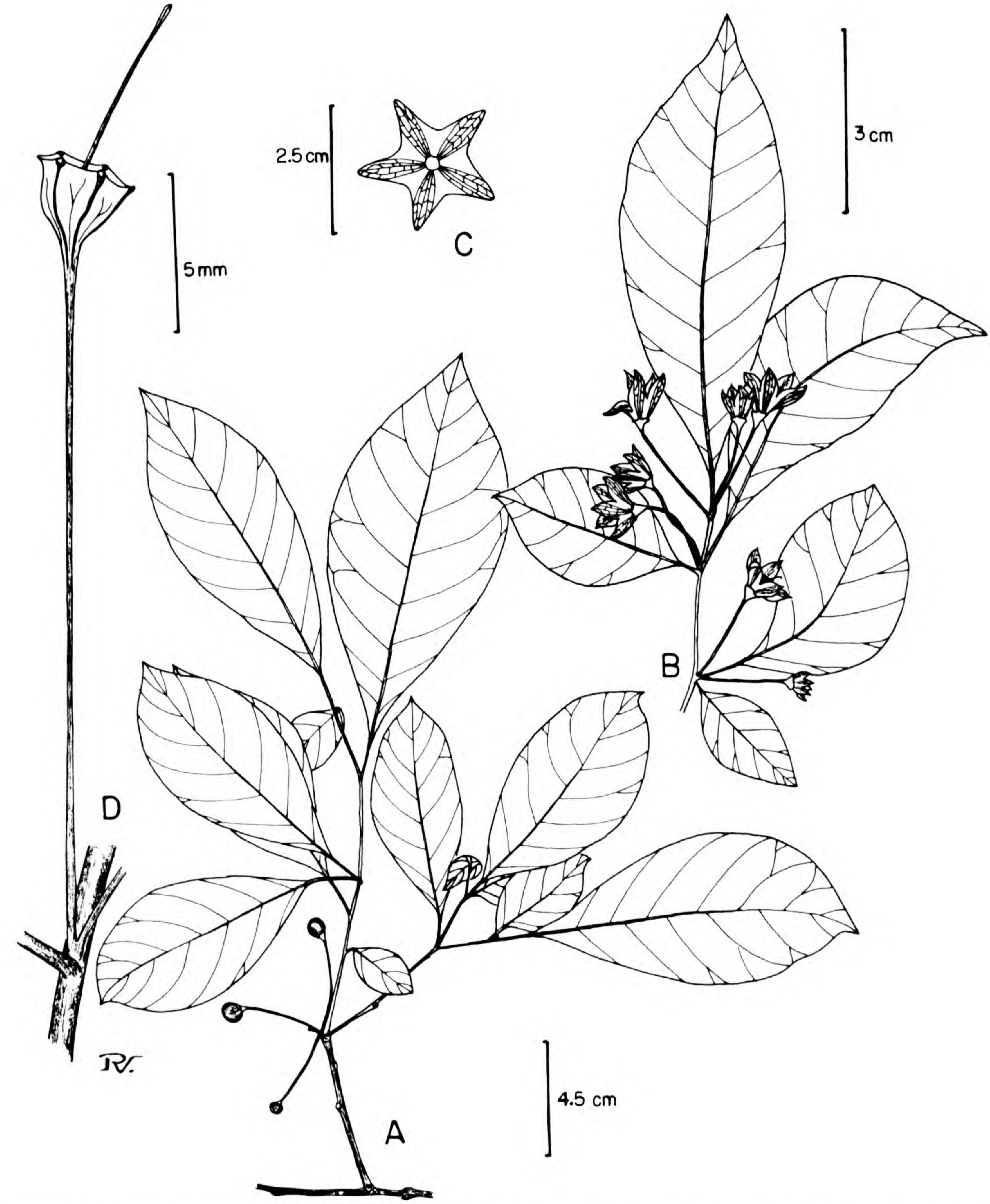

Figure 1. *Lycianthes manantlanensis* A. Rodríguez & O. Vargas. —A. Habit (*R. Cuevas et al. 6554*). —B. Detail of fertile branch showing axillary inflorescences (*R. Cuevas et al. 6274*). —C. Detail of corolla (*R. Cuevas et al. 5009*). —D. Detail of pedicel and calyx (*R. Cuevas et al. 5009*).

duous forest and the cloud forest. It grows in association with *Ardisia revoluta* Kunth, *Inga eriocarpa* Bentham, *Magnolia iltisiana* A. Vázquez, *Populus guzmanantlensis* A. Vázquez & Cuevas, *Quercus insignis* M. Martens & Galeotti, and *Siparuna andina* (Tulasne) A. DC., 800–1150 m. It also grows in the cloud forest where it is associated with *Balmea stormae* Martínez, *Beilschmiedia pendula* (Swartz) Hemsley, *Calatola laevigata* Standley, *Capparis mollicella* Standley, *Cedrela odorata* L., *Cinnamomum pachypodum* (Nees) Kostermans, *Coccoloba barbadensis* Jacquin, *Dendropanax ar-*

Table 1. Comparison of *Lycianthes manantlanensis* and its morphologically related species.

Characters	Taxa			
	L. manantlanensis	*L. barbatula*	*L. geminiflora*	*L. orogenes*
Pubescence in young parts	Glabrate	None	Puberulent	None
Leaf pubescence	None	Tufts in vein axils or along middle vein	Glabrous or puberulent in veins and margins	None
Leaf	Geminate, anisophyllous	Geminate, different in size and shape	Geminate, anisophyllous	Geminate, different in size and shape
Major leaf form	Obovate to elliptic	Elliptic to elliptic-oblong	Lanceolate to elliptic, asymmetric	Elliptic to lanceolate-elliptic
Minor leaf form	Obovate to elliptic	Ovate to orbiculate	Lanceolate to elliptic, asymmetric	Ovate to elliptic
Leaf texture	Coriaceous	Coriaceous	Smooth and not coriaceous	Coriaceous
Pedicels at anthesis	1.3–3.5 cm long	2–2.5 cm long	0.5–2 cm long	1.3–2.5 cm long
Calyx	Campanulate, 2 mm long, margin erose, with 5 minute knob-like appendages	Broadly campanulate, 2–2.5 mm long, 5 (7) appendages subequal, linear, 2–3 mm long	Campanulate, 1–1.5 mm long, margin erose, without appendages	Campanulate, 2.5–3 mm long, margin erose, 5 appendages subequal, linear, 1–1.5 mm long
Corolla	12–20 mm wide	12 mm wide	12–15 mm wide	7.5–8 mm wide
Corolla lobes	Ovate, 4–6 mm long	Lanceolate, 4 mm long	Lanceolate, 8 mm long	Lanceolate, 2 mm long
Fruit	Green, 5 mm diam.	White, 10 mm diam.	Red, 7–10 mm diam.	Green, 10 mm diam.

boreus (L.) Decaisne & Planchon, *Guarea glabra* Vahl, *Juglans major* (Torrey) A. Heller, *Licaria triandra* (Swartz) Kostermans, *Malvaviscus arboreus* Cavanilles, *Nectandra glabrescens* Bentham, *Picrasma mexicana* Brandegee, *Prunus serotina* Ehrhart subsp. *capuli* (Cavanilles) McVaugh, *Robinsonella speciosa* Fryxell, *Trichillia americana* (Sessé & Moçiño) Pennington, *Trophis racemosa* (L.) Urban, and *Urera caracasana* (Jacquin) Grisebach, 1450–1650 m. Occasionally, it has been collected in *Abies* forest, ca. 2000 m elevation.

Common name. Naranjillo.

Discussion. Lycianthes manantlanensis is recognized by its glabrous, coriaceous, and shiny leaves, long slender pedicels at anthesis and fruit, and minute knob-like calyx appendages. The calyx appendages are small and difficult to distinguish, but they emerge from a little below the erose margin. The calyx then splits irregularly and forms unequal lobes with corky-scarred margins. *Lycianthes manantlanensis* shares its coriaceous leaves with *L. barbatula* Standley & Steyermark and *L. orogenes* Standley & Steyermark. However, it differs from them by lacking conspicuous calyx appendages and other aspects seen in Table 1. Likewise, *L. manantlanensis* resembles *L. geminiflora* (M. Martens & Galeotti) Bitter in shape and size of the calyx. The pedicel length, however, is always longer in *L. manantlanensis*. In addition, the leaves in *L. geminiflora* are puberulent, not coriaceous and asymmetric.

Paratypes. MEXICO. **Jalisco:** Ayutla, near Santa Mónica, ca. 20°N, 104°30′W, 1950–2050 m, 12–13 Nov. 1952 (fl), *R. McVaugh & J. Sooby, Jr. 14060* (MICH); Casimiro Castillo, por la cañada El Tecolote, 19°36′49″N, 104°18′56″W, 1650 m, 27 Oct. 1998 (fl), *R. Cuevas, L. Guzmán & J. Aragón 6246* (ZEA), 1550 m, 29 Nov. 1998 (fl), *R. Cuevas, L. Guzmán & J. Aragón 6274* (ZEA), 1550 m, 30 Nov. 1998 (fl), *R. Cuevas, L. Guzmán & J. Aragón 6294* (ZEA), 1450 m, 13 Dec. 1998 (sterile), *R. Cuevas, L. Guzmán & J. Aragón 6380* (ZEA), 1450 m, 14 Dec. 1998 (fl), *R. Cuevas, L. Guzmán & J. Aragón 6390* (ZEA), 14 Dec. 1998 (sterile), *R. Cuevas, L. Guzmán & J. Aragón 6400* (ZEA); en la cañada de La Naranjera, cerca del árbol de aguacate, 19°37′25″N, 104°20′49″W, 1150 m, 22 Feb. 1999 (fr), *R. Cuevas, L. Guzmán & J. Aragón 6554* (ZEA), 1150 m, 24 Feb. 1999 (sterile), *R. Cuevas, L. Guzmán & J. Aragón 6589* (ZEA). **Michoacán:** Distrito de Coalcomán, 1400 m, *G. B. Hinton et al. 15942* (MICH). **Oaxaca:** Villacorzo, Paraje La Botella, ejido Plan de Ayala, 1420 m, 7 Jan. 1999 (fr), *R. Ramírez-Camacho 41* (CHAP, MEXU). **Chiapas:** Monte Ovando, 14–18 Nov. 1939 (fl), *E. Matuda 3981* (MEXU, NY); Santa María Chimalapa, cerro Salomón, ca. 2 km WNW del cerro Guayabitos, al N de la cima, ca. 43 km en línea recta al N de San Pedro Tapanatepec, 16°45′N, 94°11′W, 27 Oct. 1986 (fr), *S. Maya 4129* (CHAPA, MEXU).

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A New Species of *Weinmannia* (Cunoniaceae: Cunonieae) from Southern Ecuador

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ABSTRACT. *Weinmannia auriformis* is described and illustrated from the Cordillera del Cóndor region, Ecuador. It is distinguished by its small, auriform, revolute, entire-margined leaflets and by the dense tomentose pubescence on its branchlets, leaves, stipules, inflorescences, and calyx lobes. This new endemic species is only known from one sandstone mountain of the Cordillera de Huaracayo, east of the Cordillera del Cóndor.

RESUMEN. Se describe y se ilustra *Weinmannia auriformis* de la región de la Cordillera de Cóndor, Ecuador. Esta especie se distingue por sus folíolos pequeños que se asemejan a unas orejas con márgenes enteros y un hirsuto denso, pubescente, en sus ramas pequeñas, sus hojas, sus estípulas, sus inflorescencias y los lóbulos del cáliz. Esta nueva especie se encuentra en un cerro formado por roca arenisca en la Cordillera de Huaracayo al este de la Cordillera del Cóndor.

Key words: Cunoniaceae, Cunonieae, Ecuador, Neotropics, South America, *Weinmannia*.

The family Cunoniaceae is composed of 26 genera and about 300 species (Bradford & Barnes, 2001). The widespread genus *Weinmannia* L. is made up of approximately 150 species of trees and shrubs, more than half of which are found in the tropics (Bradford & Barnes, 2001). In the Neotropics, the genus ranges from southern Mexico to southern Chile (Harling, 1999). Ecuadorian *Weinmannia* species have leaves that are opposite, decussate, and simple or imparipinnately compound (all Ecuadorian species with compound leaves have winged rachises except for *W. trianaea* Weddell), and interpetiolar stipules (Harling, 1999). All Ecuadorian species of the genus have stereotypical flowers that are small, white, bisexual, and 4-merous, borne on unbranched spicate or elongate racemose inflorescences (i.e., pseudoracemes). *Weinmannia* species also have distinctive fruits that are small, septicidal, 2-valved capsules that have 2 persistent stylar beaks, and lobed nectary disks located beneath the gynoecium (Harling, 1999). Harling's (1999) treatment of Cunoniaceae for the *Flora of Ecuador* included 26 species; however, an additional undescribed species has been collected from the Cordillera del Cóndor region near the Peru–Ecuador border. A color photograph of the type collection can be found on the searchable W3 TROPICOS database at: ⟨http://mobot.mobot.org/W3T/search/vast.html⟩.

Weinmannia auriformis Z. Rogers, sp. nov. TYPE: Ecuador. Morona Santiago: Cantón Limón Indanza, Cordillera del Huaracayo, E of Cordillera del Cóndor and Río Coangos, Cerro Ijiach Naint, flat-topped sandstone mountain, E of Shuar village of Tinkimints, 3°15′49″S, 78°10′13″W, 2000 m, 21 Mar. 2001, *D. Neill, P. Berry, J. Manzanares & L. Jost 13112* (holotype, QCNE; isotypes, GB, MO-5300000, NY, QCA). Figure 1.

Haec species *W. loxensi* et *W. mariquitae* maxime similis, sed a hac ramulis foliis inflorescentia calyceque indumento tomentoso denso vestitis, foliolis 1.3–6.6 × 1.0–5.0 mm, margine semper integris praesertim apice revolutioribus, pseudoracemo compacto 1.1–3.1 cm tantum longo atque florum minorum lobulis calycinis 0.8–1.2 × 0.4–0.6 mm, ab illa foliolis et rhachide foliari valde concavis distinguitur.

Shrubs or trees 0.5–4 m. *Branchlets* slender, terete, red-black, tomentose, becoming less dense with age, denser at nodes, the trichomes simple, unicellular to 1.0 mm long. *Leaves* imparipinnate, 1.3–3.3 × 0.3–0.9 cm; leaflets 5- or 6-paired (rarely 4- or 7-paired), 1.3–6.6 × 1.0–5.0 mm, auriform to cochleariform, strongly concave, coriaceous, waxy and shiny, apex slightly apiculate, base obtuse, margin entire, strongly revolute, especially at apex, upper surface scrobiculate and rugose, sparsely tomentose, denser along lower half of midvein, lower surface smooth, tomentose along midvein, denser along lower half, the trichomes simple, unicellular to 1.0 mm long, midvein slightly impressed above, slightly raised below, secondary veins inconspicuous above and below, all leaflets similar in size and shape; rachis winged, tomentose above, denser below, especially pubescent at point of petiolule attachment, trichomes similar to those

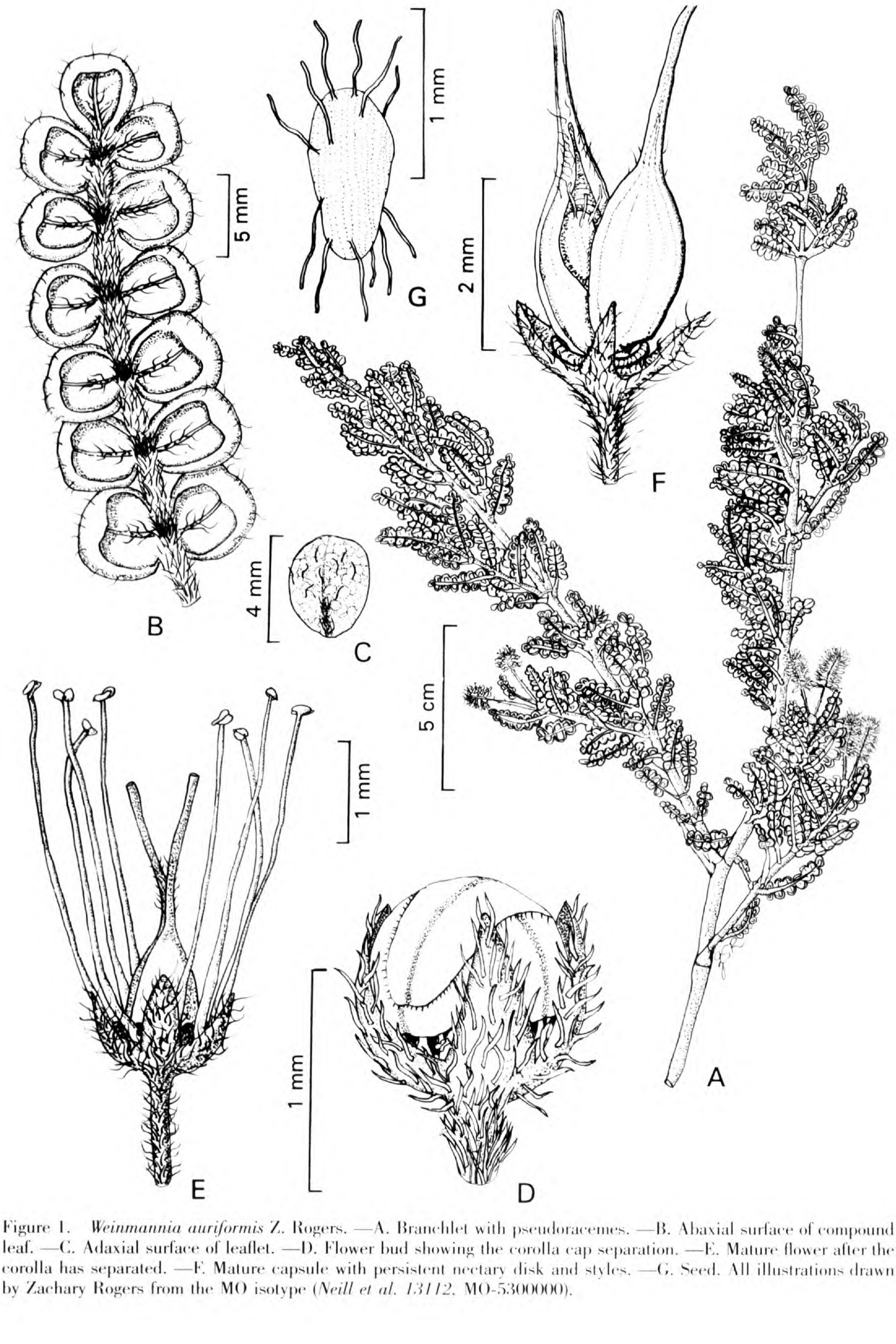

Figure 1. *Weinmannia auriformis* Z. Rogers. —A. Branchlet with pseudoracemes. —B. Abaxial surface of compound leaf. —C. Adaxial surface of leaflet. —D. Flower bud showing the corolla cap separation. —E. Mature flower after the corolla has separated. —F. Mature capsule with persistent nectary disk and styles. —G. Seed. All illustrations drawn by Zachary Rogers from the MO isotype (*Neill et al. 13112*, MO-5300000).

of the leaflets, rachis wings 2.4–5.0 × 0.8–1.7 mm, elliptical to obovate, concave, strongly revolute, coriaceous, often obscured by dense pubescence; petioles terete, 2.5–4.5 mm long, tomentose to slightly hirsute; stipules interpetiolar, free, caducous, 2.3–4.7 × 2.1–4.5 mm, broadly ovate, membranaceous to subcoriaceous, red-tinged, apex rounded, base truncate, margin entire, outside surface densely tomentose except along margin, inside surface glabrous and rugose, the trichomes similar to those of the leaflets, veins inconspicuous. *Pseudoracemes* usually in pairs, 1.1–3.1 cm long; rachis densely tomentose, trichomes simple, unicellular to 0.8 mm long; fascicles densely congested, 2- or 3- to 4-flowered; bracteoles 0.5–1.1 × 0.3–0.8 mm, narrowly oblong, membranaceous, apex acute, base truncate, margin entire, completely glabrous, usually persistent; pedicels 0.5–1.2 mm long, densely tomentose, trichomes similar to those of the inflorescence. *Flowers* 4-merous, actinomorphic, bisexual, diplostemonous; calyx lobes 4, 0.8–1.2 × 0.4–0.6 mm, narrowly ovate, membranaceous, red- or green-tinged, apex acute, base truncate, margin entire, outside surface tomentose, denser along lower half of midvein, inside surface glabrous, trichomes simple, unicellular to 0.5 mm long; petals 4, free, caducous, often falling as a unit before completely open, 1.1–1.7 × 0.7–1.4 mm, broadly obovate to broadly elliptic, membranaceous, white, apex rounded, sessile, margin entire, ciliate, midvein conspicuous; stamens 8, 2.4–4.0 mm long; filaments free, slender, flattened, 1.5–3.8 × 0.2–0.4 mm, glabrous; anthers introrse, 0.2–0.5 × 0.2–0.4 mm, orbicular, apex short acuminate, base slightly cordate, longitudinally dehiscent, versatile; nectary disk annular, consisting of 8 concrescent lobes, persistent in fruit; ovary bicarpellate, syncarpous, 0.8–1.4 × 0.5–0.8 mm, red-tinged, glabrous except for ciliate hairs where the styles meet; styles 2, divergent, 1.4–1.5 mm long; stigmas simple, capitate, persistent in fruit; ovules 4 to 6 per locule. *Fruits* septicidal capsules, 3.9–5.5 × 1.7–2.2 mm (length measurement includes persistent styles), ovoid-oblong, red- or brown-tinged, costate; seeds 0.9–1.1 × 0.5–0.6 mm, widely elliptic to elliptic, longitudinally ribbed, testae with few trichomes, simple, unicellular, 0.3–0.5 mm long.

Distribution and habitat. *Weinmannia auriformis* is an endemic species known only from the summit of Cerro Ijiach Naint, which is an isolated steep-sided sandstone mountain with a summit around 2000 m. The Cerro is part of the Cordillera de Huaracayo mountain range to the east of the Cordillera del Cóndor range. The locality is covered by a dense windswept "dwarf" forest, characterized by a low tree canopy layer to 4 m and a dense, scrubby, shrub layer to 2 m (D. Neill, pers. comm. 2001).

Affinities. According to the key in the treatment of the Cunoniaceae of Ecuador (Harling, 1999), *Weinmannia auriformis* would fit somewhere between *W. mariquitae* Szyszyłowicz and *W. loxensis* Harling, but the new species more closely resembles *W. mariquitae.* All three species have imparipinnate leaves shorter than 5 cm in length with 4–8 leaflet pairs per leaf, and all three have elongated pseudoracemes. However, *W. auriformis* is easily distinguishable from *W. mariquitae* by its distinctive leaflets, which are ear-shaped, small (1.3–6.6 × 1.0–5.0 mm), slightly apiculate at the apices, revolute, entire, lacking prominent secondary venation, and adaxially pubescent. In contrast, *W. mariquitae* has larger, more elongated leaflets (0.9–2.0 × 0.5–1.2 cm) that are adaxially glabrous with crenate-dentate margins and prominent secondary venation.

Other important distinctions are that *W. auriformis* has much shorter (i.e., more densely compacted) pseudoracemes (1.1–3.1 cm), than *W. mariquitae*, which has 3.5–12 cm long pseudoracemes; *W. auriformis* has smaller (0.8–1.2 × 0.4–0.6 mm) pubescent calyx lobes, *W. mariquitae* has larger glabrous lobes (1.5–1.8 × 0.9–1.0 mm); and *W. auriformis* has pubescence on the rachis wings, whereas the wings of *W. mariquitae* are glabrous.

On the other hand, *W. auriformis* is clearly distinct from *W. loxensis* because the leaflets of *W. loxensis* are smaller (0.2–0.4 × 0.15–0.2 cm), flat, glabrous, and tridentate along the margin. *Weinmannia loxensis* also has flat rachis wings and smaller capsules that only reach 2.5 mm in length.

Ecology. This species, like many others that are evidently endemic to the Cordillera del Cóndor region, appears to be edaphically restricted to the nutrient-poor sandstone table-top mountains that characterize the area. The new species has been found on only one such summit so far, about 1 km^2 in area, but further floristic exploration of the area may reveal additional localities. The area is not protected formally, and potential threats from mining and other activities could affect this and many other locally endemic species. The entire region merits conservation actions, which should include participation from the indigenous Shuar who inhabit the valleys and lower slopes of the mountains (David Neill, pers. comm.).

Etymology. The specific epithet refers to the ear-like shape of the small leaflets of the species.

Paratypes. ECUADOR. **Morona Santiago:** Cantón Limón Indanza, Cordillera de Huaracayo, E of Cordillera del Cóndor and Río Coangos, Cerro Ijiach Naint, flat-topped sandstone mountain, E of Shuar village of Tinkimints, ridge below W side of summit, 03º15′49″S, 78º10′28″W, 1950 m, 20 Mar. 2001, *D. Neill, P. Berry, J. Manzanares & L. Jost 13083* (AAU, LOJA, MO-5290000, QCNE, US).

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Nomenclatural Changes in North American *Lilium* (Liliaceae)

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ABSTRACT. The approaching release of the *Flora of North America* Volume 26 requires the formal publication of several nomenclatural changes that will appear there. The proposed changes standardize infraspecific nomenclature in North American *Lilium* at the subspecies level, which is appropriate for these geographically segregated yet morphometrically overlapping and intergrading taxonomic units. The changes include a new rank for *Lilium washingtonianum* Kellogg subsp. *purpurascens* (Stearn) M. W. Skinner, and several new combinations: *L. pardalinum* Kellogg subsp. *pitkinense* (Beane & Vollmer) M. W. Skinner, *L. pardalinum* Kellogg subsp. *shastense* (Eastwood) M. W. Skinner, *L. pardalinum* Kellogg subsp. *vollmeri* (Eastwood) M. W. Skinner, and *L. pardalinum* Kellogg subsp. *wigginsii* (Beane & Vollmer) M. W. Skinner. Lectotypes are designated for *L. pardalinum* and *L. washingtonianum* and for the synonym *L. parvum* Kellogg var. *luteum* Purdy, and a neotype is selected for *L. washingtonianum* subsp. *purpurascens*.

Key words: Liliaceae, *Lilium*, North America.

Ongoing biosystematic investigations of North American *Lilium* (Skinner, 1988, 1993) compel the publication of several new combinations that will appear in the *Flora of North America*. The taxa recognized and named below display significant and geographically coherent variation that is best expressed at the subspecies level (Thorne, 1978): morphological dimensions overlap between geographically adjacent taxa, variation is roughly clinal across zones of intergradation, and reproductive isolation between subspecies is primarily achieved geographically. The new names achieve uniformity at the subspecific rank for infraspecific nomenclature in North American *Lilium*. Types are supplied for one synonym, and for accepted names that currently lack them. Because prior workers often ignored or were unfamiliar with each other's work and/or the formalities of type designation, and frequently misapplied names with or without attribution to prior circumscriptions, the nomenclatural literature and history in western North American *Lilium* is abstruse. This prompts the often lengthy discussions below.

Lilium pardalinum Kellogg, Hesperian 3: 300. 1859. TYPE: Illustration, Hesperian 3(1) frontispiece, 1859 (lectotype, designated here, *University of California at San Diego*).

Lilium pardalinum var. *angustifolium* Kellogg, Hesperian 3: 300. 1859. TYPE: not designated.
Lilium roezlii Regel, Gartenflora 19: 321, t. 667. 1870, as "*L. roezli*," non *L. roezlii* Purdy, J. Int. Gard. Club 3(4): 522. 1919. TYPE: not designated.
Lilium harrisianum Beane & Vollmer, Contr. Dudley Herb. 4: 357. 1955. TYPE: not designated.

A. M. Kellogg (1859a) did not formally designate type material for *Lilium pardalinum*. At the California Academy of Sciences where Kellogg worked, most of the types were saved from the fire following the earthquake of 1906 by Alice Eastwood, but none of Kellogg's lily types (Vollmer, 1939) or other original specimens survived. In his monograph, Elwes (1877–1880) mentioned receiving a letter from Sereno Watson in 1878 in which Watson cited some Kellogg material of *L. pardalinum* and *L. pardalinum* var. *angustifolium* Kellogg at his disposal. In the letter Watson noted that Kellogg's specimen of *L. pardalinum* was from Alameda County, California (just across the San Francisco Bay from CAS); thus Alameda County can be inferred as the probable *L. pardalinum* type locality. Watson would have been at Harvard's Gray Herbarium when he wrote that letter (Stafleu & Cowan, 1988), but his specimens of *L. pardalinum* and its variety *angustifolium* are not at GH or other likely herbaria including CAS, K, MO, UC/JEPS, or US. It is likely they were returned by Watson to Kellogg and destroyed in the 1906 event.

The *Hesperian* illustrations of the plants that Kellogg described were prepared at his direction (Curran, 1885), and an illustration of *Lilium pardalinum* accompanies the protologue (Kellogg, 1859a: frontispiece). Although it comes after the title page and table of contents, this illustration has been cited as the frontispiece (Woodcock & Stearn, 1950) and is so cited here. It is one of two such plates for *Hes-*

perian 3(1); the other is a drawing of a Captain John Paty (K. Gandhi and University of California reference staff, pers. comm. 2001). The illustration of *L. pardalinum* is missing from most of the few surviving copies of *Hesperian* (the University of California at San Diego does have this volume intact with the illustration), but it is reproduced in some copies of Curran (1885) and in Woodcock and Stearn (1950: 300). Since it is all that remains of the original material that was associated with the protologue for *L. pardalinum*, it is here chosen as the lectotype.

Lilium pardalinum Kellogg occurs from sea level to 6000 feet west of the deserts in California and in the Klamath Mountains of Oregon; it is known to be "exceedingly variable" (Munz, 1968: 1344). The following systematic arrangement of the *L. pardalinum* complex organizes some of this variation, and is based on extensive fieldwork supported by herbarium and literature study. Five subordinate entities of *L. pardalinum* are recognized below as subspecies, as befits such genetically based infraspecific taxa with geographic, ecologic, and morphologic significance (Thorne, 1978). These subspecies are distributed parapatrically: each occupies a discrete range to the exclusion of any other, and hybridizes with adjacent subspecies in peripheral areas of contact, producing roughly clinal variation in which floral and vegetative measurements of adjacent subspecies often overlap considerably. In addition to their geographic coherence, the subspecies of *L. pardalinum* occupy similar perennially moist or wet habitats and share several morphological features including a continuously scaly, often branching rhizomatous bulb with jointed scales, clonal habit without the glaucous stem or undulate leaves found in certain other lilies, an odorless or scarcely fragrant, brightly colored pendent flower in which red- or red-orange-tipped tepals are strongly reflexed to resemble a Turk's cap and anthers are exserted on divergent filaments, and capsules similar in shape and proportions. The new combinations acknowledge this genetic and morphological affinity; the resulting subspecies are quite recognizable if still somewhat variable, and confusion is likely to be profound only where they meet geographically.

Flower morphology and orientation typically outweigh other features in *Lilium* alpha taxonomy, in part because these are closely correlated with pollination and likewise with reproductive isolation. In *Lilium pardalinum* subspecies these floral features are basically similar, which underlies the finding that all five are pollinated by a combination of several species of hummingbirds and large swallowtail butterflies (*Papilio* spp.; Skinner, 1988). In contrast, *L. canadense* L. and *L. michiganense* O. A. Farwell, two closely related taxa from the eastern United States, are allopatrically distributed with a common zone of morphological intergradation, but their flowers are of different forms, and consequently are pollinated primarily by different agents: campanulate *L. canadense* by hummingbirds and Turk's-cap *L. michiganense* by swallowtail butterflies (Skinner, pers. obs.). Maintaining these as separate species is thus supported despite a pattern of parapatry with some intergradation along the contact zone (Adams & Dress, 1982; Braun, 1967; Skinner, pers. obs.) that is similar to that displayed by the subspecies of *L. pardalinum* named here.

KEY TO THE SUBSPECIES OF *LILIUM PARDALINUM* KELLOGG

1a. Sepals and petals uniformly yellow or yellow-orange; sepals 3.5–7.1 cm*; anthers pale yellow, 0.5–1.3 cm; pollen yellow or orange; pistil 3.1–4.3 cm; capsules 2.3–4.2 cm; northern California and southern Oregon . . . . *Lilium pardalinum* subsp. *wigginsii*

1b. Sepals and petals ± 2-toned, with yellow or orange proximally, distal 1/5–3/5 darker orange to red; sepals 3.7–10.4 cm; anthers magenta, occasionally purple or orange, 0.5–2.2 cm; pollen yellow to rust; pistil 3.3–7.5 cm; capsules 2.2–5.7 cm; California and southern Oregon.

  2a. Sepals (5.9–)6.6–10.4 cm; anthers 1.1–2.2 cm; capsules 2.9–5.7 cm; leaves 3–12 times longer than wide, blade ± elliptic; plants usually in large clones with many stems; California . . . . *Lilium pardalinum* subsp. *pardalinum*

  2b. Sepals 3.7–8.3 cm; anthers 0.5–1.8 cm; capsules 2.2–4.8 cm; leaves 3–34 times longer than wide, blade elliptic to linear; plants usually in small clones with few stems or single; northern California and southern Oregon.

    3a. Leaves 7–34 times longer than wide, often concentrated proximally, often ascending, sometimes horizontal, blade ± linear; sepals (4.9–)5.3–8.3 cm; anthers 0.6–1.8 cm; pollen usually dark orange; extreme northwestern California and adjacent southern Oregon . . . . *Lilium pardalinum* subsp. *vollmeri*

    3b. Leaves 3–17 times longer than wide, ± evenly distributed along stem, ± ascending or horizontal, blade ± elliptic; sepals 3.7–7.6 cm; anthers 0.5–1.4 cm; pollen yellow to brown-orange; northern California and southern Oregon.

      4a. Pollen red- or brown-orange; anthers magenta; bulb scales usually 2-segmented; sepals 4.9–7.1; northern Coast Ranges near Sebastopol, California . . . . *Lilium pardalinum* subsp. *pitkinense*

      4b. Pollen usually yellow or bright orange; anthers orange to magenta;

bulb scales (1–)2–4-segmented; sepals 3.7–7.6 cm; northern California and adjacent southern Oregon . . . *Lilium pardalinum* subsp. *shastense*

*Measurements are based on fresh material and are lengths unless otherwise noted.

1a. **Lilium pardalinum** subsp. **pardalinum**

Lilium pardalinum Kellogg subsp. *pardalinum* is confined to California, and is variable in flower size, color, and leaf size and shape. Along the length of the Sierra Nevada this subspecies is replaced at higher elevations by a congener: in the north by *L. pardalinum* Kellogg subsp. *shastense* (Eastwood) M. W. Skinner, then by *L. parvum* Kellogg, and finally by *L. kelleyanum* Lemmon in the high Sierra to the south. In the Klamath Mountains it gives way to *L. pardalinum* subsp. *vollmeri* in Del Norte County, *L. pardalinum* subsp. *wigginsii* in northern Humboldt County, and to *L. pardalinum* subsp. *shastense* in northeastern Trinity County. The range disjunction between the south coast ranges in Santa Barbara County and the Peninsular ranges in San Diego County probably exists because *L. parryi* S. Watson is the sister group to *L. pardalinum* (Skinner, 1988) and replaces it in the high mountains of southern California.

Representative specimens. U.S.A. **California:** Colusa Co., Box Springs, 10 July 1972, *Alice Q. Howard 11* (JEPS); Humboldt Co., on Butte Creek Rd. [near Bridgeville, 1.1 mi. from intersection with Highway 36], 2500 ft., 24 July 1983, *M. W. Skinner* 128 (GH); Placer Co., Bear Valley, July 1951, *A. M. Vollmer & L. Beane 188* (US); Sierra Co., Goodyear's Bar, T19N R10E SW 1/4 of S6, 2600 ft., 16 July 1983, *M. W. Skinner 115* (GH).

1b. **Lilium pardalinum** subsp. **pitkinense** (Beane & Vollmer) M. W. Skinner, comb. et stat. nov. Basionym: *Lilium pitkinense* Beane & Vollmer, Contr. Dudley Herb. 4: 356. 1955. TYPE: U.S.A. California: Sonoma Co., Pitkin Marsh, 20 July 1954, *L. Beane & A. M. Vollmer 1270* (holotype, DS not seen).

The Pitkin Marsh lily is a local expression of *Lilium pardalinum* with small flowers, short stamens, and brighter anthers than most members of subspecies *pardalinum.* It is known only from the vicinity of Sebastopol in Sonoma County, California. Plants that match the type concept in Beane (1955) are extremely rare and found only in Pitkin Marsh. Plants from nearby marshes are somewhat more variable, and some clones with larger flowers, longer stamens, and darker rust-colored pollen begin to approach subspecies *pardalinum* in flower morphology; hybrids or plants virtually indistinguishable from subspecies *pardalinum* occur a few miles from Pitkin Marsh. *Lilium pardalinum* subsp. *pitkinense* can be distinguished with some difficulty from *L. pardalinum* subsp. *shastense* by its darker red-orange or brown-orange pollen.

Representative specimen. U.S.A. **California:** Contra Costa Co., cultivated at Canyon by Bert Johnson (propagated from material collected in Pitkin Marsh, Sonoma Co., California, 3 June 1983, by J. Bartel and A. Q. Howard), 20 June 1987, *A. Q. Howard 20* (GH).

1c. **Lilium pardalinum** subsp. **shastense** (Eastwood) M. W. Skinner, comb. et stat. nov. Basionym: *Lilium nevadense* var. *shastense* Eastwood, Leafl. W. Bot. 1: 42. 1933. *Lilium shastense* (Eastwood) Beane, Contr. Dudley Herb. 4: 357. 1955. TYPE: U.S.A. California: Shasta Co., Goose Valley, George Dillman ranch, July 1912, *A. Eastwood 799A* (holotype, CAS not seen).

Lilium nevadense Eastwood var. *nevadense,* Leafl. W. Bot. 1: 41. 1933. Syn. nov. TYPE: U.S.A. California: Shasta Co., Goose Valley, George Dillman ranch, July 1912, *Eastwood 799* (holotype, CAS not seen).

Lilium parvum Kellogg var. *luteum* Purdy, Erythea 5: 105. 1897. *Lilium parviflorum* (Hooker) Purdy var. *luteum* (Purdy) Purdy, Gard. and Forest 10: 502. 1897. TYPE: U.S.A. California: Plumas Co., Swamps-Butterfly Valley, 12 June 1897, *R. M. Austin 1025* (lectotype, designated here, US).

For the synonym *Lilium parvum* Kellogg var. *luteum* Purdy I have selected as lectotype a Plumas County, California, collection by Mrs. R. M. Austin. Purdy evidently based his name and description at least in part on Austin's collection or her description of it, since he noted (1897a: 105), "This showy form of *L. parvum* is from Plumas County, where it was collected by Mrs. Austin." Austin's collection is the only known original material of *L. parvum* var. *luteum.*

In California, *Lilium pardalinum* subsp. *shastense* occurs in the Sierra Nevada from Sierra and Butte Counties north to the region surrounding Mt. Shasta, and thence west to the Klamath Mountains in eastern Trinity County, and to western Siskiyou County where it intergrades with *L. pardalinum* subsp. *wigginsii.* A collection at US (*Mrs. M. M. Hardy 1509*) indicates that the southern limit of *L. pardalinum* subsp. *shastense* may extend as far as Placer County at moderately high elevations (ca. 1800 m) in the Sierra, although *L. pardalinum* subsp. *pardalinum* occurs nearby at lower elevations, for example, Bear Valley (also in Placer Co. at ca. 1400 m). Plants from near Klamath Falls, Oregon, are presumed on the basis of morphology to be this subspecies, though live material of them has not been studied.

Eastwood (1933: 42) considered that "*Lilium nevadense* and its varieties include the small-flowered tiger lilies of the Sierra Nevada." This initial publication of *Lilium nevadense* Eastwood included descriptions of three varieties: *L. nevadense* var. *shastense* Eastwood, *L. nevadense* var. *monense* Eastwood, and *L. nevadense* var. *fresnense* Eastwood. Based on geographical range and morphological description, the latter two names refer to the southern Sierran lily now known as *L. kelleyanum* Lemmon (1903), so they are of little further interest here. Eastwood (1933) designated a single Shasta County location (George Dillman ranch, Goose Valley, Shasta Co., California) as the type locality for both *L. nevadense* and *L. nevadense* var. *shastense*, though she did designate different collections as types (*Eastwood 799* for the species, *Eastwood 799A* for the variety). She assigned no unique geographical range to the variety *shastense*, although specimen citations in the protologue indicate that it extended from a northern limit in Siskiyou County south to Plumas County. Though she did not mention the autonym by name, specimens cited under *L. nevadense* exclusive of the named varieties indicate that its range coincided more or less with that of variety *shastense*, though extending farther south and encompassing Sierra County as well. Her Latin diagnosis (Eastwood, 1933) and subsequent English description (Eastwood, 1948c: 136) indicate that *L. nevadense* var. *shastense* is characterized by "narrower, more numerous and erect leaves" than the "typical" variety. In fact, *Lilium pardalinum* subsp. *shastense* includes individuals with narrow leaves and others with broad leaves, often within the same population, so Eastwood's distinction of entities with differently shaped leaves is not maintained here.

Thus *Lilium nevadense* var. *nevadense* and variety *shastense* were published simultaneously (Eastwood, 1933), and both names apply to the material encompassed under the new combination. The autonym has priority over variety *shastense* (Greuter et al., 2000, Art. 11.6), but only within the named rank (Art. 11.2). As there are no applicable epithets at the subspecies level, *shastense* is selected here for the small-flowered subspecies of *Lilium pardalinum* in northeastern California. This is appropriate for several reasons. First, Beane (1955) published *Lilium shastense* to represent the small-flowered *L. pardalinum* growing in Siskiyou, Shasta, and Plumas Counties. Because of Beane's action it is also the epithet I used—though did not publish formally—in *The Jepson Manual* (Hickman, 1993). Finally, *shastense* is preferable because the plant is common both in Shasta County and around the base of Mt. Shasta in Siskiyou County, and because the epithet *nevadense* has been erroneously linked to and therefore confused with *L. kelleyanum* via the varieties *monense*, *fresnense*, and *inyoense* Eastwood (Eastwood, 1941).

Other earlier epithets that might have been adopted for this purpose are rejected for various reasons. Purdy (1897a: 105) first published *Lilium parvum* var. *luteum* for the "showy form [of *L. parvum*] . . . from Plumas County" with "segments of the perianth revolute at the base," thus clearly designating the plant recognized here as *L. pardalinum* subsp. *shastense* and distinguishing it from the tubular-flowered *L. parvum*. Purdy (1897b) subsequently decided that *L. parvum* Kellogg should be restricted to plants with horizontal to ascending trumpet-shaped flowers (its current application), and transferred the plants with revolute perianth and pendent flowers from subalpine Plumas County to a new small-flowered Sierran taxon that can be cited as *L. parviflorum* (Hooker) Purdy var. *luteum* (Purdy) Purdy. *Lilium parviflorum* (Hooker) Purdy [var. *parviflorum*] encompassed similar plants (1897b: 502) from "the middle belt of the Sierra Nevada from Tulare County, to the south, to the base of Mt. Shasta." But Purdy's (1897b) use of *Lilium parviflorum* to describe the plant here called *L. pardalinum* subsp. *shastense* was inappropriate. Based on geography and flower size, *L. canadense* L. var. *parviflorum* Hooker (1838: 181), "[from the] Columbia and Walamet [sic] Rivers," clearly refers to what is now known as *L. columbianum* hort. Leichtlin in Ducharte (1871; see end note for discussion of this apparently new citation for *L. columbianum*). With this meaning it was first elevated to species level as *L. parviflorum* by W. G. Smith (1874), who evidently was not aware of *L. columbianum*; thus *L. parviflorum* (Hooker) Purdy is not only a misapplication but is objectionable as a later homonym (Greuter et al., 2000, Art. 53.1). Despite the illegitimate binomial, there is no inherent objection to reusing the final epithet of Purdy's (1897b) name *L. parviflorum* var. *luteum* (Purdy) Purdy within *L. pardalinum* for the plant named here (Greuter et al., 2000, Art. 55.2). Yet this, too, is precluded (Greuter et al., 2000, Art. 53.4) by the very different and prior-named *L. pardalinum* Kellogg var. *luteum* hort. T. S. Ware (in Marshall, 1889), with "yellow flowers spotted with brownish purple" that occurs "in the south, as well as more inland [in California]" (Woodcock & Stearn, 1950: 301, 303). Eastwood (1902) employed the epithet *parviflorum* in an entirely new context with publication of *L. pardalinum* Kellogg [var.] *parviflorum* Eastwood (= *L. kelleyanum* Lemmon; see end note re: priority of *L. kelleyanum*), and Johnston (1923) later misapplied Eastwood's name to the taxon named here. Eastwood's action renders the epithet *parviflorum*, like *luteum*, unavailable for the present use at any infraspecific rank within *L. pardalinum* (Greuter et al., 2000, Art. 53.4).

Representative specimens. U.S.A. **California:** Butte Co., Little Chico Creek, 1000 ft., 5 July 1900, *John B. Leiberg 5011* (US); Lassen Co., Susanville, Perkin's Ranch, 4800 ft., 26 June 1897, *Marcus E. Jones, A.M. s.n.* (US); Placer Co., 1893, *Mrs. M. M. Hardy 1509* (US); Plumas Co., Butterfly Valley, 25 June 1912, *H. M. Hall 9273* (US); Shasta Co., Goose Valley (near Burney), 29 June, 11 July 1912, *Alice Eastwood 857* (US); Sierra Co., Salmon Lake, July 1918, *Mrs. E. C. Sutcliffe s.n.* (US); Siskiyou Co., McCloud River above Big Springs, T39N R2W SW 1/4 of NW 1/4 of S13, 6 Aug. 1984, *M. W. Skinner 195* (GH); town of Mt. Shasta Kampgrounds of America, swampy ground near RR tracks, T40N R4W S9 3900 ft., 27 July 1988, *M. W. Skinner 266* (GH); in spring, Cayenne Ridge, Marble Mountain, 6 July 1940, *Marion Ownbey 2200, Fred G. Meyer* (US); Tehama Co., Brookside, Butt Mt., Deer Creek Canyon, 1500 m, 16 July 1911, *W. W. Eggleston 7249* (US); Trinity Co., Dan Rice Cr. on Scott Mt., Shasta-Trinity National Forest, T39N R7W NE 1/16 of S9, 4600 ft., 26 July 1988, *M. W. Skinner 264* (GH). **Oregon:** Klamath Co., meadows and woods near Lake of the Woods, Cascade Mts., 5000–6000 ft., 5 July 1936, *J. William Thompson 13102* (US).

1d. Lilium pardalinum subsp. **vollmeri** (Eastwood) M. W. Skinner, comb. et stat. nov. Basionym: *Lilium vollmeri* Eastwood, Leafl. W. Bot. 5: 121. 1948b. TYPE: U.S.A. California: Del Norte Co., *Darlingtonia* bog 1 mi. W of Eleven Mile Creek on the old Gasquet-Grants Pass road, 3 July 1940, *A. M. Vollmer & I. L. Wiggins 3* (holotype, DS not seen; isotype, UC).

Lilium pardalinum subsp. *vollmeri* (Eastwood) M. W. Skinner is a narrow serpentine endemic lily of the Siskiyou Mountains in extreme northwestern California and adjacent Oregon. A collection (*E. W. Hammond 384*, US) from near Wimer in Jackson County, Oregon, evidently represents the northernmost extent of this taxon. To the south it intergrades with *L. pardalinum* subsp. *pardalinum*, but can generally be distinguished by its somewhat smaller flowers (sepal length typically is 5.3–8.3 cm vs. 6.6–10.4 cm in subsp. *pardalinum*), which are often redder apically, and its frequently ascending, narrowly elliptic or linear leaves. Northern populations in Curry County, Oregon, as well as those in the shade throughout its range, are rather similar to *L. pardalinum* subsp. *pardalinum*, though generally the plants are less overtly clonal and therefore less clumped. In the eastern part of its range, for example west of Grayback Mountain in Josephine County, Oregon, and near Sanger Peak in Del Norte County, California, it intergrades extensively with *L. pardalinum* Kellogg subsp. *wigginsii* (Beane & Vollmer) M. W. Skinner, producing swarms of intermediate individuals that vary greatly in leaf arrangement and shape, and flower and anther coloration.

Purdy (1919: 522) applied the name *Lilium roezlii* to this plant, but this was an orthographic correction and misapplication of *Lilium roezlii* Regel (1870: 521, as "*L. roezli*"), a taxon of uncertain provenance and identity. Although the illustration (Regel, 1870: t. 667; it is labeled "*L. roezlei*") accompanying Regel's lily shows a narrow-leaved *Lilium pardalinum*-type lily, the implied locality of Utah (from "Mormon States") is clearly in error as no native *Lilium* occur in Utah. Based on Roezl's travels, Eastwood (1948a) decided that Roezl collected it in the Sierra Nevada; thus Regel's *Lilium roezlii* is generally considered to be synonymous with *L. pardalinum* var. *angustifolium* Kellogg (1859a: 300), itself a synonym of *L. pardalinum* subsp. *pardalinum*.

Purdy (1919) determined that there were two forms of his *Lilium roezlii*. He first (1901: 354) identified the form with flowers "orange dotted with maroon," which he subsequently (1919: 522) called the "type." This plant was later named *L. wigginsii* Beane & Vollmer (in Beane, 1955), and is combined below as another subspecies of *L. pardalinum* Kellogg. The other he described (1919: 522) as growing farther to the west and "orange in the center and deep crimson on the outer two thirds." It is this plant that Eastwood later described as *L. vollmeri*, the type of which she said (1948b: 122) was initially (mis)identified by Albert M. Vollmer as *L. roezlii* Regel.

Eastwood's suggestion (1948b: 123) that her new species *Lilium vollmeri* is perhaps only an ecological variety of *L. occidentale* Purdy is not supportable; the more or less parallel stamens and unbranched rhizome of *Lilium occidentale* are uniquely at odds with *L. pardalinum*.

Representative specimens. U.S.A. **California:** Del Norte Co., Old Gasquet Toll Rd. at mile marker 10.75, in meadow, T17N R3E NE 1/4 of SW 1/4, 1800 ft., 22 July 1985, *M. W. Skinner 199* (GH). **Oregon:** Curry Co., U.S. Forest Service Rd. 3698, 0.4 mi. before 3795, T37S R12W NE 1/4 of SE 1/4, 3700 ft., 24 July 1985, *M. W. Skinner 201* (GH).

1e. Lilium pardalinum subsp. **wigginsii** (Beane & Vollmer) M. W. Skinner, comb. et stat. nov. Basionym: *Lilium wigginsii* Beane & Vollmer, Contr. Dudley Herb. 4: 355. 1955. TYPE: U.S.A. California: Siskiyou Co., Siskiyou Mountains near the Oregon border W of Highway 99, 16 July 1954, *L. Beane & A. M. Vollmer 1266* (holotype, DS not seen; isotypes, MO, US).

Lilium pardalinum subsp. *wigginsii* is a Klamath Mountain endemic lily that occurs broadly along the boundary between Del Norte and Siskiyou Counties, California, and east through southeast Josephine County, Oregon, to Mt. Ashland in Jackson County (Ballantyne, 1980). It intergrades with *L. pardalinum* subsp. *shastense* in the Marble Mountains of Siskiyou County, California. The solid orange or yellow-orange flowers and yellow anthers are distinctive. Genetic instability in this subspecies is frequently expressed as malformed flowers with shrunken or missing reproductive structures, and is probably due to introgression with other *L. pardalinum* subspecies; similarly malformed flowers occur where *L. canadense* and *L. grayi* S. Watson intergrade in Virginia (Skinner, pers. obs.).

Purdy's (1901, 1919) application of the name *Lilium roezlii* Regel to this taxon is discussed above under *L. pardalinum* subsp. *vollmeri*. In the protologue for *L. wigginsii*, here reduced to a subspecies, Beane (1955: 355) noted that "this [may have been the lily] offered to the florist trade by Mr. Carl Purdy under the name *Lilium roezlii* (yellow) Regel." This is certainly consistent with Purdy's (1919, 1935) own writings.

Representative specimens. U.S.A. **California:** Siskiyou Co., Happy Camp to O'Brien Rd. at mile marker 7.5, T18N R6E S10, 4100 ft., 21 July 1985, *M. W. Skinner 198* (GH). **Oregon:** Jackson Co., Rogue River National Forest, 1.5 mi. S of Ashland Campground, T40S R1E SW 1/4 of SW 1/4 of S20, 23 July 1988, *M. W. Skinner 255* (GH); Josephine Co., Grayback Rd., 6.2 mi. from junction with Forest Service Rd. 4611/070, T39S R7E w 1/4 of S25, 3200 ft., 22 July 1988, *M. W. Skinner 254* (GH).

2. Lilium washingtonianum Kellogg, Hesperian 3: 340. 1859. TYPE: Illustration, Hesperian 3: 341. 1859 (lectotype, designated here).

A. M. Kellogg (1859b) did not formally designate type material for *Lilium washingtonianum*, and specimen material associated with the protologue is unknown. There are no Kellogg specimens of *L. washingtonianum* at likely major herbaria including K, MO, UC/JEPS, or US. The only known Kellogg specimen of *L. washingtonianum* [*A. M. Kellogg & Harford 898* (or *998*, the number is illegible), GH] lacks locality information (Walter Kittredge, pers. comm. 2001) and is therefore unsuitable. The protologue contains no indication of any specimens that Kellogg relied on other than his own. It appears that the illustration from the protologue (Kellogg, 1859b: 341) is the earliest surviving original material associated with Kellogg's description, so it is chosen here as the lectotype following the rationale for typification of *Lilium pardalinum* discussed above. It is a black and white drawing of a mature fruit (Kellogg, 1859b: 341).

KEY TO THE SUBSPECIES OF *LILIUM WASHINGTONIANUM* KELLOGG

1a. Sepals and petals aging light pink or remaining white; bulbs usually (36%) without notched or segmented scales; sepals 8–11.3 cm; Sierra Nevada and southern Cascades of California . . . . *Lilium washingtonianum* subsp. *washingtonianum*
1b. Sepals and petals aging deep pink or lavender; bulbs usually (88%) with some notched or segmented scales; sepals (6.1–)6.7–9.5 cm; mountains of northern California and Oregon . . . . *Lilium washingtonianum* subsp. *purpurascens*

2a. Lilium washingtonianum subsp. **washingtonianum**

Distribution. California: the Sierra Nevada from Fresno County north to the southern Cascade Ranges at Mt. Shasta.

Representative specimens. U.S.A. **California:** Butte Co., cut-over yellow pine forest now grown up to dense brush about 1/2 mi. W of Chaparral, very fragrant, 5100 ft., 6 July 1940, *Albert M. Vollmer & Ira L. Wiggins 10* (US); Mariposa Co., near Yosemite, Sierra Nevada, 1875, *John Muir 8095* (MO); Nevada Co., Highway 20, 2.7 mi. NE of White Cloud Campground, 14 July 1983, *M. W. Skinner 104* (GH); Tuolumne Co., hill S of Camp 127, 7500 ft., 21 July 1863, *W. H. Brewer 1931* (US).

2b. Lilium washingtonianum subsp. **purpurascens** (Stearn) M. W. Skinner, stat. nov. Basionym: *Lilium washingtonianum* var. *purpurascens* Stearn, Gard. Chron. 124: 13. 1948. *Lilium purpureum* Purdy, J. Roy. Hort. Soc. 26: 351–362. 1901. *Lilium washingtonianum* var. *purpureum* (Purdy) Purdy, J. Int. Gard. Club 3: 509. 1919, non *Lilium washingtonianum* var. *purpureum* hort. W. Bull ex Baker, J. Linn. Soc. Bot. 14: 233. 1874. TYPE: U.S.A. California: Humboldt Co., 0.4 mi. S of Onion Lake on U.S. Forest Service road 13N01, T11N R4E SE 1/4 of SE 1/4 of S6, 4400 ft., 5 Aug. 1983, *M. W. Skinner 161a & b* (neotype, designated here, GH).

With this taxon, Carl Purdy (1901, 1919) polished his habit of appropriating previously published names and misapplying them to other taxonomic concepts, often without attribution to the original authors. To describe the pink-flowered northern plants of *Lilium washingtonianum* Kellogg here called *Lilium washingtonianum* Kellogg subsp. *purpurascens* (Stearn) M. W. Skinner, Purdy (1901) evidently recycled the final epithet of *L. washingtonianum* Kellogg var. *purpureum* hort. W. Bull ex Baker (1874) (= *L. rubescens* Watson, 1879) and elevated it to species as *L. purpureum* Purdy. [According to T. Masters (1874), *L. washingtonianum* Kellogg var. *purpureum* hort. W. Bull ex Baker had first been distributed (but not formally published) by Bull as *L. purpureum* in 1873; subsequent mentions of the latter name by Masters (1874) and T. Moore (1874) did not validly affect publication since neither author accepted the taxon (Greuter et al., 2000, Art. 34.1).] Curiously, Purdy (1901) reproduced in support of his *L. purpureum* the illustration from Masters's (1874) supplemental description of *L. washingtonianum* var. *purpureum* hort W. Bull ex Baker (1874), the ascending and erect flowers of which clearly diagnose *L. rubescens* S. Watson. Watson (1879) had cited Baker's name in synonymy and Masters's use of it and his work links the name *L. rubescens* to that particular illustration. Despite illustrating the wrong taxon—for which he confusingly retained the original Masters (1874) label of *L. washingtonianum* var. *purpureum*—Purdy's (1901) description of *L. purpureum* unequivocally indicates what is here called *Lilium washingtonianum* subsp. *purpurascens*. (Purdy notes a distribution extending through Oregon to the Columbia River and heavy bulb with jointed scales, a combination which could diagnose no other taxon.) Purdy subsequently (1919) reevaluated his new species and reduced it to *L. washingtonianum* var. *purpureum* (Purdy) Purdy, although he (1901: 361; 1919: 511) and others considered this same name sensu Baker (1874) to be a synonym of *L. rubescens*. Stearn (1948) recognized that *L. washingtonianum* var. *purpureum* sensu Purdy conflicted with the earlier Baker name, and rectified this with a new name, *L. washingtonianum* var. *purpurascens* Stearn. The present action elevates Stearn's name to subspecies.

W. T. Stearn did not designate type material of *L. washingtonianum* var. *purpurascens* nor was there a diagnostic illustration accompanying the protologue. According to Roy Vickery (BM, pers. comm. 2001), there are no specimens annotated by Stearn to variety *purpurascens* at BM, where Stearn worked and deposited his collections, nor is there any known material of this taxon annotated or collected by Carl Purdy. The lack of original type material necessitates designation of a neotype; for this I have chosen a collection from Humboldt County, California, an area that Purdy knew well and which was undoubtedly close to the place that provided the plants on which his taxon was based.

Lilium washingtonianum subsp. *purpurascens* supplants the Sierran subspecies *washingtonianum* near Mt. Shasta in Siskiyou County, California, where intermediates occur, and extends west through the Klamath Mountains and north through the Cascade ranges to Mt. Hood in Clackamas County, Oregon. In addition to the characters mentioned in the key, subspecies *purpurascens* is distinguished from subspecies *washingtonianum* by more compact bulbs with longer scales. These modest differences indicate that these taxa are best recognized as subspecies rather than species.

Representative specimens. U.S.A. **California:** Humboldt Co., Forest Service 15N01 [the Gasquet–Orleans road], 3.8 mi. S of intersection with Forest Service 13N01, T12N R5E NE 1/4 of NW 1/4 of S16, 4400 ft., 30 July 1983, *M. W. Skinner 143* (GH); 0.4 mi. S of Onion Lake on U.S. Forest Service road 13N01, T11N R4E SE 1/4 of SE 1/4 of S6, 4400 ft., 5 Aug. 1983, *M. W. Skinner 162a & b* (GH); Siskiyou Co., among shrubs, summit of Cayenne Ridge, Marble Mountain, flowers white with purple spots, 6 July 1940, *Marion Ownbey 2196, with Fred G. Meyer* (US). **Oregon:** Klamath Co., Swan Lake Valley, 7 July 1905, *Elmer I. Applegate 705* (US).

A NOTE ON THE CORRECT CITATION OF *L. COLUMBIANUM*

Ducharte's (1871) recapitulation in July 1871 of a letter from M. Leichtlin apparently represents the first confirmed and valid publication of *Lilium columbianum;* thus the name may be cited as *L. columbianum* hort. Leichtlin in Ducharte, J. Soc. Cent. Hort. France sér. 2, 5: 98 (1871). Leichtlin's letter and Ducharte's commentary provide the distribution and distinguishing features of the taxon, and precede by two months a short, unauthored notice (Anonymous, 1871) published in September 1871 in *Gardeners' Chronicle*, which also validly established the name. This brief notice, sometimes attributed to J. G. Baker (e.g., Watson, 1880: 167) but more likely the work of M. Thomas Masters (John Wiersema and Brent Elliott, pers. comm. 2001), attributes the name to earlier "New York publications," but that precise reference—which may well be the first instance of the name—has not been found. Baker (1873) subsequently published *L. columbianum* hort. Leichtlin without an adequate description: only the distribution was given, and this could not have been considered by him to distinguish the plant from others (Greuter et al., 2000, Art. 32.2). In his revision of the Tulipae, Baker

(1874) then validly published the name as *L. columbianum* Hanson in hort., Leichtlin. It is this last that is usually cited in floras and other works, the authority variously given as Hanson, or Baker, or Hanson ex Baker. Although Baker (1874) ascribed the name to Hanson rather than to himself as he does for other *nomina nova* in this work, no indication is given that Hanson contributed to the description; this later homonym is perhaps best cited (Greuter et al., 2000, Art. 46.4) as *L. columbianum* hort. Hanson ex Baker (1874).

A NOTE ON THE PRIORITY OF *LILIUM KELLEYANUM* LEMMON

Eastwood's (1902) *Lilium pardalinum* Kellogg [var.] *parviflorum* Eastwood precedes Lemmon's (1903) publication of *L. kelleyanum*, but as noted above, at the rank of species her epithet *parviflorum* becomes a later homonym of *L. parviflorum* (Hooker) W. G. Smith (1874) (= *L. columbianum* hort. Leichtlin, in Ducharte, 1871). Therefore the next legitimate specific epithet must be adopted (Greuter et al., 2000, Art. 11.3), and this is Lemmon's (1903) *L. kelleyanum*. Lemmon's description is somewhat incomplete but it well fits the plant now known as *L. kelleyanum*, especially his flower size [segment length 1–1.5 inches (2.5–4 cm)]. His obscure reference (1903: 300) to "plants of the larger, yellow-flowered lily [that] abound in the vicinity" is probably to *L. pardalinum* Kellogg subsp. *pardalinum* growing at lower elevations. The type localities that he cited in the protologue—along Bubb's Creek and Copper Creek in Fresno County, California—are located near the center of the range of *L. kelleyanum*, and there are no other *Lilium* with small flowers (segments < ca. 7 cm) until the southern limit of *L. parvum* Kellogg is reached about 60 miles to the north.

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Novae Gesneriaceae Neotropicarum IX: *Cremospermopsis*, A New Genus from Colombia

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ABSTRACT. A new genus in the Gesneriaceae, *Cremospermopsis* L. E. Skog & L. P. Kvist, is described from the very humid forests in the Colombian departments of Antioquia and adjacent Bolívar. The new genus of two species, *C. cestroides* and *C. parviflora*, is similar and may be related to *Cremosperma*, but differs in having inflorescence bracts, unequal calyx lobes, and spherical papillate seeds.

Key words: Colombia, *Cremosperma*, *Cremospermopsis*, Gesneriaceae.

The flowering plant family Gesneriaceae is better represented in Colombia than in any other neotropical country, with approximately 400 known species according to a recent survey by Kvist et al. (1998). While identifying Colombian Gesneriaceae for that survey, the authors found collections of an undescribed gesneriad that is apparently endemic. This new genus, *Cremospermopsis*, is from a small area in the northwestern Colombian department of Antioquia, with two collections from adjacent Bolívar. Specimens of the new genus had often been filed in herbaria among unidentified material of Rubiaceae or (less frequently) Acanthaceae. A closer look demonstrates that *Cremospermopsis* cannot be a member of either of those families because of the presence of hypogynous flowers and the absence of stipules on the stems of the new genus. In addition, plants have unilocular capsules with many tiny seeds, four anthers with coherent stamens, and a more or less regular or divided nectary surrounding the ovary, characteristics that place the genus in the Gesneriaceae.

Other specimens of *Cremospermopsis* were recognized as Gesneriaceae, and mostly as unknown species of *Cremosperma* Bentham. This was reasonable since the two genera are similar in having connate calyx lobes and filaments adnate to the corolla tube base. The name of the new genus alludes to the similarity of *Cremospermopsis* to *Cremosperma*.

The two species of *Cremospermopsis* have a unique combination of characters, such as zygomorphic calyces, corolla limbs with glandular trichomes, and spherical papillate seeds, which justifies placing them in a new genus. They share more characteristics (e.g., erect habit, opposite leaves, calyx lobes connate, etc.) with *Cremosperma* than with any other genus, but are clearly distinguished by the presence of floral bracts.

We will not here assign *Cremospermopsis* to a tribe. Possible tribes are Beslerieae and Napeantheae, as defined by Wiehler (1983). The presence or absence of inflorescence bracts has been given much importance in the taxonomy of neotropical Gesneriaceae, mostly because Wiehler (1983) maintained an amended tribe Beslerieae, including *Besleria* L., *Cremosperma* Bentham, *Gasteranthus* Bentham, *Reldia* Wiehler, and *Resia* H. E. Moore, on the absence of floral bracts, a superior ovary, the lack of tubers or rhizomes, and seeds without funicles, etc., in the included genera. At the present time, however, the circumscription of Beslerieae may be open to question. For example, the discovery of a new subspecies of *Resia ichthyoides* Leeuwenberg having floral bracts led Skog and de Jesus (1997) to transfer the genus *Resia* from the Beslerieae to the formerly monotypic tribe Napeantheae where it seems better placed. The fact that species of *Cremospermopsis* also have bracts despite their close resemblance and possible relationship to *Cremosperma* makes it even clearer that tribal limits may well have to be reexamined. Table 1 compares *Cremospermopsis* with *Reldia* and *Cremosperma*

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Table 1. Morphological comparison of *Cremospermopsis* with four other similar genera of Gesneriaceae.

	Cremospermopsis	*Resia*	*Napeanthus*	*Cremosperma*	*Reldia*
Character state					
Habit	Erect	Apical cluster	Rosulate to erect	Erect	Rosulate to erect
Leaf arrangement	Opposite	Congested	Congested	Opposite	Alternate
Inflorescence bracts	Present	Present or absent	Present	Absent	Absent
Calyx lobe connation	Present	Basal or to ⅓	Absent or rarely to ½	Present	Absent
Calyx lobe equality	Unequal	Equal	Equal	Equal	Equal to unequal
Corolla	Zygomorphic	Zygomorphic	Actinomorphic or rarely zygomorphic	Zygomorphic	Zygomorphic
Spur	Absent	Absent	Absent	Absent	Present
Corolla length vs. calyx length	Longer	Longer	Very short to nearly the same	Longer	Longer
Corolla throat	Glandular-hairy	Not glandular	± Glabrous	Glandular or not	Glandular or not
Filament adnation to corolla tube base	Adnate	Nearly free	Adnate	Adnate	Nearly free
Thecae confluent	Yes	No	Yes	Yes	Partly
Nectary	Present	Present	Absent	Present	Present
Seeds	Papillate	Striate	Striate	Striate	Striate

(both included in Beslerieae) as well as with *Napeanthus* and *Resia* (the two genera currently in the tribe Napeantheae).

Although *Cremospermopsis* appears to be most similar to *Cremosperma*, further studies are necessary to determine if Beslerieae might have to be expanded to include genera and species having floral bracts, or alternatively if *Cremosperma* should be transferred to Napeantheae together with *Cremospermopsis*.

Cremospermopsis L. E. Skog & L. P. Kvist, gen. nov. TYPE: *Cremospermopsis cestroides* (Fritsch) L. E. Skog & L. P. Kvist.

Ad *Cremosperma* affinis sed in inflorescentiis congestis bracteatis in lobis calycis inaequalibus zygomorphis, cum trichomatibus glandularibus in capsulis in sicco fatiscentibus et seminibus sphaericis papillatis differt.

Plants herbs to subshrubs, erect or rarely appressed to ground. *Leaves* opposite, subisophyllous in pairs, blades mostly ovate, elliptic, obovate or oblanceolate, adaxially darker green than abaxially, lateral veins 8 to 12 per side; petiolate. *Inflorescences* umbel-like cymes, usually congested but occasionally relatively open, of several flowers, pedunculate and pedicellate; with mostly 4 lanceolate to ovate bracts from the apex of the peduncle. *Calyx* lobes connate between 1/3 and 2/3 of their length, subequal to strongly unequal, 3 or 4 lobes usually lanceolate, the remaining 1 or 2 much wider and ovate but variable even within the same inflorescence and even more unequal in fruiting than during flowering, all lobes directed forward and with entire margins. *Corolla* ecalcarate, funnelform to tubular, outside glabrous or glandular hairy, especially on the limb, inside glabrous; limb ± bilabiate, lobes rotund, 3 lower lobes larger than 2 upper lobes. *Filaments* adnate to corolla tube base at least 2/3 of their length, glabrous, anthers coherent, thecae confluent, staminode sometimes but apparently not always present. *Nectary* annular or higher on both sides of ovary and low or absent in between. *Ovary* and style glabrous, stigma capitate. *Fruit* a dry capsule, compressed and with two grooves, dehiscing irregularly and disintegrating in the persistent calyx, which may function as a splash-cup; seeds very numerous, ± regularly spherical, very small, surface papillate.

Cremospermopsis is easily recognizable by the combination of congested, bracteate inflorescences with small to tiny corollas lacking spurs, but having densely glandular hairy throats and limbs. Both species are particularly similar to species of *Cremosperma*, where the type species was formerly placed. The unequal calyx lobes and the resulting zygomorphic calyces is an unusual feature, and other differences from *Cremosperma* include the presence of spherical, papillate seeds vs. narrowly elliptic non-papillate seeds in *Cremosperma*, and the abundance of glandular trichomes on the limb and in the throat of *Cremospermopsis*. The fruits are also different. The capsules in *Cremosperma* split (more or less regularly) but their valves remain surrounding the seed mass during dispersal, while the capsules of *Cremospermopsis* apparently disintegrate and virtually disappear leaving the seeds free in the persistent calyx.

The two *Cremospermopsis* species have similar geographical ranges almost completely restricted to the Colombian department of Antioquia (*C. cestroides* has also been collected twice in adjacent Bolívar). The species have both been collected at several different localities suggesting that they may also occur in the same habitat, viz., very humid forests and often close to streams. Plants have been collected from near sea level (in the Cauca River valley) to 1550 m elevation, but most collections come from between 500 to 900 m elevation, possibly corresponding to the low-elevation cloud forests with a very high Gesneriaceae diversity like that found in western Ecuador (Skog & Kvist, 2000).

Little is known about the ecology of the *Cremospermopsis* species, which have not yet been studied by the authors in their natural habitats. Both species have small flowers, not particularly conspicuous by their coloration, which varies from white to yellow, but the corolla limbs and throats have numerous glandular trichomes suggesting the liberation of substances that might attract pollinators. In addition, the expanded calyx lobes, which tend to be more conspicuous than the corollas particularly in *Cremospermopsis parviflora*, may also help to attract pollinators. The corolla tubes of *Cremospermopsis* flowers seem nearly blocked by the coherent anthers, which tend to be located about where the corolla tube is narrowest. However, both species have well-developed glands around the ovary suggesting that pollinators may indeed find nectar in the flowers.

Cremospermopsis has numerous tiny seeds like many other understory Gesneriaceae, and the surrounding persistent calyces may function as splash-cups, as the capsules seem to disintegrate at maturity. Water transport, and possibly small animals to which the papillate seeds may adhere, may disperse the seeds.

The status of the two *Cremospermopsis* species in the wild is unknown. It is possible, however, that both species are endangered. Low-elevational humid forests in Antioquia have mostly disappeared, and humid forest Gesneriaceae tend to be very vulnerable to deforestation, as they cannot survive the exposure to dryer microclimates.

KEY TO THE SPECIES OF *CREMOSPERMOPSIS*

1a. Corolla nearly 2 times as long as the calyx and not hidden by the calyx lobes; leaf blades oblanceolate or less commonly elliptic, apex acuminate . . . . *C. cestroides*

1b. Corolla shorter than the calyx and hidden by the calyx lobes; leaf blades obovate or occasionally elliptic, apex obtuse or less frequently acute . . *C. parviflora*

Cremospermopsis cestroides (Fritsch) L. E. Skog & L. P. Kvist, comb. nov. Basionym: *Besleria cestroides* Fritsch, Notizbl. Bot. Gart. Berlin 11: 962. 1934. *Cremosperma cestroides* (Fritsch) C. V. Morton, J. Wash. Acad. Sci. 28: 348. 1938. TYPE: Colombia. Antioquia: Guadalito, growing in forest shade, 2000 ft., 4 Feb. 1880, *W. Kalbreyer 1391* (lectotype, designated here, K; B photo, US). Figure 1.

Plants herbs to subshrubs, stems erect (0.3–) 0.70–1.5(–2.0) m tall, to 7 mm diam., glabrescent below to distally pilose or villous and occasionally strigose, internodes (0.3–)1–5(–9) cm long. *Leaves* with blades oblanceolate or less commonly elliptic, 8–18(–22) × (2–)4–7(–9) cm, apex acuminate, base cuneate, rarely acute, margin remotely serrate to subentire, adaxially pilose to glabrous, abaxially ± sparsely pilose or strigose, secondary veins 8 to 12 per side, pilose or strigose below. *Inflorescences* of umbel-like cymes, of 3 to 15 flowers, pilose, strigose or puberulent; peduncles 2–5(–8) cm long, distally with 2 to 4 bracts, each ovate, 5–10 × 1–4 mm; pedicels 2–8 mm long. *Calyx* lobes green, occasionally red tinged, outside pilose especially along margin, inside glabrous, connate, subequal to unequal, lanceolate to ovate with acute to acuminate apex, all 8–10 mm long and up to 12 mm long in fruiting stage, 3 or 4 of the lobes only 2–4 mm wide and the other 1 or 2 lobes to 6 mm wide. *Corolla* tubular, 1.2–1.7 cm long, tube 1.0–1.4 cm, 1–2 mm wide at base, diam. 2.5–3.5 mm basally, narrowing to 2.0–2.5 mm and then ampliate to 3–4 mm distally, yellow or white, outside upper 2/3 of length glandular pilose to villous, inside glabrous except apically; throat 3.5–5 mm diam., limb yellow, densely glandular hairy with trichomes that may be short or have a more extended stalk of several cells, dorsal lobes often with pink or violet markings, 1.5–2 mm long, lateral and ventral lobes 2–3.5 mm long. *Filaments* adnate to corolla tube base for 5–8 mm, above free for 1.5–3 mm; anthers 0.7–1.3 × 0.5–0.8 mm; nectary ± regularly annular, 0.3–0.7 mm high. *Ovary* 2 mm high. *Capsule* 5 × 3 × 2 mm.

Distribution and ecology. Plants are endemic to the Colombian departments of Antioquia and Bolívar, growing in disturbed primary or old secondary wet forest, along streams and in shady areas; (20–) 500–1000(–1550) m, and collected in flower in all months of the year, except April and November; in fruit in June, but probably most of the year.

Cremospermopsis cestroides is distinguished from the apparently more abundant *C. parviflora* (see below) by the acuminate leaf apices and by larger corollas of the former.

This species, described originally by Fritsch as a *Besleria* species and later transferred to *Cremosperma* by Morton, was typified by a specimen at B (*Kalbreyer 1391*). Unfortunately, the holotype is no longer extant, although a photograph of the specimen at B taken in the 1930s is lodged at US and probably in other herbaria. The duplicate of *Kalbreyer 1391* at K is selected here as lectotype. It is remarkable that neither Fritsch nor Morton commented on the bracteate inflorescences on the types and clearly evident in the photograph of the holotype and on the lectotype specimen at K.

Additional specimens examined. COLOMBIA. **Antioquia:** Mpio. Anorí, 3 km from Providencia hydroelectric plant, valley near confluence of Tirana stream with Río Anorí, 28 km SW of Zaragoza, *Alverson et al. 130* (COL); Mpio. Amalfi, 8–15 km from Amalfi to Rumazón, Salazar and La Playa sites, *Betancur et al. 776* (F, MO, US); border with Bolívar department, near the confluence of the Ité and Tamar rivers into Cimitarra river, ca. 38 km W of Barrancabermeja, *de Bruijn 1537* (MO, US); Mpio. San Luis, bank of Río Samaná Norte, above Medellín–Bogotá road, *Callejas et al. 4104* (MO, US (2)); Mpio. Anorí, Dos Bocas–Providencia road, near Río Nechí, *Callejas et al. 4466* (HUA, NY); Mpio. Remedios, vereda Santa Lucia, 9–18 km SW of Remedios along road to Puerto Berrio, *Callejas et al. 8106* (HUA, US); Mpio. San Carlos, correg. Alto de Samaná, vereda Miraflores, *Callejas et al. 8603* (HUA); Mpio. San Luis, Villa del Sol site, vereda La Cristalina on Medellín–Bogotá road, *Callejas et al. 11159* (HUA); Mpio. San Francisco, Carretera de Aquitania, nacimiento de la quebrada La Cristalina, *Cárdenas L. et al. 2629* (MO); Mpio. San Carlos, correg. Alto de Samaná, vereda Miraflores, *Fonnegra et al. 3018* (HUA, MO, US); Mpio. San Luis, Río Samaná-Río Claro sector near Medellín–Bogotá road, *Hernández et al. 124* (HUA, SEL), *469(4)* (HUA), *675* (HUA); Mpio. San Luis, 8 km E of bridge over Río Caldera on Medellín road, *Juncosa & Escobar 724* (MO, US); La Cuchilla, correg. El Prodigio, vereda Los Medios, *Lázaro T. 99* (MO); San Luis, near Río Claro, *Loaiza & Cogollo 33* (MEDEL); Mpio. San Luis, quebrada La Cristalina, *Ramírez & Cárdenas 393* (COL, HUA), *543* (COL, HUA), *1123* (COL, HUA, MO); Mpio. Anorí, correg. Providencia, Río Anorí valley, between Dos Bocas and Anorí, *Soejarto et al. 3283* (MEDEL); Mpio.

Figure 1. *Cremospermopsis cestroides* L. E. Skog & L. P. Kvist. —A. Stem apex. —B. Abaxial leaf margin. —C. Corolla exterior. —D. Opened corolla with 4 stamens and 1 staminode at lower left. —E. Infructescence with bracts. —F. Calyx. —G. Pistil with calyx and nectary. —H. Capsule surrounded by persistent nectary. —I. Seeds. A from *Fonnegra et al. 3018*; B, C, D from *Roldán & Betancur 718*; E, H, I from *Callejas et al. 4104*; F, G from *Callejas et al. 4390.*

Anorí, Buenos Aires, between Providencia and Alhibe, *Soejarto et al. 4505* (MEDEL); Cordillera Central Autopista from Medellín to Bogotá, ridge above Río Cocorna, *Stein et al. 3182* (MO); Mpio. Anorí, valley of Río Anorí along road 3–5 km upstream from Providencia Hydroelectric Plant, between Dos Bocas and Anorí, *Zarucchi 3322* (MO, US). **Bolívar:** Mpio. Achi, correg. La Raya, refugio El Paraíso, near Ciénega Grande, 3–4 hours from Caucasia above Cauca river, *Callejas et al. 4390* (HUA, MO, US(2)); Mpio. Achi, La Raya, *Cuadros & Gentry 3587* (US).

Cremospermopsis parviflora L. E. Skog & L. P. Kvist, sp. nov. TYPE: Colombia. Antioquia: Mpio. San Carlos, Embalse Punchiná, margin of streams leading into reservoir near site of dam, 6°12′N, 74°52′W, 780 m, 18 May 1988, *J. L. Zarucchi, O. Escobar & A. Ayala 6651* (holotype, HUA; isotypes, MO, US). Figure 2.

C. cestroidis affinis sed foliis plerumque ad apicem obtusibus, tubo corollae a calycis lobis occultis.

Plants herbs, stems mostly erect, occasionally appressed to ground, 20–40(–60) cm tall, to 5 mm diam., glabrescent proximally to tomentose distally; internodes 0.5–1.5(–3) cm long. *Leaves* with obovate or occasionally elliptic blades, 8–20 × 4–12 cm, apex obtuse, or less frequently acute, base acute, margin subentire, occasionally rugose, adaxially glabrous, occasionally sparsely pilose, abaxially sparsely appressed pilose, secondary veins (8 to)10 to 12 per side, below with appressed pilose to tomentose indumentum; petioles (0.5–)1–2 cm long, mostly tomentose. *Inflorescences* congested cymes but occasionally more open with an extended axis, of 5 to 12 (to 18) flowers; peduncles 2–9 cm long, pilose, sometimes dark purple, distally with mostly 4 bracts with often variable shapes and sizes in same inflorescence, each ovate to lanceolate, 0.7–1.2 cm long, mostly tomentose and light green to whitish; pedicels to 3 mm long. *Calyx* lobes light green to yellowish, outside pilose to tomentose, inside glabrous, connate and unequal, narrowly to broadly ovate, all 4–5 mm long, 3 or 4 of the lobes ca. 1 mm and the other 1 or 2 lobes to 3 mm wide. *Corolla* nearly hidden by surrounding calyx lobes and only the limb conspicuous, 5–6 mm long, tube funnelform to tubular, 3–4 mm long, ca. 1.5 mm wide at base, narrowing to nearly 1 mm and then ampliate to nearly 2 mm distally, white, glabrous both outside and inside; throat ca. 2 mm diam., densely glandular hairy with short trichomes, dorsal lobes often pink, up to 1 mm long, lateral and ventral lobe white or yellow, up to 2 mm long. *Filaments* adnate to corolla tube base for ca. 2 mm, above free for 0.5–1.5 mm; anthers ca. 0.6 × 0.4 mm; nectary ca. 0.8 mm high at both sides of ovary but in between much lower or absent. *Ovary* 1.5 mm high. *Capsule* 3 × 2 × 1.5 mm.

Distribution and ecology. Plants of *Cremospermopsis parviflora* are endemic to Colombia (Antioquia), growing on streamsides in disturbed primary wet forest or old secondary rain forest at (400–)500–900(–1250) m, and collected in flower in January to June, October and December, in fruit in April, August, and November.

The tiny corollas of *Cremospermopsis parviflora* are nearly hidden by the calyx lobes, a character that distinguishes the species from *C. cestroides*, which has corollas approximately twice as large and not hidden by the calyx lobes. The calyces and bracts of *C. parviflora* are apparently also mostly pale green to white while these may be darker green to yellow or red in the other species. In addition, *C. parviflora* is a small herb that rarely exceeds 50 cm, while *C. cestroides* can often be more than 1 m tall, and may be somewhat subshrubby. *Cremospermopsis parviflora* also tends to have obovate leaves with an obtuse apex and a nearly entire margin contrasting with the mostly oblanceolate leaves with an acute apex and a remotely serrate margin in *C. cestroides*. The indumentum of the former tends toward pilose while the latter has a rather tomentose indumentum.

Paratypes. COLOMBIA. **Antioquia:** Lake Punchiná, 47.5 km E of San Carlos, *Brant et al. 1661* (HUA, MO, US); Mpio. San Luis, vereda La Josefina, above the Medellín–Bogotá road, 16 km SW of San Luis, *Callejas et al. 4186* (NY, US); Mpio. San Luis, veredas La Cristalina & La Josefina, Río Claro region, 98 km SE of Medellín, *Callejas & Acevedo 11167* (HUA); Mpio. San Luis, vereda las Confusas, *Cardenas et al. 2670* (MO); Mpio. San Luis, vereda La Josefina, quebrada La Mariola, *Cardenas & Ramírez 2729* (MO); Mpio. San Luis, carretera to Aquitania, 12 km from Medellín–Bogotá road, *Cogollo et al. 3756* (MO); Mpio. San Luis, vereda La Josefina, quebrada La Mariola, *Cogollo et al. 4285* (MO); Mpio. San Francisco, correg. Aquitania, Río Venado, *Fonnegra et al. 4183* (MO, US); Mpio. San Luis, Río Samaná-Río Claro sector near Medellín–Bogotá road, *Hernández et al. 191* (HUA, SEL), *211* (HUA, SEL), *280* (HUA); San Luis, Río Claro, *Loaiza & Cogollo 42* (MEDEL); Mpio. Amalfi, NE of Salazar, along road between Amalfi and Fraguas 23–26.5 km from Amalfi, *MacDougal et al. 4025* (US); bank of Guatepé river between San Rafael and Holanda, *Orozco et al. 729* (COL (2)); Mpio. San Carlos, near ISA hydroelectric dam reservoir, *McPherson 13330* (HUA); Mpio. San Luis, quebrada La Cristalina, *Ramírez & Cárdenas 232* (HUA, MO), *367* (COL, HUA, MO), *599* (HUA), *1127* (COL, HUA), *1350* (MO), *1517* (COL, HUA), *1922* (HUA, MO); road from Independencia to Santa Rita, *Romero-Castañeda 1573* (COL); Mpio. Anorí, Río Anorí valley near Planta Providencia, *Shepherd 456 p.p.* (MO), *564 p.p.* (WIS); Mpio. Anorí, Río Anorí valley between Dos Bocas and Anorí, close to Planta Providencia, SW of Zaragoza, *Shepherd 456 p.p.* (COL), *564 p.p.* (COL, MEDEL); Mpio. Anorí, near Providencia hydroelectric plant, *Soejarto & Villa 2692* (GH (2)), *2693* (GH (2)); Mpio. Amalfi, mina

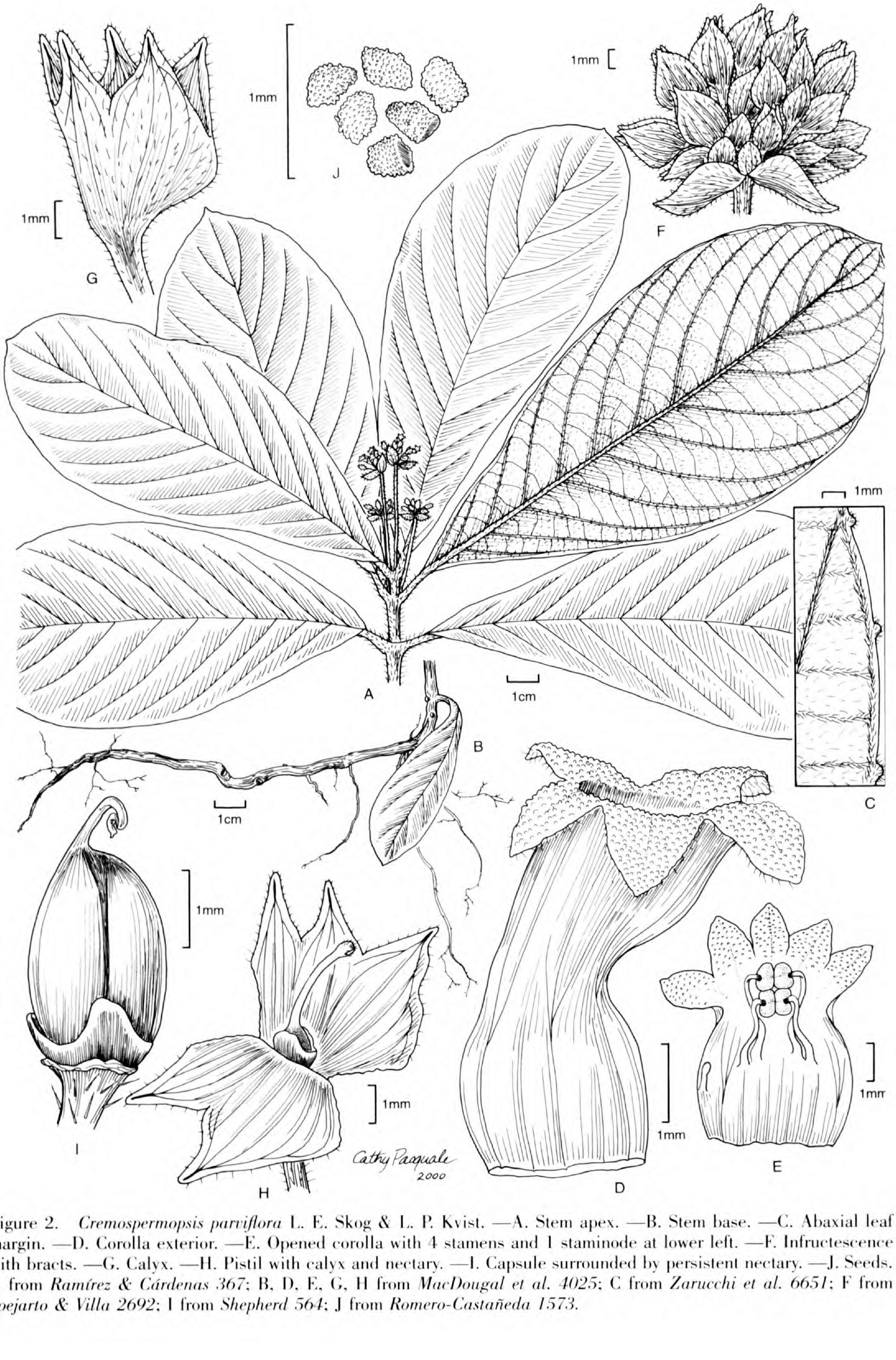

Figure 2. *Cremospermopsis parviflora* L. E. Skog & L. P. Kvist. —A. Stem apex. —B. Stem base. —C. Abaxial leaf margin. —D. Corolla exterior. —E. Opened corolla with 4 stamens and 1 staminode at lower left. —F. Infructescence with bracts. —G. Calyx. —H. Pistil with calyx and nectary. —I. Capsule surrounded by persistent nectary. —J. Seeds. A from *Ramírez & Cárdenas 367*; B, D, E, G, H from *MacDougal et al. 4025*; C from *Zarucchi et al. 6651*; F from *Soejarto & Villa 2692*; I from *Shepherd 564*; J from *Romero-Castañeda 1573*.

La Vetilla, edge of quebrada Vetillita, *Tuberquia & Gómez 20* (HUA); Mpio. Anorí, Anorí river valley near Providencia electric plant ca. 35 km SW of Zaragoza, *Waide 62408* (US).

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Varietal Status for a Hirsute Phase of *Mirabilis linearis* (Nyctaginaceae)

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Abstract. For the upcoming treatment of the genus *Mirabilis* for the *Flora of North America North of Mexico, M. linearis* (Pursh) Heimerl is treated as having three thoroughly intergrading varieties: *M. linearis* var. *linearis, M. linearis* var. *decipiens* (Standley) S. L. Welsh, and *M. linearis* var. *subhispida* (Heimerl) Spellenberg, a new combination published here, based on *M. linearis* f. *subhispida* Heimerl. *Mirabilis linearis* var. *subhispida* is common on the Great Plains, where it has most often passed as narrow-leaved phases of *M. hirsuta* (Pursh) Macmillan, or as *M. gausapoides* (Standley) Standley. A key is provided to distinguish the three varieties of *M. linearis.*

Key words: *Mirabilis*, North America, Nyctaginaceae.

While I was preparing a taxonomic treatment for *Mirabilis* for volume 4 of the *Flora of North America*, I followed the lead of S. L. Welsh (1986) in considering narrow-leaved plants of *Mirabilis* with pubescent fruits that have low tubercles as belonging within the large and variable complex of forms encompassed by a broadly delineated *M. linearis* (Pursh) Heimerl. Welsh's variety is distinguished in the key below; another variety, formerly recognized within *Oxybaphus* (Dayton, 1959), requires a new combination in *Mirabilis* and is also distinguished by the key.

Mirabilis linearis (Pursh) Heimerl var. **subhispida** (Heimerl) Spellenberg, comb. et stat. nov. Basionym: *Mirabilis linearis* (Pursh) Heimerl f. *subhispida* Heimerl, Ann. Cons. Jard. Bot. Genève 5: 186. 1901. TYPE: U.S.A. New Mexico: Lincoln Co., N of Capitan Mts., 31 Aug. 1900, *F. S. Earle & E. S. Earle 383* (holotype, G-DEL not seen; isotypes, MO, NMC, US not seen).

Standley (1909: 342) seems to have been the first to bring in Heimerl's infraspecific epithet into easily accessible North American literature for the Nyctaginaceae, presenting as a new combination without an indication of rank the trinomial "*Allionia linearis subhispida* (Heimerl) Standley." He wrote, "It seems to be a smaller plant, too, and is probably a good species, but the author has seen no very good material." The plant has sparse, hirsute pubescence on the basal parts of the stem. The name has been rarely used, but within the taxon herein covered by the infraspecific epithet "*subhispida,*" density of pubescence and stature vary considerably. Standley cited, without rank for the epithet, "*Mirabilis linearis subhispida* Heimerl" as the basionym, although Heimerl had clearly used "forma" in his protologue. Standley, in Wooton and Standley (1913: 120), recombined Heimerl's trinomial as *Allionia subhispida* (Heimerl) Standley and, in 1918, Standley considered those plants covered by the epithet "*subhispida*" at any rank to be part of *A. gausapoides* (p. 222), a species he described in Standley (1911: 406). In none of these publications did Standley suggest rank for the epithet when used infraspecifically.

Dayton (1959) published the combination *Oxybaphus linearis* var. *subhispida* (Heimerl) W. Dayton, *Oxybaphus* being a segregate genus of *Mirabilis.* Reed (1969: 170) incorrectly used "var." for the rank of the epithet "*subhispida*" in all infraspecific combinations in *Allionia* and *Mirabilis,* which were proposed as synonyms of *Mirabilis gausapoides* (Standley) Standley in his work. Varietal rank had never been established for the epithet "*subhispida*" at the infraspecific level within *Allionia* or *Mirabilis.*

Mirabilis sect. *Oxybaphus,* to which this variety belongs, is notorious for its taxonomic difficulty (briefly reviewed by Spellenberg, 1998) stemming from extensive intergradation and variation of all taxa. Most plants with hispid pubescence on the Great Plains are often considered to belong to *M. hirsuta* (Pursh) Macmillan (in the treatment for FNA this is a synonym of *M. albida* (T. Walter) Heimerl) if leaves are comparatively broad, or *M. gausapoides* if leaves are linear. The forms with narrow leaves and fruits with tubercles not tall and bract-like are considered all to be *M. linearis*, accreted into varieties as indicated in the following key. *Mirabilis gausapoides* is considered a synonym of *M. linearis* var. *subhispida*.

KEY TO THE VARIETIES OF *MIRABILIS LINEARIS*

1a. Stems hirsute, at least basally . . . . *M. linearis* var. *subhispida*
1b. Stems minutely puberulent, glabrate, or glabrous basally.
  2a. Leaves linear, grayish or bluish green, glaucous; perianth white to deep rose-pink . . . . *M. linearis* var. *linearis*
  2b. Leaves linear-lanceolate to lanceolate, green; perianth deep pink . . . . *M. linearis* var. *decipiens* (Standley) S. L. Welsh

Acknowledgments. I am grateful to Ronald McGregor and Craig Freeman for pointing out this nomenclatural oversight in their review of the manuscript for *Mirabilis* for the *Flora of North America*. Fred Barrie and George Pilz provide helpful comments in their reviews of this article.

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Rubiacearum Americanarum Magna Hama Pars VII. New Species of *Palicourea* (Psychotrieae) from Central America and Western South America

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ABSTRACT. Six new species of *Palicourea* Aublet are described and illustrated: *P. calophlebioides* from Costa Rica differs from *P. calophlebia* Standley of the Andes in part by its purple inflorescences; *P. ianthina* from western Panama differs from *P. chiriquina* Standley of the same region in part by its purple inflorescences and longer calyx limbs; *P. premontana* from Ecuador differs from *P. semirasa* Standley of Venezuela and Bolivia in part by its glabrous corollas; *P. quinquepyrena* from northern Peru is closely related to *P. ulloana* C. M. Taylor of Ecuador but differs from that species in part by its larger, subsessile leaves; *P. roseofaucis* from western Panama differs from *P. sulphurea* (Ruiz & Pavón) DC. of the Andes in part by its white to pink corollas; and *P. stellata* from east-central Colombia, with yellow flowers, is unusual in its well-developed fleshy appendages on the corolla lobes.

Key words: Neotropics, *Palicourea*, Psychotrieae, Rubiaceae.

As circumscribed by Taylor (1997), *Palicourea* (Psychotrieae) is distinguished within the Rubiaceae by its persistent stipules that are interpetiolar to usually united around the stems into a continuous sheath and usually bilobed in their interpetiolar portions; generally brightly colored inflorescences—blue, purple, red, orange, or yellow—with the flowers usually pedicellate; corollas that are usually similarly brightly colored, five-lobed, and with well-developed tubes that are somewhat swollen at the base and glabrous internally except for a dense ring of pubescence situated just above this basal swelling; and drupaceous fruits with usually two pyrenes. This neotropical genus includes about 200 species of shrubs and small trees found from sea level to montane forests. The species are typically distylous and generally pollinated by hummingbirds.

Palicourea calophlebioides C. M. Taylor, sp. nov. TYPE: Costa Rica. Limón: Cantón de Talamanca, Parque Nacional Cordillera de Talamanca, Río Lori, 300 m aguas arriba unión Quebrada Kuisa, entre Ujarrás y San José Cabécar, 9°21′35″N, 83°13′45″W, 1800 m, 23 Mar. 1993, *G. Herrera 5994* (holotype, CR-5952; isotype, MO-4999475). Figure 1A, B.

Haec species a *Palicourea calophlebia* (ex Aequatoria et Colombia occidentali) foliorum ampliorum petiolis plerumque longioribus, stipulis brevioribus atque inflorescentia corollisque purpureis lilacinisve distinguitur.

Shrubs flowering at 2.5 m tall, to 3 m tall; stems quadrate and often becoming channeled, tomentellous to glabrescent. *Leaves* opposite; blades broadly elliptic to elliptic-obovate, 25–26 × 14–16 cm, at apex rather abruptly acuminate with tips 5–12 mm long, at base acute to obtuse, drying papyraceous, adaxially glabrous, abaxially pilosulous; secondary veins 26 to 29 pairs, usually looping to interconnect at least in distal 1/2 of blade, without or with 1(to 3) very weak intersecondary vein(s) present between pairs of secondary veins, adaxially costa and secondary veins prominulous and remaining venation plane, abaxially costa prominent, secondary veins prominulous, and reticulated higher-order venation plane to thickened; margins thinly to distinctly cartilaginous, entire; *petioles* 2.5–3.5 cm long, tomentellous to velutinous; *stipules* pilosulous to tomentellous, persistent at least with leaves, united around stem into a continuous truncate sheath 5–8 mm long, lobes 2 on each side, narrowly triangular to deltate, 4–6 mm long, acute, entire. *Inflorescences* terminal, erect; peduncles 2.5–10.5 cm long; panicles narrowly pyramidal, 10–24 × 3.5–6.5 cm, with 20+ pairs of developed secondary axes, with flowers pedicellate in cymules of 3 to 7; bracts entire, those subtending secondary axes narrowly triangular to lanceolate, 6–20 × 4–7 mm, acute, those subtending pedicels lanceolate to ligulate, 4–7 × 1–2 mm, acute to obtuse; pedicels 1–6 mm long; peduncle, axes, bracts, and pedicels

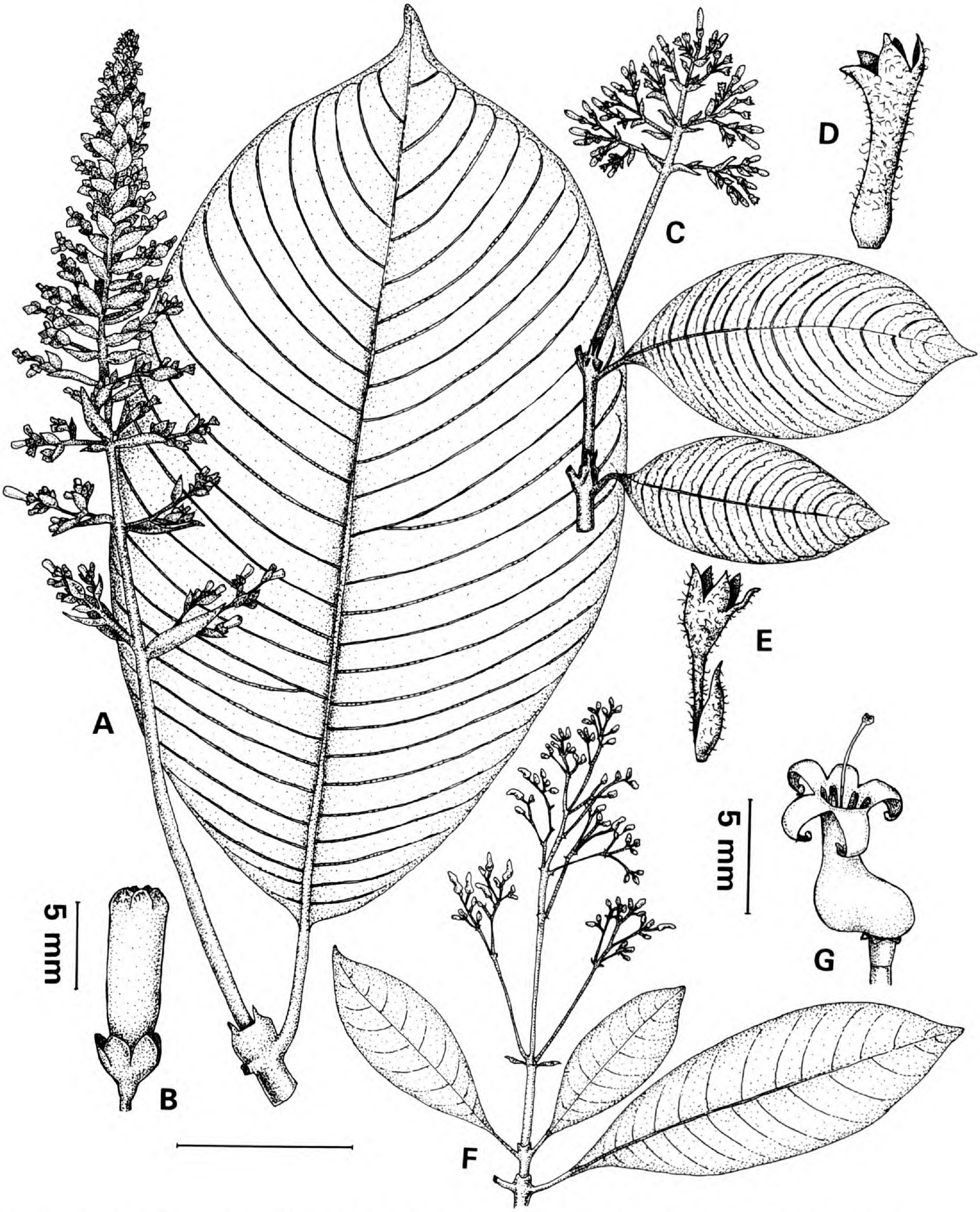

Figure 1. A, B, *Palicourea calophlebioides* C. M. Taylor. —A. Flowering branch. —B. Flower bud. C–E, *Palicourea ianthina* C. M. Taylor. —C. Flowering branch. —D. Corolla. —E. Calyx, pedicel, and floral bract. F, G, *Palicourea roseofaucis* C. M. Taylor. —F. Flowering branch. —G. Flower at anthesis. A, C, F to 5-cm scale; B, D, E, G to 5-mm scale. A, B, based on *Herrera 5994*; C, based on *Knapp & Sytsma 2638*; D, E, based on *Croat 48509*; F, based on *McPherson 9143*; G, based on *McPherson 9086*.

lilac to purple, densely pilosulous except bracts frequently glabrous; *flowers* in bud with hypanthium turbinate, ca. 1 mm long, glabrous; calyx limb glabrous, 2.5–3 mm long, divided nearly to base, lobes ligulate to lanceolate, acute, entire; corollas tubular, purple to lilac, a little swollen at base, generally straight there and in tube, externally glabrous except hirtellous on lobes, internally glabrous except for a pilosulous ring ca. 1 mm wide just above basal swelling, tube ca. 10 mm long, ca. 1.5 mm diam. near middle, lobes deltoid, ca. 2 mm long, acute, a little thickened adaxially; anthers and stigmas not seen. *Infructescences* not seen.

Distribution, habitat, and phenology. In wet forest at 1800 m, Costa Rica; collected with young flowers in March.

This new species is similar in overall aspect to *Palicourea calophlebia* Standley of western Colombia and Ecuador, and the specific epithet refers to this similarity. *Palicourea calophlebia* differs from *P. calophlebioides* by its leaves 14–25 × 5–13.5 cm, its petioles 1.5–2.5 cm long, its stipules with the sheaths 10–14 mm long and the lobes 10–15 mm long, its green inflorescences, and its white corollas that usually turn pale blue with age.

Paratype. COSTA RICA. **Limón:** Cantón de Talamanca, Parque Nacional Cordillera de Talamanca, 300 m antes de unión Quebrada Kuisa con Río Lori, entre Ujarrás y San José Cabécar, 9°21′35″N, 83°13′45″W, *G. Herrera 5952* (MO).

Palicourea ianthina C. M. Taylor, sp. nov. TYPE: Panama. Veraguas: trail on ridge to summit of Cerro Tute, Cordillera de Tute, 1 km past Escuela Agrícola Altos de Piedras, W of Santa Fe, 8°36′N, 81°06′W, 1250–1410 m, 15 Dec. 1981, *S. Knapp & K. Sytsma 2638* (holotype, MO-2937075). Figure 1C–E, 3E.

Haec species a *Palicourea chiriquina* inflorescentia floribusque purpureis, limbo calycino 2.0–2.2 mm longo atque corolla extus dense hirtella distinguitur.

Shrubs flowering at 1 m tall, to 1.5 m tall; stems quadrate, hirtellous to hirsute or glabrescent. *Leaves* opposite; blades elliptic to elliptic-oblong or oblanceolate, 6.5–10 × 2.5–5.2 cm, at apex rather abruptly acuminate with tips 5–8 mm long, at base cuneate to obtuse or truncate, drying subcoriaceous, adaxially glabrous except sometimes densely hirtellous along costa, abaxially glabrescent to hirtellous, more densely so on secondary and tertiary venation and sometimes hirsute on costa; secondary veins 10 to 15 pairs, usually extending to unite with margins, with 1(to 3) sometimes weak intersecondary vein(s) usually present between pairs of secondary veins, adaxially venation plane or costa, secondary, and tertiary venation all thickened, abaxially costa and secondary veins prominulous to prominent and higher-order venation prominulous; margins rather thickly cartilaginous, entire; *petioles* 0.4–1.5 cm long, hirtellous; *stipules* glabrous to hirtellous, persistent, united around stem into a continuous truncate sheath 4–7 mm long, lobes 2 on each side, narrowly triangular to deltoid, 3–5 mm long, acute, entire. *Inflorescences* terminal, erect to deflexed; peduncles 1.5–7 cm long; panicles pyramidal, 3–11 × 4–10.5 cm, with 5 to 10 pairs of developed secondary axes, with flowers pedicellate in cymules of 3 to 7; bracts entire to ciliolate, those subtending secondary axes narrowly triangular or narrowly ligulate, 5–12 mm long, acute to obtuse, those subtending pedicels narrowly lanceolate, 2–3 mm long, acute; pedicels 2–3 mm long; peduncle, axes, bracts, and pedicels lavender to purple, moderately to densely pilosulous or hirtellous to rather hirsute; *flowers* with hypanthium turbinate, ca. 1 mm long, densely hirtellous to glabrous; calyx limb densely hirtellous to glabrous, 2–2.2 mm long, divided nearly to base, lobes narrowly triangular to narrowly ligulate, acute to obtuse, entire; corolla tubular-funnelform, purple to lavender, a little swollen at base, generally straight there and in tube, externally densely hirtellous with multiseriate trichomes, internally glabrous except for a pilosulous ring ca. 1 mm wide at ca. 2 mm above base, tube ca. 7 mm long, ca. 1 mm diam. near middle, lobes triangular, ca. 2 mm long, acute, a little thickened adaxially; anthers ca. 2 mm long, positioned in corolla throat; stigmas not seen. *Infructescences* similar to inflorescences, apparently purple; immature *fruits* narrowly ellipsoid to narrowly obovoid, ca. 7 × 4 mm, somewhat flattened laterally, glabrous to hirtellous, color unknown; pyrenes 2, planoconvex, dorsally with 3 to 5 low rounded longitudinal ridges.

Distribution, habitat, and phenology. In wet forest at 1100–2200 m, western Panama; collected in flower in August, September, November, and December, in young fruit in February.

This new species is distinguished by its rather thickly textured leaves with the secondary veins uniting with the margins, its stipules united into a continuous truncate sheath, its purple to lavender inflorescences and flowers, its relatively well developed calyx limbs, and its corollas that are densely hirtellous externally. The specific epithet refers to the inflorescence and flower color. The flowers seen are similar to short-styled flowers of distylous *Palicourea* species in the arrangement of their anthers and stigmas. *Palicourea ianthina* is similar to *P. adusta* Standley and *P. chiriquina* Standley. *Palicourea adusta* differs from *P. ianthina* by its leaves drying papyraceous to chartaceous, its stipules with sheaths 1–3 mm long and lobes 1–3 mm long, its calyx limbs 0.5–1.5 mm long, and its corollas externally glabrous or sometimes sparsely hirtellous on the lobes, while *P. chiriquina* differs from *P.*

ianthina by its floral bracts 1–1.5 mm long, its calyx limbs 0.8–1 mm long, and its externally glabrous yellow corollas.

Paratypes. PANAMA. **Chiriquí:** Fortuna Dam area, N of reservoir, ridge along continental divide and S from Quebrada de Arena, *D'Arcy & Todzia 15937* (MO); Cerro Pate Macho, along the continental divide, on trail to Finca Serrano, NE of Boquete, ca. 5 mi. above Boquete, *Croat 48509* (MO). **Veraguas:** N of Santa Fe, summit of Cerro Arizona, *Hammel 4727* (MO, SCZ); above Santa Fe and above Alto de Piedra, on ridge-trail to top of Cerro Tute-Arizona, 8°30′N, 81°10′W, *McPherson 12077* (MO).

Palicourea premontana C. M. Taylor, sp. nov. TYPE: Ecuador. Pastaza: along road between Puyo and Diez de Agosto and Arajuno, 18 km NE of main Puyo–Macas road (beginning 3.7 km from center of Puyo at Hotel Europa), 8.2 km NE of Diez de Agosto, 1°27′S, 77°51′W, 970 m, 4 May 1984, *T. Croat 59005* (holotype, MO-3189941). Figures 2D, E, 3B.

Haec species a *Palicourea semirasa* lobulis stipularibus longioribus, inflorescentia pro ratione angustiore, corollae extus glabrae lobulis brevioribus atque fructu rotundato distinguitur.

Shrubs flowering at 2 m tall, to 6 m tall; stems terete to somewhat quadrate, glabrous. *Leaves* opposite; blades elliptic, 15–27 × 5.5–10 cm, at apex acute to usually acuminate with tips to 15 mm long, at base cuneate to obtuse, drying papyraceous, adaxially glabrous, abaxially glabrous or sometimes puberulous on costa; secondary veins 11 to 15 pairs, not or sometimes weakly looping to interconnect near margins, often with 1(to 3) weak intersecondary vein(s) present between pairs of secondary veins, adaxially costa and secondary veins prominulous and remaining venation plane, abaxially costa prominulous to prominent and secondary veins and loosely reticulated higher-order venation prominulous; margins cartilaginous; *petioles* 1.5–4 cm long, glabrous; *stipules* glabrous, persistent, united around stem in a continuous concave sheath 0.5–2 mm long, lobes 2 on each side, ligulate to ovate, 3–8 mm long, obtuse to rounded, entire to ciliolate. *Inflorescences* terminal, erect; peduncles 6–10.5 cm long; panicles narrowly pyramidal to cylindrical, 10–11 × 4.5–8 cm (excluding corollas), with 9 to 16 pairs of developed secondary axes, with flowers pedicellate in cymules of 3 to 7; bracts entire, lanceolate to triangular, acute to acuminate, those of secondary axes 0.5–2 mm long and displaced along these axes to near middle of first internode, those subtending pedicels 0.1–0.8 mm long and displaced to above base of pedicel; pedicels 1–6 mm long; peduncle, axes, branches, bracts, and pedicels puberulous, red to pink or orange; *flowers* distylous; hypanthium cylindrical to turbinate, ca. 1 mm long; calyx limb glabrous to puberulous, ca. 0.8 mm long, sinuate to shallowly lobed, lobes triangular to semicircular, obtuse to rounded, entire to ciliolate; corolla tubular-funnelform, yellow, a little swollen at base, straight there and in tube, externally glabrous, internally glabrous except for a densely pilose ring ca. 1 mm wide at 1.5–2 mm above the base, tube 10–14 mm long, 1.5–3 mm diam. near middle, lobes deltoid, 1–1.5 mm long, acute, smooth adaxially; anthers in short-styled form ca. 3.5 mm long, included and positioned in uppermost part of the corolla tube, in long-styled form 3.5–4 mm long, included and positioned ca. 1/2 of length of corolla tube above its base; stigmas 2, in short-styled form ca. 1 mm long, included and positioned ca. 1/2 of length of corolla tube above the base, in long-styled form 1–1.5 mm long and exserted. *Infructescences* similar to inflorescences, becoming red-purple; *fruits* ovoid, 5 × 4–4.5 mm, rounded laterally, glabrous, purple-black to black; *pyrenes* 2, planoconvex, dorsally with 3 to 5 low rounded longitudinal ridges.

Distribution, habitat, and phenology. In wet forest of Ecuador and southern Colombia at 600–1650 m; collected in flower in January, March–July, September, and November, in fruit in August and October.

This new species is similar to *Palicourea guianensis* Aublet, and was included in the circumscription of that species presented by Taylor (1999). *Palicourea premontana* generally occupies a higher elevational range than *P. guianensis*, and is even more similar in morphology and habitat to *P. semirasa* Standley of Venezuela, northeastern Colombia, and Bolivia. *Palicourea semirasa* differs from *P. premontana* by its stipule lobes 1.5–2 mm long, its pyramidal to broadly rounded inflorescences with the branched portion 4–10 × 5–11 cm and the bracts usually positioned at the bases of the secondary axes, its externally glabrous corollas with lobes 2–3 mm long, and its laterally flattened fruits. *Palicourea guianensis* differs from *P. premontana* by its pyramidal inflorescences 9–19 × 7–15 cm with the bracts usually positioned at the bases of the secondary axes and its externally pubescent corollas with lobes 2–5 mm long. In general both *P. premontana* and *P. semirasa* appear to be closely related to *P. guianensis*, and to replace this third species at middle elevations in the Andes. The specific epithet of this new species refers to its elevational distribution and habitat. Relatively few well-preserved flowers of this species have been

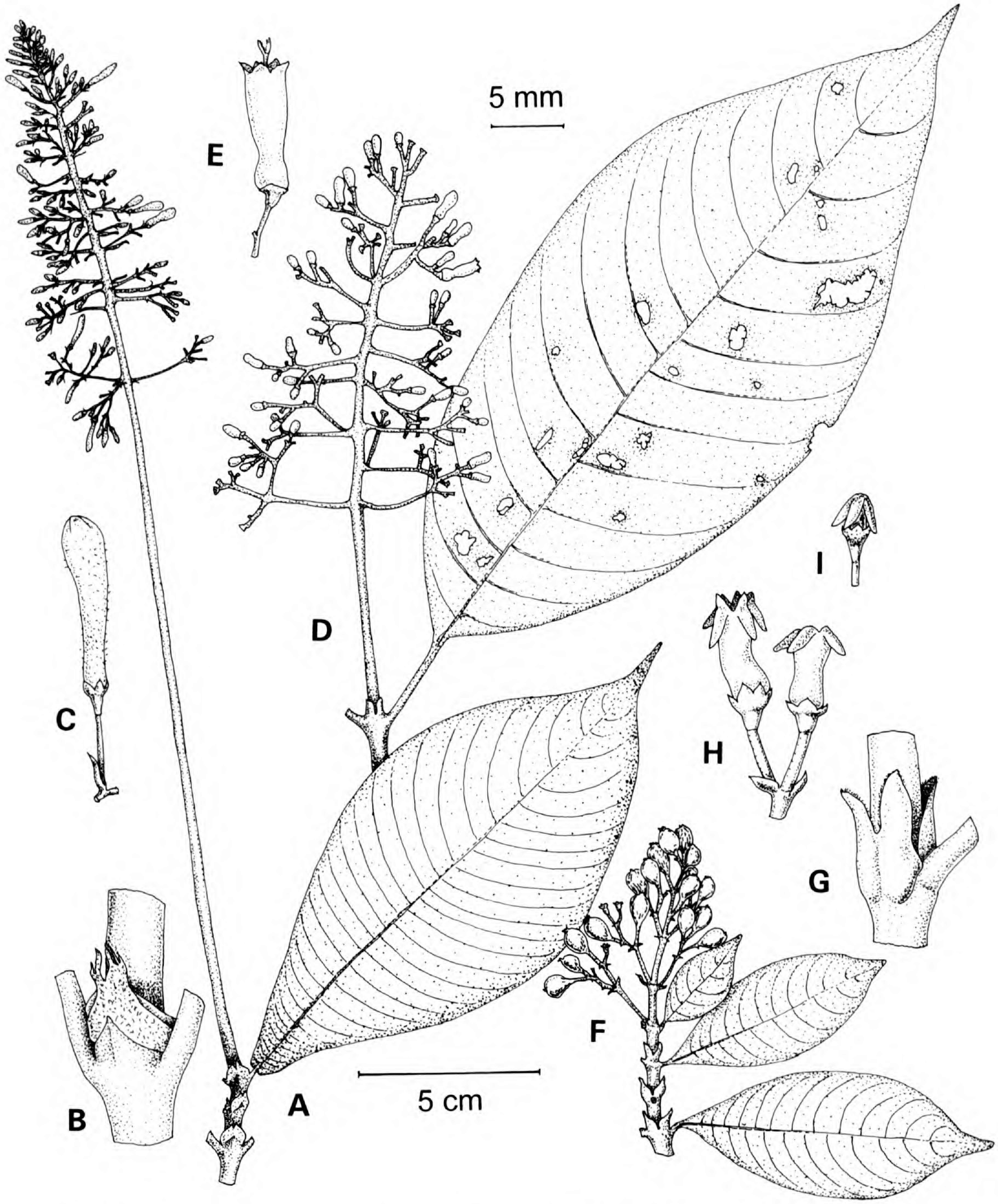

Figure 2. A–C, *Palicourea quinquepyrena* C. M. Taylor. —A. Flowering stem. —B. Stem node with stipule. —C. Flower bud, pedicel, and floral bract, of part of inflorescence axis. D, E, *Palicourea premontana* C. M. Taylor. —D. Flowering branch. —E. Flower at anthesis with pedicel. F–I, *Palicourea stellata* C. M. Taylor. —F. Fruiting branch. —G. Node with stipule. —H. Portion of inflorescence with flower bud (right) and flower at anthesis (left). —I. Young flower bud. A, D, F to 5-cm scale; B, C, E, G, H, I to 5-mm scale. A, C, based on *Vásquez et al. 25275*; B, based on *Campos 4212*; D, based on *Croat 59005*; E, based on *Gentry et al. 30918*; F, G, H, I, based on *Lozano 2264*.

seen, but these are unusual in *Palicourea* in the relatively long stigmas of the long-styled flowers and the apparently included anthers of the short-styled flowers.

Paratypes. COLOMBIA. **Caquetá:** mpio. de Florencia, vereda Las Brisas, carretera Florencia–Suaza, Km 28, 1°36′N, 75°37′W, *J. G. Ramírez et al. 5055* (JAUM, MO). ECUADOR. **Morona-Santiago:** 27 km SE of San Juan Bosco, *Gentry et al. 30918* (MO). **Napo:** cantón Tena,

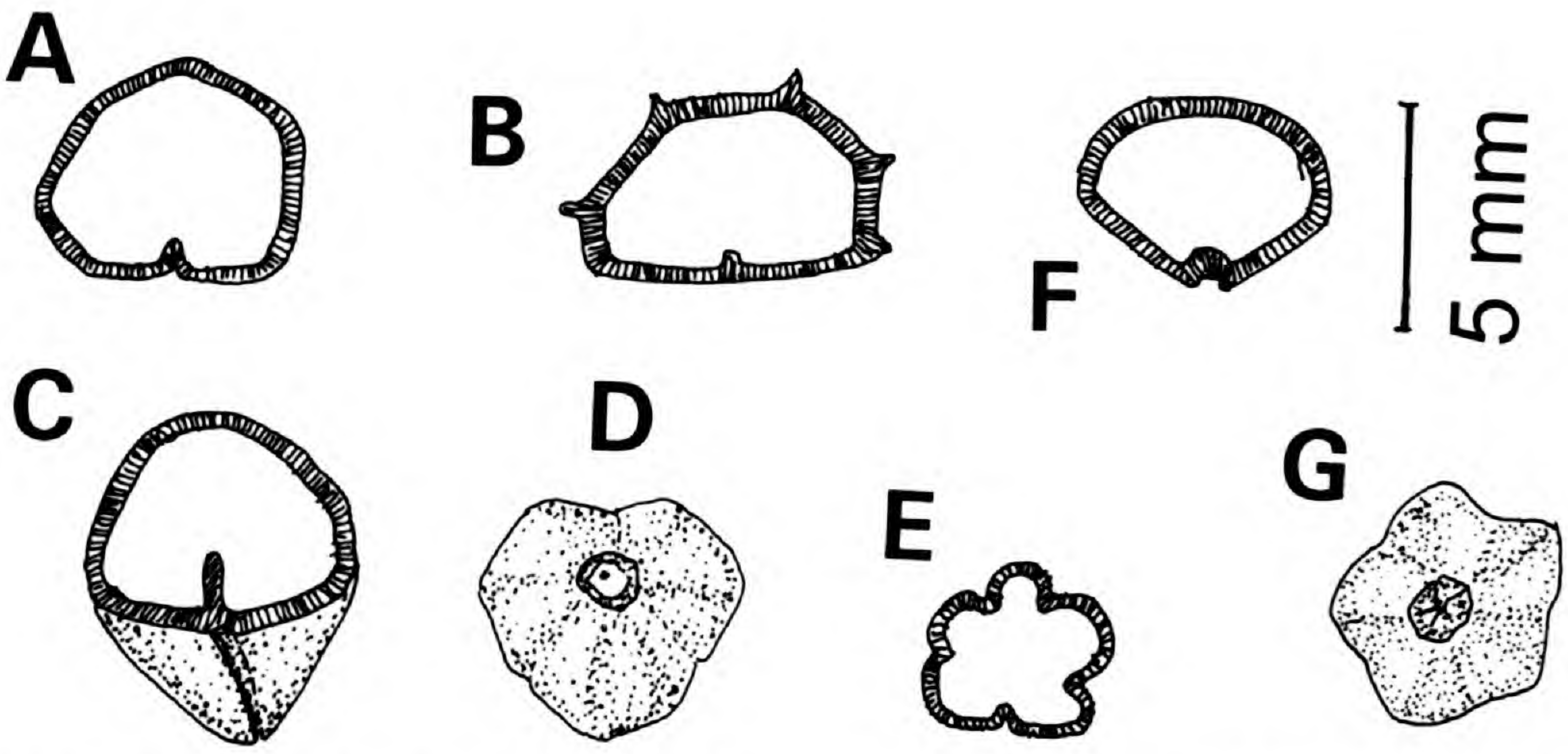

Figure 3. Pyrenes and fruits of five new species of *Palicourea*. —A. Cross section of pyrene wall of *P. stellata*; based on *Lozano 2264*. —B. Cross section of pyrene wall of *P. premontana*; based on *Gentry 30918*. —C. Cross section and partial adaxial view of pyrene wall of *P. roseofaucis*; based on *McPherson 11657*. —D. Apical view of dried fruit of *P. roseofaucis*; based on *McPherson 11657*. —E. Cross section of pyrene wall of *P. ianthina*; based on *McPherson 12077*. —F. Cross section of pyrene wall of *P. quinquepyrena*; based on *Campos 4212*. —G. Apical view of dried fruit of *P. quinquepyrena*; based on *Campos 4212*. All to same 5-mm scale.

Estación Biológica Jatun Sacha, 8 km abajo de Puerto Misahuallí, margen derecha del Río Napo, 1°04′S, 77°36′W, *A. Alvarez 77* (MO, QCNE), *Bensman 79* (MO), *Cerón 1653* (MO, QCNE), *Persson et al. 7* (MO), *Rueda et al. 1073* (MO); cantón Archidona, comunidad de Pacto Sumaco, límite del Parque Nacional Sumaco, 00°38′56″S, 77°35′49″W, *A. Alvarez et al. 1881* (MO, QCNE); cantón Orellana, Sector Huashito, 20 km al N de Coca, propiedad de PALMORIENTE, 00°20′S, 77°05′W, *Gudiño 149* (MO, QCNE); Chonta Punta at Río Napo, vicinity of Santa Rosa, *H. Lugo S. 2140* (US). **Pastaza:** Mera, along Río Allpayacu, *Harling & Andersson 16964* (MO); 2 km N of Shell-Mera, 1°29′S, 78°03′W, *Holm-Nielsen & Jeppesen 369* (MO); Pindo, ca. 6 km E of Mera, *H. Lugo S. 2388* (MO); Parayacu, ca. 10 km E of Canelos, *H. Lugo S. 4562* (MO, US); El Porvenir, ca. 5 km N of Puyopungu, *H. Lugo S. 4887* (MO).

Palicourea quinquepyrena C. M. Taylor, sp. nov. TYPE: Peru. Amazonas: Distrito Bagua, Aramango, Chorro Blanco, 5°29′30″S, 78°20′04″W, 1500–1800 m, 11 Feb. 1998, *R. Vásquez & R. Rojas 25275* (holotype, MO-5333613). Figures 2A–C, 3F, G.

Haec species a *Palicourea ulloana* foliorum ampliorum subsessilium brevipetiolatorumve venis secundariis pluribus brochidodromis distinguitur.

Shrubs flowering at 0.8 m tall, to 1 m tall, apparently little or not branched, apparently accumulating litter in leaf bases; stems terete, glabrous. *Leaves* opposite; blades elliptic to usually oblanceolate, 14.5–30.5 × 4.5–12 cm, at apex acute to usually acuminate with tips to 20 mm long, at base obtuse to truncate or rounded, drying papyraceous, adaxially glabrous, abaxially puberulous at least on veins; secondary veins 24 to 28 pairs, spreading sometimes to more than 90°, usually looping to interconnect at least weakly, with 1(to 2) weak intersecondary vein(s) usually present between pairs of secondary veins, adaxially costa and remaining venation prominulous, abaxially costa prominulous to prominent and secondary veins and reticulated higher-order venation prominulous; margins thinly cartilaginous; *petioles* 3–6 mm long, glabrous; *stipules* puberulous, persistent or sometimes fragmenting, united around stem into a continuous truncate sheath 3–4 mm long, with interpetiolar portion triangular, lobes 2 to 4 on each side, narrowly triangular, 3–7 mm long, acute, entire, closely grouped, inserted below top of sheath at intersection of two diagonal costae. *Inflorescences* terminal, apparently erect; peduncle 14–25 cm long; panicle cylindrical to narrowly pyramidal, 10–20 × 3.5–14 cm (excluding corollas), with 14 to 16 pairs of developed secondary axes, with flowers pedicellate in cymules of 3 to 7; bracts entire to ciliolate, narrowly triangular, acute, those subtending secondary axes 3–6 mm long, those subtending pedicels 1.5–3 mm long; pedicels 2–8 mm long; peduncle, axes, bracts, and pedicels densely puberulous, color not noted; *flowers* with hypanthium cylindrical to turbinate, ca. 0.8 mm long; calyx limb glabrous, 0.8–1.5 mm long, divided nearly to base, lobes elliptic to narrowly ligulate, often somewhat unequal on a single flower, acute to obtuse, entire; corolla slenderly funnelform, red, swollen and a little bent at base, straight in tube, externally papillose to puberulous, internally glabrous except for a sparsely pilosulous ring ca. 2 mm wide at ca. 1.5 mm above base, tube ca. 12 mm long, ca. 1.5 mm diam. near middle, lobes triangular, ca. 2 mm long, acute, smooth adaxially; anthers ca. 3.5 mm long, positioned ca. 2/3 of length of corolla tube above its base; stigmas

5, ca. 1 mm long, exserted. *Infructescences* similar to inflorescences except apparently deflexed to pendulous, purple; *fruits* ellipsoid to oblate, ca. 3.5 × 4.5 mm, glabrous, color unknown; pyrenes 5, triangular in horizontal section, the internal faces planar, dorsally smooth, rounded.

Distribution, habitat, and phenology. In wet forests at 1500–1800 m in northern Peru; collected in flower in February, in fruit in July.

This new species is distinguished by its subsessile to shortly petiolate leaves with relatively numerous secondary veins and obtuse to rounded bases, its stipules with the lobes tightly grouped and inserted near the middle of the interpetiolar portion of the sheath, its relatively long peduncles, its well-developed calyx lobes, and its fruits with five smooth pyrenes. The specific epithet refers to these fruits. This species shares its unusual stipule morphology and fruits with several pyrenes with *Palicourea ulloana* C. M. Taylor of Ecuador; *P. ulloana* differs from *P. quinquepyrena* by its leaves 4.5–14 × 1.4–5 cm with acute to cuneate bases and 10 to 12 pairs of secondary veins that extend to unite with the margins, its stipules with the sheaths 1–2.5 mm long and two lobes 2–3.5 mm long on each side, its peduncles 3–9 cm long, its inflorescences with the branched portion 3.5–10.5 × 2–3 cm (excluding the corollas), and its fruits with four pyrenes. The few flowers of *P. quinquepyrena* seen are similar to the long-styled form of distylous *Palicourea* species in the arrangement of their anthers and stigmas. The leaves of *P. quinquepyrena* apparently accumulate litter in their bases, similar to some other species of Rubiaceae (e.g., *Pentagonia wendlandii* Hooker f.) and other families; this has been called at times a "trash bucket" habit.

Paratypes. PERU. **Cajamarca:** prov. San Ignacio, dtto. Huarango, Nuevo Mundo-Caserío Gosén, La Colmena, 5°18′30″S, 78°43′00″W, *J. Campos et al. 4212* (MO); Nuevo Mundo, Caserío Gosén, arriba del margen izquierdo de la quebrada Las Juntas, *E. Rodríguez R. & P. Reyes M. 1748* (MO).

Palicourea roseofaucis C. M. Taylor, sp. nov. TYPE: Panama. Chiriquí: vicinity of Fortuna Dam, along trail across valley of Quebrada Hornito, 8°40′04″N, 79°50′04″W, 1150 m, 26 Feb. 1987, *G. McPherson 10579* (holotype, MO-4390379). Figures 1F, G, 3C, D.

Haec species a *Palicourea sulphurea* corolla ex alba rosea suffusa distinguitur, etiam eae areas geographicas disjunctas habitant.

Shrubs and trees flowering at 5 m tall, to 12 m tall; stems quadrate, glabrous. *Leaves* opposite; blades elliptic, 6–20 × 2–6.5 cm, at apex acute to acuminate with tips to 10 mm long, at base acute to cuneate, drying chartaceous to subcoriaceous, adaxially glabrous and shiny, abaxially glabrous except hirtellous in a line along each side of costa; secondary veins 8 to 16 pairs, usually extending to near margins or sometimes looping weakly to interconnect near margins, without or infrequently with 1 weak intersecondary vein usually present between pairs of secondary veins, adaxially costa and secondary veins prominulous and reticulated higher-order venation plane to impressed, abaxially costa prominent, secondary veins prominulous, and reticulated higher-order venation plane; margins thinly to distinctly cartilaginous, entire; *petioles* 1–2.5 cm long, glabrous; *stipules* glabrous, persistent, united around stem in a continuous sheath, interpetiolar portion 5–7 mm long, emarginate to shallowly bilobed, lobes 1–2 mm long, rounded, entire. *Inflorescences* terminal, erect, with peduncles 0.5–2.5 cm long or sessile and seemingly "tripartite"; branched portion narrowly pyramidal, 8–16 × 5–9 cm (excluding corollas), with 5 to 6 pairs of developed secondary axes, with flowers sessile to shortly pedicellate in cymules of 3 to 9; bracts entire, those subtending secondary axes narrowly triangular to lanceolate, 3–13 mm long, acute, those subtending pedicels ligulate to triangular, 1–2 mm long, acute; pedicels 0–1 mm long; peduncle, axes, bracts, and pedicels strigillose to hirtellous, apparently green; *flowers* distylous; hypanthium turbinate, ca. 1 mm long, strigillose; calyx limb glabrous to strigillose, ca. 1 mm long, divided nearly to base, lobes triangular to deltoid, acute to obtuse, entire; corolla tubular-funnelform, externally white, internally pink, markedly swollen at base, bent ca. 90° at base and then again ca. 90° just above basal swelling, externally puberulous to glabrous, internally glabrous except for a pilose ring ca. 1 mm wide just above basal swelling, tube ca. 6 mm long, ca. 2.5 mm diam. near middle, lobes triangular, ca. 3 mm long, triangular, acute, a little thickened adaxially; anthers in short-styled form 1–1.2 mm long, partially exserted, in long-styled form ca. 2 mm long, included and positioned near middle of tube; stigmas 2, in short-styled form ca. 2.5 mm long, included and positioned ca. 2/3 of length of tube above base, in long-styled form ca. 0.3 mm long and exserted. *Infructescences* similar to inflorescences, red-purple; *fruit* ellipsoid to obovoid, ca. 5 × 5.5 mm, somewhat flattened laterally, glabrous, blue; pyrenes 2 to 3, planoconvex, dorsally smooth or with 3 to 5 longitudinal angles.

Distribution and habitat. In wet forest in western Panama at 1100–1350 m; collected in flower in February and April, in fruit in June and September.

This new species is distinguished by its stipules with the interpetiolar portion emarginate or with at most short rounded lobes, its rather tough-textured leaves that are usually shiny on the adaxial surface, its corollas that are white externally, pink internally, and strongly gibbous and bent near the base, and its dorsally smooth or longitudinally angled pyrenes. The specific epithet refers to the corolla color. This new species is similar to *Palicourea sulphurea* (Ruiz & Pavón) DC. of Andean Colombia to Peru; *P. sulphurea* differs from *P. roseofaucis* by its yellow corollas, and these two species appear to be allopatric. *Palicourea tumidonodosa* Dwyer from the Panama–Colombia border is also similar to both of these species, but *P. tumidonodosa* is known only from specimens with very young inflorescences, on which several important characters are not evident, in particular the colors of the inflorescences and corollas, the mature sizes of the calyx and corolla, and the size and morphology of the pyrenes. *Palicourea tumidonodosa* may be conspecific with *P. roseofaucis* or *P. sulphurea*, or it may represent a third species, but because none of these possibilities can be excluded, *P. tumidonodosa* is here provisionally recognized as distinct.

Paratypes. PANAMA. **Bocas del Toro:** Fortuna Dam region, along continental divide W of highway pass, 8°45′N, 82°15′W, *McPherson 9688* (MO). **Chiriquí:** along road between Gualaca and the Fortuna Dam site, at 8.3 mi. NW of Los Planes de Hornito, *Antonio 4146* (MO); Fortuna Dam region, above northern edge of lake, 8°45′N, 82°15′W, *McPherson 9086* (MO); vicinity of Fortuna Dam, along trail from highway down to the reservoir, *McPherson 9143* (MO); vicinity of Fortuna Dam, along trail from highway across Rio Hornito, S of reservoir, 8°45′N, 82°15′W, *McPherson 11657* (MO).

Palicourea stellata C. M. Taylor, sp. nov. TYPE: Colombia. Santander: mpio. de Gámbita, vereda El Taladro, carretera Duitama–Charalá, 2100–1900 m, 14 Feb. 1983, *S. Díaz P. 4053* (COL-239056). Figures 2F–I, 3A.

Haec species a congeneris foliorum venatione utrinque prominula ac venis intersecundariis bene evolutis, limbo calycino bene evoluto atque corollae flavae quoque lobulo appendicem carnosam 3–4 mm longam gerente distinguitur.

Shrubs flowering at 1.5 m tall, to 5 m tall; stems terete to rather quadrate, hirtellous to glabrous. *Leaves* opposite; blades elliptic to oblanceolate, 3.5–11.5 × 1–4 cm, at apex acute to usually acuminate with tips to 10 mm long, at base acute to cuneate, drying chartaceous, adaxially glabrous or sometimes sparsely hirtellous along sides of costa, abaxially glabrous or hirtellous along sides of costa; secondary veins 10 to 23 pairs, reticulating near margins or usually extending to unite with margins, with 1(to 3) well-developed intersecondary vein(s) usually present between pairs of secondary veins and often difficult to distinguish from these, adaxially and abaxially costa prominulous to prominent and secondary veins and strongly reticulated tertiary venation prominulous; margins thinly to distinctly cartilaginous, entire to usually ciliolate; *petioles* 3–7 mm long, glabrous to hirtellous; *stipules* glabrous to hirtellous, persistent, interpetiolar, 5–9 mm long, ovate to ligulate, bilobed for 1/3–1/2, lobes narrowly triangular to deltate, rounded to obtuse or acute, entire to ciliolate. *Inflorescences* terminal, erect, seemingly "tripartite" with bracts subtending the basalmost pair of axes well developed and foliaceous; branched portion pyramidal to narrowly pyramidal, 6–10 × 3–7 cm (excluding corollas), with 4 to 5 pairs of developed secondary axes, with flowers pedicellate in cymules of 3 to 7; bracts entire to ciliolate, those subtending secondary axes narrowly lanceolate to narrowly triangular, 4–10 mm long, acute, those subtending pedicels triangular, 1–2 mm long, acute, sometimes displaced by up to 1/3 of length of pedicel above its base; pedicels 1.5–7 mm long; peduncle, axes, bracts, and pedicels glabrous to pilosulous, yellow; *flowers* with hypanthium turbinate, ca. 2 mm long; calyx limb glabrous, 1.2–2 mm long, divided for 1/3–2/3, lobes triangular to ovate and overlapping on lateral margins, obtuse to rounded, entire to ciliolate; corolla tubular to tubular-funnelform, cream to usually yellow, a little swollen at base, generally straight there and in tube, externally glabrous, internally glabrous except for a pilose ring ca. 1.5 mm wide at ca. 1 mm above base, tube 7–8 mm long, ca. 2 mm diam. near middle, lobes triangular, ca. 2 mm long, acute, adaxially with a fleshy, conical to spatulate, reflexed projection 3–4 mm long, the projections together forming a star-like shield on top of the corolla in bud; anthers ca. 2.5 mm long, partially exserted; stigmas 2, ca. 2 mm long, included and positioned ca. 1/2 length of corolla tube above base. *Infructescences* similar to inflorescences, becoming red to red-purple; *fruit* obovoid, ca. 7 × 6 mm, somewhat flattened laterally, glabrous, bright blue; *pyrenes* 2, planoconvex, dorsally with 3 to 5 longitudinal planar angles.

Distribution, habitat, and phenology. In wet forests at 1800–2750 m of the Eastern Andean Cordillera of Colombia; collected in flower in February, May, June, and October, in fruit in May, June, and December.

This new species is distinguished by its interpetiolar stipules, its leaves with the venation prominulous on both surfaces and the intersecondary veins well developed, its rather well-developed calyx limb, its corollas with unusually well developed appendages on the lobes, its obovate fruits, and its pyrenes dorsally with planar angles. The corolla lobe appendages are unusual in *Palicourea*, and the grouped appendages give the corollas in bud a star-like appearance; the specific epithet refers to this structure. Similarly well developed corolla lobe appendages are found on a few other species of *Palicourea*: *P. lehmannii* (Rusby) Standley differs from *P. stellata* by its stipules united around the stem into a well-developed sheath and its blue to purple corollas with tubes 24–30 mm long, and is known only from a small region near Cali in the Western Cordillera of the Andes; *P. cornigera* C. M. Taylor differs from *P. stellata* by its pilosulous pubescence on both vegetative and reproductive parts, its stipules that are united around the stem in well-developed sheaths, its calyx limbs 3.5–6 mm long, and its white to blue corollas with tubes 15–20 mm long, and is known only from Ecuador; *P. corniculata* C. M. Taylor differs from *P. stellata* by its stipules united around the stem into continuous sheaths, its subglobose hypanthia, its corollas with tubes 10–15 mm long and the lobe appendages 1.5–2.5 mm long, and its pyrenes with rather sharp dorsal ridges, and is also known only from Ecuador. *Palicourea stellata* is similar also to *P. sulphurea* (Ruiz & Pavón) DC., which is sympatric but differs by its corollas with unappendaged lobes. The leaves of *P. stellata* are rather unusual in that their abaxial and adaxial surfaces are similar in color, texture, prominence of the venation, and especially in having similar pubescence along the sides of the costa on both surfaces. The flowers seen of *P. stellata* are similar to the short-styled form of distylous *Palicourea* species in the arrangement of their anthers and stigmas.

Paratypes. COLOMBIA. **Boyacá:** mpio. El Encino, corregimiento de Virolín, Hacienda La Sierra, *Lozano 2264* (COL); mpio. Arcabuco, vereda Piedras Blancas, Finca La Delicias, *Rangel et al. 13175* (COL); mpio. de Gámbita, vereda El Taladro, *J. H. Torres R. 2634* (COL). **Santander:** mpio. de Charalá, vereda El Taladro, Km 50–55, carretera Duitama–Virolín, *S. Díaz P. 1613* (COL); mpio. de Charalá, vereda El Volcán, *L. D. Moreno & A. V. Méndez 73* (COL), *L. D. Moreno & A. V. Méndez 76* (COL); mpio. de Gámbita, vereda El Taladro, *J. H. Torres R. 2542* (COL); mpio. de Charalá, corregimiento de Virolín, sitio Cañaverales, *J. H. Torres R. 2647* (COL).

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Rubiacearum Americanarum Magna Hama Pars VIII. New species of *Gonzalagunia* and *Sabicea* from Mesoamerica and Colombia

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ABSTRACT. The new species *Gonzalagunia osaensis* C. M. Taylor, found from central Panama to eastern Costa Rica, is described and illustrated; it has previously been confused with *G. rudis* (Standley) Standley. The new species *Sabicea chocoana* C. M. Taylor, found from eastern Panama to western Colombia, is also described and illustrated; it has previously been confused with *S. panamensis* Wernham.

Key words: Colombia, *Gonzalagunia*, Mesoamerica, Rubiaceae, *Sabicea*.

The new species of *Gonzalagunia* Ruiz & Pavón and *Sabicea* Aublet described below were discovered during preparation of the Rubiaceae treatment for the *Flora Mesoamericana*.

Gonzalagunia (Isertieae; Robbrecht, 1993) comprises about 35 (Ståhl, 1999) neotropical species distributed from central Mexico and the Antilles to Bolivia and southern Brazil. This genus is characterized by its usually shrubby habit; its triangular interpetiolar stipules that are frequently persistent; its terminal, spiciform, bracteate inflorescences with the flowers borne singly or in congested cymules directly from the well-developed primary axis; its calyx lobes four; its salverform pink or white corollas with the lobes four and imbricated (or reportedly infrequently valvate: Ståhl, 1999); and its fleshy fruits with the numerous small angled seeds borne loose and dry inside two or four bony pyrenes. The long slender inflorescences and infructescences are often pendulous, giving the plants a distinctive aspect. The flowers are generally fragrant and distylous. The fruits at maturity are typically mealy or spongy rather than juicy. The number of pyrenes in the fully developed fruits, two vs. four, has been considered taxonomically informative (e.g., Ståhl, 1999). Species of *Gonzalagunia* are commonly found in secondary vegetation and produce flowers and fruits for relatively long periods, and are therefore commonly collected. The genus has not been studied comprehensively.

Sabicea comprises about 120–130 neotropical and African species (Andersson, 1999). This genus has often been included in the tribe Isertieae (e.g., Robbrecht, 1993), although it has also been treated in the tribe Sabiceeae when this is separated from Isertieae (Bremer & Thulin, 1998). In the Neotropics *Sabicea* is distributed from central Mexico and the Antilles to Bolivia and southern Brazil. This genus is characterized in the Neotropics by its usually twining habit; its interpetiolar stipules that are usually ovate to elliptic, persistent, and reflexed; its axillary, bracteate, capitate to cymose inflorescences; its calyx lobes five; its salverform to funnelform, usually white corollas with five valvate lobes; its stigmas and ovary locules five; and its fleshy fruits with numerous small angled seeds distributed through the pulp. The fruits are juicy and usually pass through pink and red stages to finally become red-purple to violet-black at maturity. Species of *Sabicea* are commonly found in secondary vegetation, and produce flowers and fruits often and for relatively long periods. Some South American species are low pyrrhophytes in savanna and cerrado vegetation (e.g., *S. brasiliensis* Wernham, *S. humilis* S. Moore), and a few apparently may grow as self-supporting shrubs (e.g., *S. camporum* Sprague). Many species of *Sabicea* bear white or tan arachnoid pubescence; the presence and distribution of this pubescence on the plant has been considered taxonomically informative (e.g., Steyermark, 1967) although its variation in living populations has apparently not been studied. *Sabicea* was monographed by Wernham (1914), but this work is now outdated.

Gonzalagunia osaensis C. M. Taylor, sp. nov. TYPE: Costa Rica. Puntarenas: Reserva Forestal Golfo Dulce, Aguabuena, Rincón de Osa, 8°42′N, 83°32′W, 50–150 m, 10 Aug. 1991, *R. Aguilar 259* (holotype, CR; isotype, MO-4234234). Figure 1C, D.

Haec species a *Gonzalagunia dicocca* lobulis calycinis linearis 1.5–3 mm longis atque lobulis corollinis acutis 3.5–6 mm longis distinguitur.

Shrubs or small trees to 4 m tall, with branches often slender and arching; stems densely strigillose.

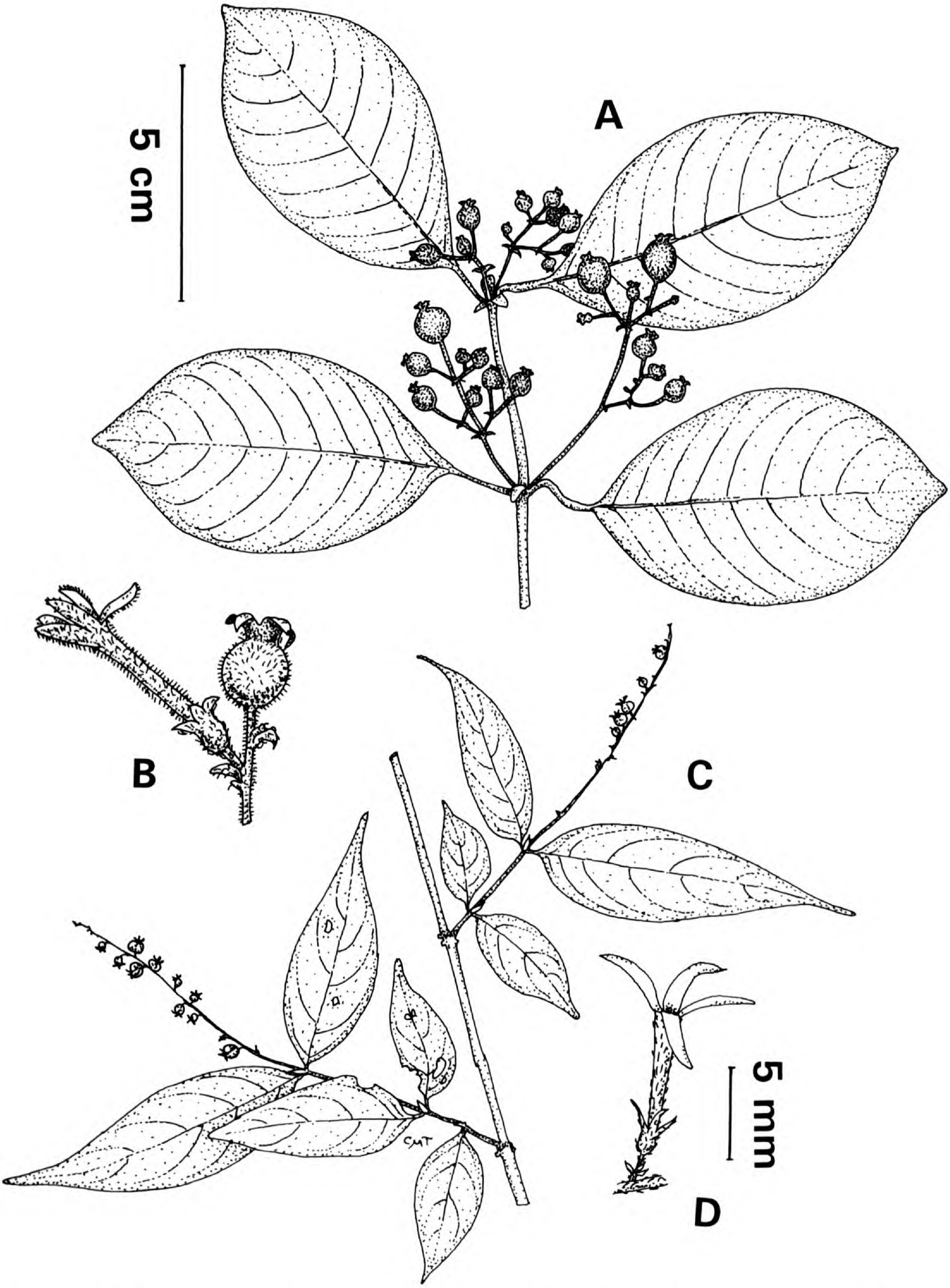

Figure 1. A, B, *Sabicea chocoana* C. M. Taylor. —A. Flowering branch; based on *León 516*. —B. Detail of inflorescence showing flower and young fruit; based on *Gentry & Aguirre 15236*. C, D, *Gonzalagunia osaensis* C. M. Taylor. —C. Flowering branch; based on *Cuadros 8050*. —D. Flower; based on *Grayum 8634*. A, C to 5-cm scale; B, D to 5-mm scale.

Leaves lanceolate, 3–10 × 1–2.5 cm, at apex tapered and acuminate, at base cuneate to obtuse, drying papyraceous, adaxially sparsely strigillose to glabrescent on lamina and densely strigillose on costa and secondary veins, abaxially sparsely to moderately strigillose at least on veins; secondary veins 4 to 6 pairs, usually at least weakly looping to interconnect, adaxially costa thinly prominulous and remaining venation plane or secondary veins sometimes a little thickened, abaxially costa and secondary veins prominulous and remaining venation plane, without domatia; *petioles* 1–4 mm long, densely strigillose; *stipules* interpetiolar, narrowly triangular to subulate, 3.5–7 mm long, long-acute, persistent, adaxially densely strigillose, abaxially densely strigillose on basal part and midrib and glabrescent on margins of upper part. *Inflorescences* terminal on rather short lateral branches (i.e., these with 1 to 2 or occasionally up to 4 leaf-bearing nodes), densely strigillose, arching to pendulous, spiciform with primary axis prolonged and flowers borne singly directly from it; peduncles 0.5–1 cm long, slender; flowering portion 2.5–8 × 1 cm; bracts narrowly triangular to linear, 1–4 mm long, acute, borne in clusters of 2 to 3 at bases of pedicels or sometimes 1 to 2 bracts basal to pedicel and 1 to 2 bracts borne along its length; pedicels 1–1.8 mm long; *flowers* distylous; hypanthium ellipsoid, ca. 1 mm long, densely strigillose; *calyx limb* 1.8–2 mm long, densely strigillose, lobed for 2/3–3/4, lobes 4, linear, sometimes somewhat unequal (i.e., with less than 30% difference in length); *corolla* salverform, white, externally densely sericeous to strigillose, internally glabrous except puberulous to hirtellous on bases of lobes, tube 7–9 mm long, lobes 4, narrowly triangular, 3.5–6 mm long, acute; *anthers* subsessile, narrowly oblong, included, in short-styled form ca. 1.5 mm long and situated ca. 2/3 of length of corolla tube above its base, in long-styled form ca. 1.2 mm long and situated just below middle of corolla tube; *stigmas* 2, linear, in short-styled form situated ca. 1/3 of length of corolla tube above its base and included, in long-styled form ca. 1.2 mm long and situated in corolla throat, included or with tips exserted. *Fruits* when dry ellipsoid, ca. 3 × 3.5 mm, laterally flattened, somewhat didymous, strigillose, white, at maturity quickly becoming inflated; pyrenes 2, subglobose.

Habitat, distribution, and phenology. In wet forest at 0–650 m, southeastern Costa Rica to western Panama; collected in flower May through October, in fruit August through February.

This new species is distinguished by its rather low slender habit, its relatively small lanceolate leaves, its rather short inflorescences with the flowers borne directly and singly from the primary axis, its linear calyx lobes 1.5–3 mm long, its acute corolla lobes 3.5–6 mm long, and its fruits with 2 pyrenes. The species epithet refers to its geographic distribution. This new species is similar to *Gonzalagunia dicocca* Chamisso & Schlechtendal, found in northern to central South America, in general aspect and in its fruits with 2 pyrenes; but *G. dicocca* differs from *G. osaensis* in its calyx lobes 0.2–1 mm long and its corolla lobes 3–3.5 mm long. *Gonzalagunia osaensis* has also been previously confused with *G. rudis* (Standley) Standley (Dwyer, 1980; Burger & Taylor, 1993), but *G. rudis* differs from *G. osaensis* in its habitat, in usually seasonal or moist forest; its densely sericeous hypanthium; its corollas with tubes ca. 3.5 mm long and lobes ca. 1.5 mm long; and its fruits with 4 pyrenes. *Gonzalagunia osaensis* appears to be locally common, particularly in the Osa and Burica Peninsulas, and seasonal in its flowering and fruiting.

Paratypes. COSTA RICA. **Puntarenas:** cantón de Osa, Reserva Forestal Golfo Dulce, *Aguilar 1216* (INB, MO); cantón de Osa, Parque Nacional Corcovado, Península de Osa, Estación San Pedrillo, *Aguilar 2350* (MO); cantón de Golfito, Parque Nacional Corcovado, Península de Osa, Estación Sirena, *Aguilar 2450* (INB, MO), *Aguilar et al. 3539* (INB, MO); cantón de Golfito, Península de Osa, El Tigre, cabecera del Río Agujas, Finca Azofeifa, *Aguilar 2654* (INB, MO); cantón de Osa, Rincón de Osa, fila Casa Loma, sendero Las Ranas, *A. Chacón 911* (CR, MO); ridge between Quebrada Aguabuena and Quebrada Banegas, ca. 5 km W of Rincón de Osa, *Grayum 4055* (MO); ridge between Quebrada Banegas and Río Riyito, ca. 7 km W of Rincón de Osa, *Grayum 4092* (MO); Reserva Forestal Golfo Dulce, Osa Península, Rancho Quemado, ca. 15 km W of Rincón, *Hammel et al. 16814* (CR, MO), *Hammel et al. 17003* (CR, MO); cantón de Osa, Reserva Forestal Golfo Dulce, Península de Osa, Playa Campanario o San Josecito, Sierpe, *Harmon 296* (INB, MO); 12 km E of Golfito, *Harmon & Fuentes 6180* (MO); E of Sirena headquarters, Corcovado National Park, *Hartshorn 1866* (MO); cantón de Osa, Rancho Quemado, Sierpe, cabeceras del Río Drake, *G. Herrera 4226* (CR, MO); Corcovado National Park, Osa Peninsula, near Park headquarters at Sirena, *Janzen 11031* (MO); Parque Nacional Corcovado, upper Camaronal, *Kernan & Phillips 595* (MO), Ollas trail, *Kernan et al. 875* (CR, MO); ridge N of airport, Rincón de Osa, *Liesner 1960* (MO); Corcovado National Park, 0–2 km W of park headquarters at Sirena, *Liesner 2914* (MO); cantón de Osa, Reserva Forestal Golfo Dulce, Península de Osa, Rincón de Osa, *Lobo 79* (INB, MO); cantón de Osa, Reserva Forestal Golfo Dulce, Rancho Quemado, Fila Guerra, Rincón, Finca G. Padilla, *A. L. Marín & Gutiérrez 56* (INB, MO); cantón de Osa, Rancho Quemado, Fila División, *J. Marín 24* (CR, MO); cantón de Osa, tierras del Grupo de Conservación de Rancho Quemado, Sierpe, *J. Marín 221* (INB, MO); cantón de Osa, Agua Buena, Rincón [de Osa], al N de BOSCOSA, *Morales 113* (CR, MO); cantón de Osa, camino a la toma de agua, Rancho Quemado, Rincón [de Osa], *Quesada*

244 (INB, MO); Cantón de Osa, Reserva Forestal Golfo Dulce, Península de Osa, Rancho Quemado, Quebrada El Brote, *Quesada & Segura 762* (INB, MO); along camino de Altura, 2–5 mi. W of Rincón [de Osa], trail to airfield from Mile 4, *Raven 21669* (MO); Parque Nacional Corcovado, Estación Sirena, *Saborío 80* (INB, MO); La Gamba, Parque Nacional Espinas, *Will 26/07/99/71* (MO); Refugio de Fauna Silvestre Golfito, *Zamora 1056* (CR, MO); Reserva Nacional de Vida Silvestre Golfito, Fila Gamba, camino entre Golfito y Villa Briceño, *Zamora et al. 1916* (INB, MO). **Puntarenas–San José Border:** Tarrazú, faldas del Cerro Nara, ca. Esquipulas, límite Quepos y Tarrazú, *Gómez-Laurito et al. 11579* (CR, MO). **San José:** Zona Protectora La Cangreja, along Quebrada Grande and on adjacent ridges, ca. 2 km NNE of Mastatal de Puriscal, *Grayum 8634* (CR, MO). PANAMA. **Chiriquí:** Burica Peninsula, San Bartolo límite, 21 km WNW of Puerto Armuelles, *Busey 459* (MO); Burica Peninsula, Quebrada Mérida, 4 mi. S of Puerto Armuelles, *Liesner 379* (MO). **Herrera:** above Chepo de Las Minas, *Folsom et al. 6980* (MO); distrito de Las Minas, Chepo, *Galdames et al. 1658* (MO); between Las Minas and el Toro, near village of Chepo, *McPherson 10302* (MO). **Los Santos:** vicinity of headwaters of Río Pedregal, 25 mi. SW of Tonosí, *Lewis et al. 2922* (MO); valley of Río Guanico, *McPherson 9237* (MO). **Los Santos–Veraguas Border:** southern Azuero Peninsula, near proposed route of road from El Cortezo to Arenas, Azuero, ca. 10 km SW of El Cortezo, *Hammel 5412* (MO). **Veraguas:** 18 km W of Las Minas, N slope of Cerro Alto Higo, *Hammel 4249* (MO); Isla de Coiba, Playa Hermosa, *Cuadros et al. 8050* (MA, MO); Isla Coiba, distrito de Montijo, Playa Brava, *Galdames et al. 3244* (MO).

Sabicea chocoana C. M. Taylor, sp. nov. TYPE: Colombia. Antioquia–Chocó border: zona de Urabá, Cerro El Cuchillo, Finca Cidon a la Cumbre, 20–100 m, 9 Oct. 1987, *D. Cárdenas 584* (holotype, JAUM; isotype, MO-3822736). Figure 1A, B.

Haec species a congeneris inflorescentiae pedunculatae ramosae pedicellis 2–10 mm longis, praeter corollam omnibus partibus vegetativis reproductivisque pubescentia pilosula breve uniformi vestita, lobulis calycinis 1.2–2.2 mm longis atque corolla pubescentia hirsuta patente vestita distinguitur.

Suffrutescent twiners, climbing to 2 m high; stems densely uniformly pilosulous. *Leaves* elliptic-oblong to broadly so, 5.5–11 × 4–8 cm, at apex obtuse to usually gently acuminate, at base cuneate to truncate, drying papyraceous, adaxially moderately strigillose on lamina and densely pilosulous to occasionally hirtellous on costa and secondary veins, abaxially moderately to densely strigillose to usually pilosulous with usually denser and always spreading pubescence on veins; secondary veins 7 to 11 pairs, weakly looping to interconnect, without domatia; *petioles* 3–15 mm long; *stipules* ligulate, 3–4 mm long, obtuse to rounded, persistent, reflexed, adaxially strigillose to glabrescent, abaxially densely pilosulous. *Inflorescences* 2–4 cm long, densely pilosulous, paniculate with 1 to 2 pairs of secondary axes; peduncles 5–22 mm long; bracts subtending secondary axes narrowly ligulate, 1.5–5 mm long, obtuse to acute, bracts subtending pedicels and flowers narrowly triangular, 0.3–1.5 mm long, acute; pedicels 2–10 mm long; *flowers* with hypanthium ellipsoid, ca. 2 mm long, densely pilosulous; *calyx limb* adaxially strigillose to glabrescent, abaxially densely pilosulous, with tube ca. 1 mm long, lobes 5, ligulate to narrowly so, 1.2–2.2 mm long, obtuse to acute; *corolla* salverform, white, externally densely hirsute, internally not seen, tube 8–9 mm long, lobes 5, narrowly triangular, 2–3 mm long, acute; *anthers* not seen; *style* ca. 6 mm long, stigmas ca. 1.2 mm long; disk annular, ca. 1 mm high. *Fruits* subglobose to ellipsoid, 8–9 mm diam., deep purple to black; seeds angled, ca. 0.3 mm long, finely striate.

Habitat, distribution, and phenology. In wet forest at 10–600 m, eastern Panama to northwestern and central western Colombia; collected in flower May through July and in October, in fruit in May, July, and September through November.

This new species is distinguished by the combination of its pedunculate branched inflorescences with pedicels 2–10 mm long; vegetative organs, inflorescence axes, and hypanthia that are pilosulous with uniform spreading trichomes; strongly reflexed calyx lobes 1.2–2.2 mm long; and externally hirsute corollas. The specific epithet refers to its geographic range, which is centered in the Chocó biogeographic region of western Colombia and adjacent eastern Panama. Only one specimen (*Haught 2210*) has mature flowers in condition adequate for study; whether this new species is distylous or homostylous cannot be determined. This new species is similar to the sympatric species *Sabicea panamensis* Wernham; *S. panamensis* differs from *S. chocoana* in its appressed, usually strigose or strigillose pubescence on all parts and its acute calyx lobes 2–6 mm long. This new species is also similar to *S. thyrsiflora* L. Andersson of northwestern Ecuador; *S. thyrsiflora* differs from *S. chocoana* in its appressed to only weakly spreading pubescence, longer stipules (6.5–7 mm long), longer bracts (5–7 mm long), and longer calyx lobes (2.5–2.7 mm long) that are ascending in fruit.

Paratypes. COLOMBIA. **Antioquia:** mpio. Turbo, carretera Tapón del Darién, sector Río León-Lomas Aisladas, Km 37, *Brand & González 680* (JAUM, MO); mpio. Caucasia, along road to Nechí ca. 19 km E from Caucasia–Planeta Rica road, *Brant & Escobar 1185* (HUA, MO). **Bolívar:** Palotal, *R. Romero-Castañeda 1172* (F). **Chocó:** mpio. Riosucio, zona de Urabá, Cerro del Cuchillo, *D. Cárdenas 787* (JAUM, MO), cerros del Cuchillo, sector

NO, *D. Cárdenas 254* (JAUM, MO), sector Cuchillo Negro, *D. Cárdenas 363* (JAUM, MO), camino entre Cuchillo Negro y Punta de las Flores, *D. Cárdenas 1944* (JAUM, MO), Cuchillo Negro (Río María) a cumbre NO, *D. Cárdenas 2240* (JAUM, MO); 2–4 km NW of Teresita, *Duke 11039* (MO), *Duke 11054* (MO); trail from Río Tigre base camp up Serranía del Darién W of Unguía, *Gentry & Aguirre 15236* (MO); mpio. de Riosucio, Parque Natural Nacional Los Katyos, Salto de Tilupo, *León 137* (COL, MO), camino Tilupo, Alto vía Sautatá, desviando por el camino a Tilupo Salto parte baja, *León 516* (COL, MO). **Santander:** Madgalena valley, Campo Capote, 30 km E of Carare, *Gentry et al. 20079* (MO); vicinity of Barranca Bermeja (El Centro), *Haught 2210* (F, MO). PANAMA. **Darién:** 0.5–1.5 mi. E of Manene, *Hartman 12104* (MO); trail NW of Cana, *Sullivan 715* (MO).

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Typhonium jinpingense, a New Species from Yunnan, China, with the Lowest Diploid Chromosome Number in Araceae

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ABSTRACT. *Typhonium jinpingense* Z. L. Wang, H. Li & F. H. Bian (Araceae) from Yunnan, China, is described as a new species in Araceae. The karyotype of metaphase chromosomes in somatic cells is: $2n = 10 = 2m+2st+6sm$. This is the lowest diploid number so far reported in this family.

Key words: Araceae, chromosome numbers, *Typhonium*.

Fieldwork was conducted in the southeast part of Yunnan Province, China, in October 1999. The new species was found on a slope near a small stream with an elevation from 1000 to 1550 m in Jinping County, Yunnan Province, China. This plant was first collected and identified as *Typhonium blumei* Nicolson & Sivadasan, as the leaves were quite similar to this species. The plants were subsequently grown and propagated; so far, more than 20 individuals are cultivated in the Kunming Botanical Garden. From April to August 2000 four of them flowered, displaying quite different characteristics from *T. blumei*. After checking the chromosome number for several individuals, we found the lowest diploid chromosome number in Araceae reported to date. We checked the morphological characteristics carefully and compared them to all the species in the genus *Typhonium*, and realized this taxon is an undescribed species.

According to the revision of *Typhonium* (Sriboonma et al., 1994) and our recent investigations, 16 species and 4 varieties in the genus have been found in China thus far, belonging to 5 sections. Recently, Hetterscheid and Boyce (2000) merged the genus *Sauromatum* Schott (all 3 species found in China) with *Typhonium* Schott (Wang & Li, 1999). Thus the number of *Typhonium* species in China is now thought to be 19. However, based on species richness in neighboring countries (Hetterscheid et al., 2001; Hetterscheid & Nguyen, 2001), this is likely to be an underestimate of the actual number of *Typhonium* species in China, especially in the southern part of Yunnan Province.

MATERIALS AND METHODS

The plants were collected in the field from Jinping, Yunnan, China, and cultivated in the Kunming Botanical Garden for the taxonomic and cytological study.

For the taxonomic study, we first checked the characteristics carefully, using the key for *Typhonium* developed by Sriboonma et al. (1994) to determine which section the species belongs to. We then compared it to all described *Typhonium* species, including the species published subsequent to the 1994 revision.

For the cytological study, growing root-tips were pre-treated in 0.002 mol/L 8-hydroxyquinoline at room temperature for 3 hours, then fixed in Clarke (ethanol/acetic acid, 3:1) solution at 4°C for 30 minutes. They were then hydrolyzed in 1 mol/L hydrochloric acid at 60°C for 3–4 minutes. After being rinsed in distilled water 3 times, the root tips were dyed in Carbol Fuchsin solution for 1 hour, then squashed and sealed. Photos were taken using the method described in Li and Zhang (1991). The chromosomes were classified by arm ratio according to Leven and Fredga (1964). The karyotype classification followed the criteria developed by Stebbins (1971).

RESULTS

CYTOLOGICAL STUDY

The chromosome number was counted in more than 15 somatic cells, and the karyotype analysis was carried out in 1 good cell. The karyotype of the new species is described in Table 1 and illustrated in Figure 2. The chromosome number in somatic cells is 10, and the karyotypical formula is $2n = 2x = 10 = 2m+2st+6sm$. This species is a diploid. The length in somatic mitotic cells ranges from 2.9 μm to 6.1 μm, while the relative length of the chromosomes ranges from 6.5 to 13.2. The ratio of the longest chromosome (No. 1) to the shortest one (No. 10) is 2.04. The percentage with Long Arm/Short Arm >2:1 is 80%. The karyotypical asymmetry belongs to the 3B type.

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Table 1. The parameters of somatic chromosomes in mitotic metaphase of *Typhonium jinpingense*.

Pair	TL	AR	PC
1	13.3	2.0	sm
2	12.7	2.6	sm
3	10.1	2.4	sm
4	7.7	3.3	st
5	6.6	1.4	m

Note: TL = Total relative length; AR = arm ratio; PC = position of centromere.

TAXONOMIC DESCRIPTION

Typhonium jinpingense Z. L. Wang, H. Li & F. H. Bian, sp. nov. TYPE: China. Yunnan Province: Jinping Xian, Shuangjin Bridge, road side by stream, 1200 m, 30 Oct. 1999, *F. H. Bian & R. Li 200* (holotype, KUN). [Cultivated in Kunming Botanical Garden, $2n = 10$.] Figure 1.

Haec species *Typhonio blumei* affinis, sed spathae tubo ovato, 1.5 cm longo, 5 mm diam., pallide viridi inferne, atropurpureo superne, lamina angusta, lanceolata, 11 cm longa, medio 1 cm lata, basi atropurpurea, cretacea supra basin, florum sterilium rudimentis clavatis, chromosomatibus $2n = 10$ differt.

Perennial herb, seasonally dormant, rhizome tuberous, irregularly cylindrical, brown, horizontal or erect, producing small gemmules and many filiform roots, 2–2.5 cm long, 0.7–1.0 cm diam. Leaves 1–3, petiole smooth, green, 10–17 cm long, 0.1 cm diam., sheathing below ca. 1.5–2 cm long; blade chartaceous, green, cordate, usually cordate-hastate or deeply cordate at base, 5–8 × 4–10 cm. Peduncle about 1 cm long. Spathe: tube ovoid, pale green, dark purple at the top, 1.5 cm long, 0.5 cm diam.; the blade narrowly lanceolate, chalky-white but dark purple at base, 11 cm long, 1 cm wide below the middle, spreading and slightly arching, the apex long-acuminate but not twisted. Spadix ca. 14 cm long, pistillate portion ca. 0.5 cm long, greenish, the style short, stigma dark purple, sterile portion ca. 0.4 cm long, densely covered proximally, erect, yellowish, clavate rudiments, with naked interstice to 2 cm long; staminate portion to 0.5 cm long, densely congested, yellow; terminal appendix cylindrical, erect, purple, ca. 10 cm long, 2 mm diam., sessile and not swollen at base, with very strong odor. Flowering from the end of April to August.

Distribution. Known only from Jinping County, southeastern Yunnan, China, in wet fields and roadsides by streams, altitude 1000–1550 m.

Discussion. *Typhonium* is commonly accepted as comprising five sections as described by Sriboonma et al. (1994). This new species belongs to section *Typhonium.* From the shape of the leaf blade, this new species is easily differentiated from the other Chinese *Typhonium* species, except *T. blumei.* It is distinguished from *T. blumei* in having the spathe tube pale green, dark purple at the top (not entirely dark purple), the blade narrowly lanceolate (not broadly ovate), dark purple, spreading and arching, apex long acuminate but not twisted, clavate sterile rudiments, erect, and in its chromosome number, $2n = 10$.

Based on recent comprehensive reviews of the cytology of the Araceae (Grayum, 1990; Mayo et al., 1997; Petersen, 1989, 1994), the chromosome numbers vary greatly between and also within genera, from $2n = 14$ (*Ulearum*) to $2n = 168$ (*Arisaema*). The lowest diploid number so far known in Araceae is $2n = 14$, observed in *Ulearum sagittatum* Engler; based on our results, *Typhonium jinpingense* ($2n = 10$) has the lowest chromosome number known to occur in the family. The chromosomes were easy to group into five pairs (Fig. 2), so *Typhonium jinpingense* is a diploid species and the basic chromosome number is 5. Other species of *Typhonium* have chromosome numbers of: $2n = 16, 18, 20, 26, 36, 52, 54, 65, >100$ (Mayo at al., 1997), making it one of the most variable genera in this regard in Araceae.

Primary basic chromosome number is a main area of research in cytological studies. The discovery of the lowest diploid number in this study may spur further investigation of this aspect. Possibly the following questions will be proposed: Was it caused by extreme aneuploid reductions? Or is $2n = 10$ some kind of "ancestral number" only kept in *Typhonium*? We think the former is more likely. It is well known that very low chromosome numbers (as well as very high ones) are more common in advanced genera than in basal ones. Petersen (1994) postulated that very low chromosome numbers were explained as aneuploid reductions, from an ancestral number $x = 12$ or 14. Other authors proposed that there was an "original" series with $x = 5, 6, 7, 8$, and 9, and that all arose from 7 as they speculated the primary basic number as 7 (Jones, 1957; Larsen, 1969; Marchant, 1973). As stated by Mayo et al. (1997), reduction in diploid number occurs in various morphologically advanced genera. We agreed with this opinion: *Typhonium* is a much advanced genus in Araceae; such a low chromosome number was possibly reduced from a higher one. Other evidence came from our recent cytological studies in 9 *Typhonium* spe-

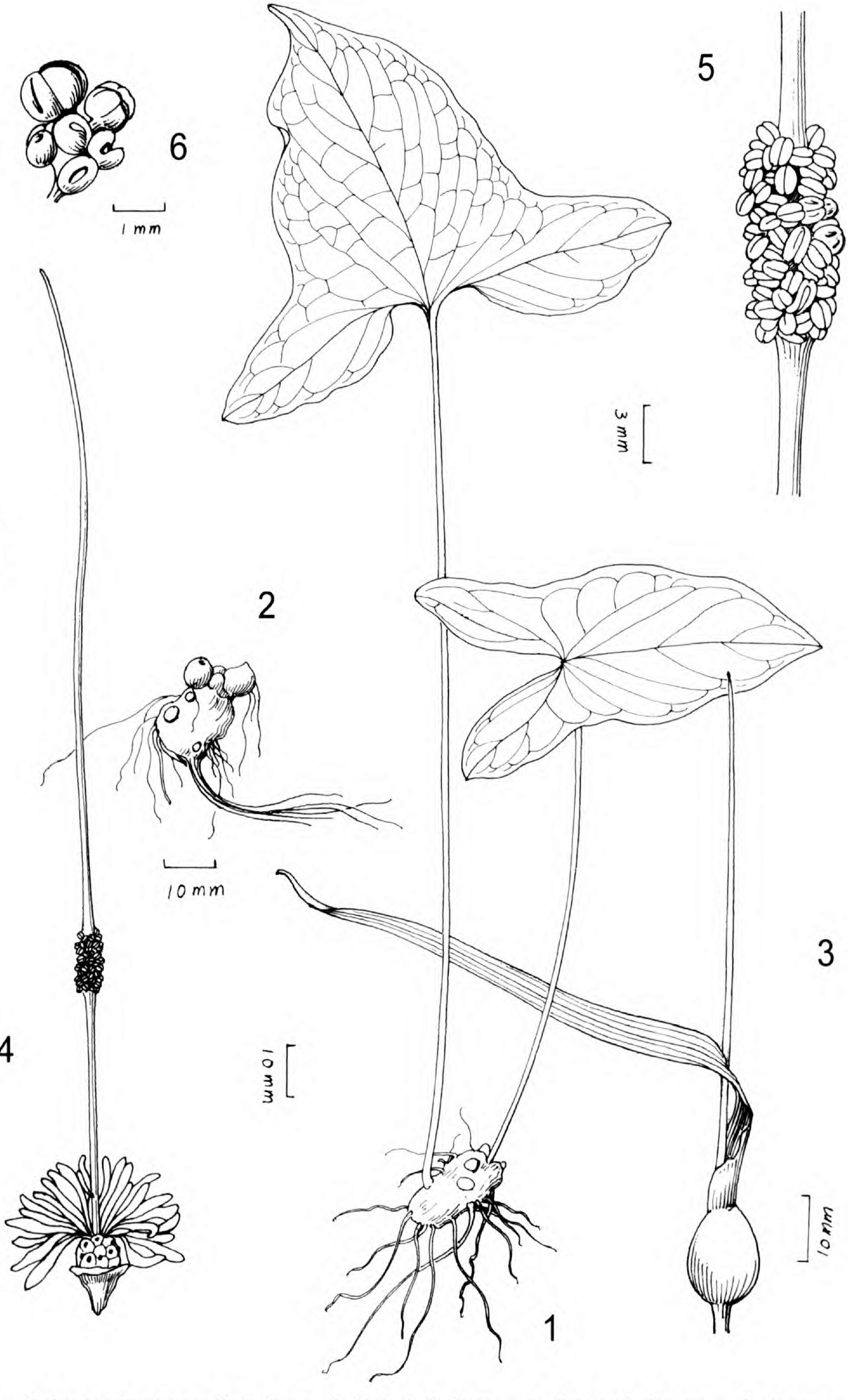

Figure 1. *Typhonium jinpingense* Z. L. Wang, H. Li & F. H. Bian. —1. Plant with rhizome. —2. Rhizome. —3. Spathe. —4. Spadix. —5. Male portion. —6. Male flower.

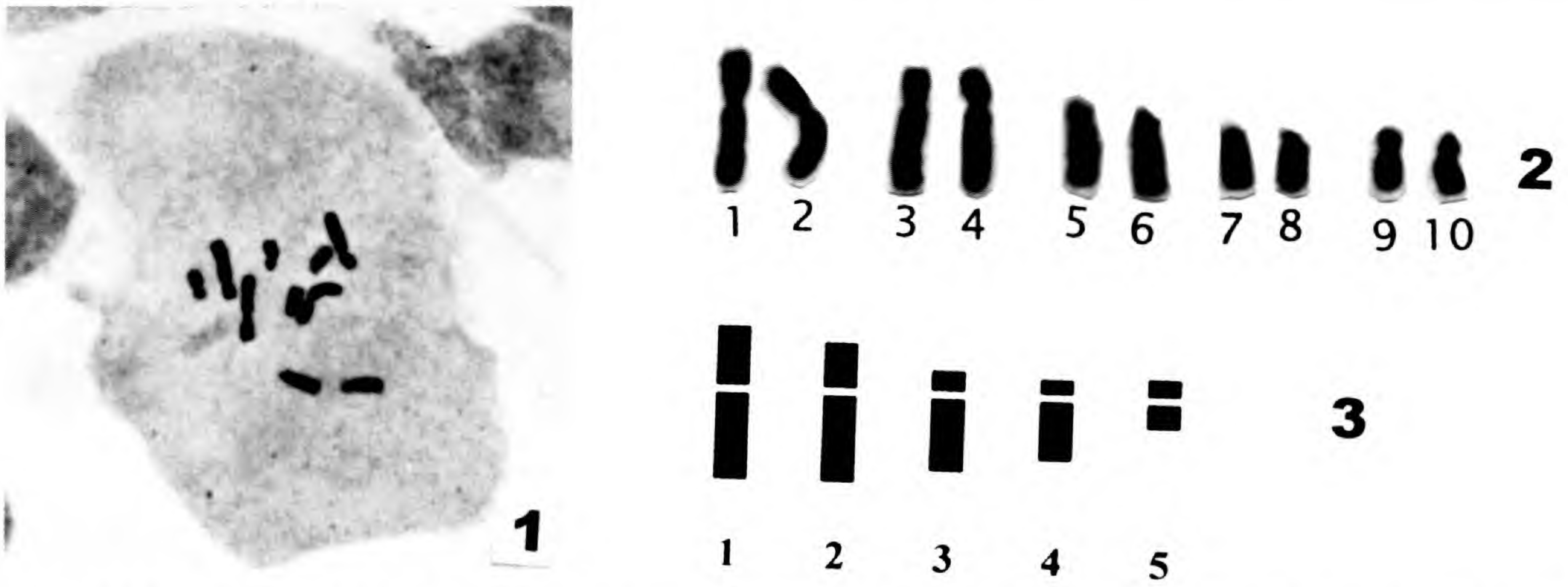

Figure 2. Cytological plates of *Typhonium jinpingense*. —1. Mitotic metaphase chromosomes in somatic cell. —2. Karyotype. —3. Idiogram.

cies. The chromosome number in somatic cells of these species is from 10 to 52, the karyotypical asymmetry for *T. giganteum* Engler belongs the 2A type, and 6 species, *T. calcicolum* C. Y. Wu, *T. kunmingense* H. Li, *T. blumei*, *T. trilobatum* (L.) Schott, *T. roxburghii* Schott, and *T. omeiense* H. Li, belong to the 2B type, while *T. jinpingense* and triploid *T. flagelliforme* (Loddiges) Blume, $2n = 3x = 24$, belong to the 3B type. It is commonly known that the more asymmetric the chromosome, the more advanced the species (Stebbins, 1971). The 3B type is more asymmetric than the 2A type and the 2B type. So, from the standpoint of karyotype, *T. jinpingense* and triploid *T. flagelliforme* may be considered to be the most advanced among the 9 *Typhonium* species studied.

Jinping County is an interesting place for the cytological study of *Typhonium*, as well as of the family Araceae. In addition to the new species with its low chromosome count, triploid *T. flagelliforme* $2n = 3x = 24$ was also found in this county, and the latter can easily be propagated by the stem, but is not yet found to bear fruits both in the wild and in the garden. The reason we chose the specific epithet is to emphasize the importance of this place.

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Three New Sections and a New Subgenus of *Phyllanthus* (Euphorbiaceae)

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ABSTRACT. Three new sections of *Phyllanthus* are described: section *Antipodanthus* (subg. *Isocladus*; type *P. dictyospermus* Müller Argoviensis), 15 species of South America and Australia; section *Pityrocladus* (subg. *Emblica*; type *P. symphoricarpoides* Kunth), 5 species of tropical America; and section *Hylaeanthus* (subg. *Conami*; type *P. attenuatus* Miquel), 6 species of tropical America. Two new species are described: *P. cuatrecasanus* (sect. *Pityrocladus*) and *P. callejasii* (sect. *Hylaeanthus*). A new subgenus with unique pollen structure, *Cyclanthera* (type *P. lindenianus* Baillon), is proposed; it includes sections *Callitrichoides* and *Cyclanthera*.

Key words: Euphorbiaceae, Neotropics, *Phyllanthus*.

Phyllanthus, with over 800 species, is the third largest genus of Euphorbiaceae (Govaerts et al., 2000). The remarkable diversity in growth form and floral morphology (Bancilhon, 1971; Nozeran et al., 1984), and especially in pollen (Punt, 1967, 1987), is reflected in its complex classification, with 10 subgenera and over 30 sections (Webster, 1956–1958, 1967). Although about 70% of the species of *Phyllanthus* are confined to the Old World, the 200-plus neotropical species have not received extensive study except for the treatments of Müller (1873) for Brazil, Jablonski (1967) for the Amazon basin, and Webster (1956–1958, 1999) for the West Indies and Venezuelan Guayana. During the course of a revision of the neotropical species, a considerable number of undescribed taxa have been detected. Because the names of three newly recognized sections and a new subgenus are being cited in a study of the pollen morphology of neotropical taxa (Webster & Carpenter, 2002), they are being published here in advance of the overall revision of the neotropical taxa.

Phyllanthus subg. **Isocladus** G. L. Webster

Phyllanthus sect. **Antipodanthus** G. L. Webster, sect. nov. TYPE: *Phyllanthus dictyospermus* Müller Argoviensis.

A sectione *Paraphyllantho* differt disco ♀ integro, pollinis grana grosse reticulata; ab aliis sectionibus subgenero *Isoclado* differt foliis spiraliter insertis.

Monoecious or dioecious shrubs or subshrubs, branching unspecialized, branches smooth or papillate; phyllotaxy spiral; leaves petiolate, stipules persistent; flowers pedicellate, in axillary glomerules; sepals 5 or 6, imbricate, entire; staminate disk of 5 or 6 segments; stamens 3, filaments free or connate; anthers vertically or horizontally dehiscent; pollen grains subglobose, 3- or 4-colporate, mostly coarsely reticulate; pistillate disk patelliform; ovary glabrous, 3-locular; styles ± free, bifid; fruits capsular, seeds smooth or verruculose.

About 15 species can be referred to *Phyllanthus* sect. *Antipodanthus*, which belongs to subgenus *Isocladus* by virtue of its unspecialized (non-phyllanthoid) branching. It appears to be the Southern Hemisphere vicariant of section *Paraphyllanthus* Müller Argoviensis. The two sections seem morphologically similar in many respects, but in section *Paraphyllanthus* the anthers are always vertically dehiscent and the pistillate disk dissected. Only 5 species have been described from South America, mostly Brazil; the others are native to Australia (species 19, 21, 25–27, 29–32, 35–37, and 39 in Bentham, 1873). A number of the Australian species have recently been treated by Hunter and Bruhl (1996, 2000). The Australian and South American species differ in some characters, the American species having mostly connate filaments and horizontally dehiscing stamens; it is conceivable that cladistic analysis may show that some of the Australian species should be referred to section *Lysiandra* (F. Mueller) G. L. Webster. The Australian species are therefore listed here but not treated in detail.

Australian species included: *Phyllanthus aridus* Bentham, *P. australis* J. D. Hooker, *P. calycinus* Labillardière, *P. carpentariae* Müller Argoviensis, *P. fuernrohrii* F. Mueller, *P. hirtellus* Müller Argoviensis, *P. maitlandianus* Diels, *P. oblanceolatus* J. T. Hunter & J. J. Bruhl, *P. scaber* Klotzsch, *P. similis* Müller Argoviensis, and *P. striaticaulis* J. T.

Hunter & J. J. Bruhl. It is possible that *P. erwinii* J. T. Hunter & J. J. Bruhl and *P. lacunarius* F. Mueller are also referable to *Phyllanthus* sect. *Antipodanthus.*

KEY TO THE AMERICAN SPECIES OF *PHYLLANTHUS* SECT. *ANTIPODANTHUS*

1a. Filaments connate; stems ± terete; stipules 1–6 mm long; seeds 2–2.7 mm long; monoecious or dioecious.
  2a. Stipules 3–6 mm long; stems smooth; leaves on main stems > 5 mm long; dioecious.
    3a. Leaves on main stems > 5 mm broad; seeds reticulate or irregularly verruculose . . . . 1. *P. dictyospermus*
    3b. Leaves on main stems < 5 mm broad; seeds foveolate-punctate . . . . 2. *P. pinifolius*
  2b. Stipules 1–2.5 mm long; stems smooth or papillose; leaves on main stems mostly < 5 mm long; monoecious or dioecious.
    4a. Dioecious; stems papillose; staminate flowers distinctly pedicellate (pedicel > 1 mm long); pistillate sepals 5; leaf blade margins strongly revolute, tip blunt with abruptly reflexed acumen . . . . 3. *P. ramillosus*
    4b. Monoecious; stems smooth; staminate flowers subsessile (pedicel < 1 mm long); pistillate sepals 5 or 6; leaf blade margins not revolute, apically tapering to a straight acumen . . . . . 4. *P. dawsonii*
1b. Filaments free; stems decurrent-angled from nodes; stipules 2 mm long or less; seeds 1.4–1.7 mm long; dioecious . . . . 5. *P. rosmarinifolius*

1. Phyllanthus dictyospermus Müller Argoviensis, DC. Prodr. 15(2): 394. 1866. TYPE: Brazil. Minas Gerais: *J. F. Widgren 1003* (holotype, G).

Phyllanthus regnellianus Müller Argoviensis, Fl. Brasil. 11(2): 58. 1873. TYPE: Brazil. Minas Gerais: Caldas, *A. F. Regnell II 48* (lectotype, designated here, S).

Montane scrublands, ca. 1000–1500 m, Brazil (Minas Gerais). *Phyllanthus regnellianus,* which was distinguished by Müller only on the basis of a questionable difference in seed sculpturing, shows no clear differences and is here reduced to synonymy.

2. Phyllanthus pinifolius Baillon, Adansonia I. 5: 353. 1865. TYPE: Brazil. Paraná: Curitiba, *A. St. Hilaire 1559o* [15590?] (holotype, P; isotype, K).

Scrublands, 1500–2800 m, Minas Gerais, Espírito Santo, and Paraná.

3. Phyllanthus ramillosus Müller Argoviensis, Linnaea 32: 36. 1863. TYPE: Brazil, Santa Catarina: *Herb. Franqueville* (syntype, G); "Brasilia meridionali," *F. Sellow* (syntype, B destroyed).

?*Phyllanthus cordobensis* (Kuntze) K. Schumann, Bot. Jahresber. 26(1): 350. 1898. *Diasperus cordobensis* Kuntze, Rev. Gen. Pl. 3(2): 285. 1898. TYPE: Argentina. Córdoba: San Roque, *O. Kuntze* (holotype, NY).

Since the Sellow syntype of *Phyllanthus ramillosus* was destroyed, the Herb. Franqueville specimen logically should become the lectotype; however, that specimen could not be located in the Prodromus Herbarium in Geneva. If the Herb. Franqueville specimen cannot be located, *St. Hilaire 1821* (P) could be designated as a neotype. It is also possible that a duplicate of Sellow may yet be discovered.

Woodlands and scrub, 15–2700 m, Bolivia, northern Argentina, and Brazil (Santa Catarina and Rio Grande do Sul). The status of *Phyllanthus cordobensis* remains uncertain; Kuntze's description is inadequate, and the single specimen is somewhat different from other collections of *P. ramillosus;* possibly it might be validated at subspecific status when better known.

4. Phyllanthus dawsonii Steyermark, Los Angeles Co. Mus. Contr. Sci. 21: 13. 1958. TYPE: Brazil. Goiás: Chapada dos Veadeiros, *E. Y. Dawson 14776* (holotype, R).

Cerrado and campos rupestres, 1250–1500 m, Goiás.

6. Phyllanthus rosmarinifolius Müller Argoviensis, Fl. Brasil. 11(2): 60. 1873. TYPE: Brazil. Rio de Janeiro: Serra dos Orgãos, *G. Gardner 5852* (holotype, G).

Recorded only from rocky slopes, 2000–2250 m, Rio de Janeiro, Brazil.

Phyllanthus subg. **Emblica** (Gaertner) Kurz

Phyllanthus sect. **Pityrocladus** G. L. Webster, sect. nov. TYPE: *Phyllanthus symphoricarpoides* Kunth.

A sectione *Emblica* differt sepalis plerumque 5, antheris muticis, stylis liberis non dilatatis; a sectione *Microglochidionis* differt foliis non glanduliferis, antheris muticis, pollinis grana 4- vel 5-colporatis non diporatis.

Monoecious (rarely dioecious) shrubs, often scandent; branches and branchlets ± scabridulous or papillate to hirtellous or scurfy; deciduous branchlets pinnatiform (not ramified), with ca. 10–50 leaves; leaf blades chartaceous, lacking a subapical laminar gland; stipules persistent; flowers pedicellate, in axillary unisexual or bisexual cymules; staminate sepals 5 or 6, subequal, free, imbricate; disk segments 5; stamens 2–5(–7), filaments connate (rarely free); anthers muticous, dehiscing horizontally or obliquely; pollen grains subprolate, 4- or 5-colporate, colpi monorate and unbordered, exine reticulate; pistillate sepals 5, imbricate; disk crateriform or dissected; ovary 3-locular; styles free, spreading, bifid to unlobed; fruits dehiscent or indehiscent; seeds smooth.

Phyllanthus sect. *Pityrocladus*, which is a neotropical representative of *Phyllanthus* subg. *Emblica* (Gaertner) Kurz, includes 6 described species (and at least 1 or 2 undescribed) mainly of South America, but with one species in Costa Rica. The 4–5-colporate reticulate pollen grains (Webster & Carpenter, 2002) suggest placement in subgenus *Emblica*, even though the shape of the grains is scarcely prolate. The section, named for the characteristic scabridulous or scurfy indumentum of the axes of some of the species, is similar to section *Microglochidion* (Müller Argoviensis) Müller Argoviensis in some pollen characters but differs in its tendency to a scandent habit, more or less scurfy indumentum, eglandular leaves, and less elongated pollen grains with fewer colpi.

KEY TO THE SPECIES OF *PHYLLANTHUS* SECT. *PITYROCLADUS*

1a. Leaves glabrous on both faces (at most scabridulous or papillate on petiole or midrib); veins distinctly prominulous on abaxial surface; branchlets 10–30 cm long, 0.8–1.8 mm thick; with 20–35 leaves; staminate pedicels 3–7 mm long; stamens 3–6; fruiting pedicels 2–4 mm long.
  2a. Monoecious; leaf blades elliptic, 1.5–2.5 cm long, apically rounded and apiculate; stamens (3)4–6; fruits indehiscent; styles unlobed or apically bifid; branchlets not distinctly winged . . . . . . 1. *P. symphoricarpoides*
  2b. Dioecious; leaf blades ovate-lanceolate, 3–6 cm long, acuminate; stamens 3; fruits dehiscent; styles bifid; branchlets narrowly winged . . . . 2. *P. sponiifolius*
1b. Leaf blades glabrous or hirsutulous adaxially; veins not prominulous abaxially (or if so, blades distinctly hirsutulous abaxially); branchlets 5–25 cm long, 0.4–1 mm thick, with 5–75 leaves; staminate pedicels 0.5–7.5 mm long; stamens 2 or 3; fruiting pedicels 1–4 mm long.
  3a. Leaf blades abaxially copiously hirsutulous, with prominent lateral veins; stamens 2; styles unlobed.
    4a. Monoecious; branchlets 0.6–0.9 mm thick, with 5–11 leaves; leaf blades 1.5–3.5 cm long; petioles 1–2 mm long; stipules 3–4.5 mm long . . . . 3. *P. popayanensis*
    4b. Dioecious; branchlets 0.4–0.6 mm thick, with 20–45 leaves; leaf blades 1–1.5 cm long; petioles ca. 0.5 mm long; stipules 1.5–2 mm long . . 4. *P. ruscifolius*
  3b. Leaf blades abaxially glabrous or minutely scabridulous, veins not prominulous; stamens 2 or 3.
    5a. Leaf blades elliptic, strongly inaequilateral at base, secondary veins straight, nearly perpendicular to midrib, abaxially separated from midrib; branchlets 0.4–0.7 mm thick; stipules 1–1.5 mm long; staminate disk segments discrete, flat . . . . 5. *P. cuatrecasanus*
    5b. Leaf blades oblong, not inaequilateral at base, secondary veins distant, curving, not abaxially separated from midrib; branchlets 0.7–1 mm thick; stipules 2–3.5 mm long; staminate disk segments massive, ± confluent . . . . . . 6. *P. valerii*

1. Phyllanthus symphoricarpoides Kunth, in Humboldt, Bonpland & Kunth, Nov. Gen. Sp. 2: 114. 1817. *Glochidion symphoricarpoides* (Kunth) Pax & K. Hoffmann, in Engler & Harms, Nat. Pflanzenfam. ed. 2, 19c: 58. 1931. TYPE: Ecuador. Loxa [Loja]: *Humboldt & Bonpland* (holotype, P; isotype, B).

Montane thickets, 1500–2750 m, Colombia to Peru.

2. Phyllanthus sponiifolius Müller Argoviensis, Linnaea 32: 25. 1863. TYPE: Ecuador. *L. Fraser* (holotype, G).

Montane thickets, 1000–2000 m, Colombia to Ecuador.

3. Phyllanthus popayanensis Pax, Bot. Jahrb. 26: 503. 1899. TYPE: Colombia. Popayán: Páramo de Guanacas, *F. C. Lehmann 4708* (holotype, B destroyed; lectotype, designated here, K).

Montane thickets, 2000–2800 m, Colombia (Cauca). The specimen at Kew is chosen as lectotype because no other specimens of *Lehmann 4708* have been found.

4. Phyllanthus ruscifolius Müller Argoviensis, DC. Prodr. 15(2): 358. 1866. TYPE: Colombia. Prov. Cauca: *J. J. Triana 3659* (holotype, P).

Montane thickets, 1900–2200 m, Colombia (Valle del Cauca).

5. Phyllanthus cuatrecasanus G. L. Webster, sp. nov. TYPE: Colombia. Caquetá: Quebrada del Río Hacha, 2100–2250 m, *J. Cuatrecasas 8533* (holotype, US). Figure 1.

Similis *Phyllanthi valerii,* differt foliis laevibus, dolabriformis, nervis lateralibus rectis; stipulis minoribus; segmentis disci tenuioribus.

Dioecious shrub; branchlets terete, copiously hirtellous, 8–14 cm long, 0.4–0.7 mm broad, with ca. 20–50 leaves; leaf blades glabrous, mostly 5–7 mm broad, elliptic, abruptly acute, ± inaequilateral at base, abaxially alveolate-reticulate, veins straight, these and reticulum of veinlets prominulous; stipules oblong, blunt, glabrous, 1–1.2 × 0.3–0.4 mm; staminate flowers 2–5 per axil on brachyblasts; pedicel 1.3–1.5 mm long; sepals 5, 1.3–1.6 × 0.8–1.4 mm; disk segments 5, elliptic, 0.2–0.25 mm broad; stamens 2, filaments completely connate into a column 0.5–0.6 mm high; anthers < 0.5 mm long, dehiscing obliquely; pistillate flowers unknown.

Known only from the type collection. The distinguished collector, José Cuatrecasas, described the perianth segments as "amarillentos con nérvios rojizos." The specimen of *Phyllanthus cuatrecasanus* superficially resembles small-leaved forms of *P. ruscifolius,* but differs sharply from that species (as well as *P. valerii*) in the glabrous, strongly inaequilateral apiculate leaf blades with curious glaucous-reticulate bands alternating with green lateral veins.

6. Phyllanthus valerii Standley, Field Mus. Publ. Bot. 18: 619. 1937. TYPE: Costa Rica. Heredia: Yerba Buena, NE of San Isidro de Heredia, 2000 m, *P. C. Standley & F. L. Valerio 49814* (holotype, F).

Montane forests, Costa Rica, 1200–2050 m; very similar plants have been collected in Bolivia.

Phyllanthus subg. **Conami** (Aublet) G. L. Webster

Phyllanthus sect. **Hylaeanthus** G. L. Webster, sect. nov. TYPE: *Phyllanthus attenuatus* Miquel.

A sectione *Nothoclema* differt ramulis pinnatiformibus (non bipinnatiformibus), fructibus baccatis; a sectione *Apolepis* differt filamentis connatis, disco ♀ integro.

Monoecious or dioecious trees or shrubs; branchlets pinnatiform, usually subtended by reduced leaves (but generally not by cataphylls); flowers in axillary unisexual or bisexual cymules borne on brachyblasts; sepals 6 (rarely 5), usually biseriate; disk of discrete segments or cupular; stamens 3, filaments free or connate; anthers muticous, dehiscing horizontally or obliquely; pollen grains globose, porate (lacking distinct colpi), exine pilate; pistillate sepals persistent in fruit; ovary 3–5-locular; styles free or connate, bifid to unlobed; fruits baccate; seeds smooth.

This new section of *Phyllanthus* subg. *Conami* (Aublet) G. L. Webster, named for the prevalent distribution of its species in lowland Amazonian forest (Hylaea), has escaped recognition partly because of its vegetative resemblance to species of two sections of *Phyllanthus* subg. *Xylophylla* (L.) Persoon: section *Brachycladus* G. L. Webster (Webster, 2001) and section *Elutanthos* Croizat (Croizat, 1943); this has led to confusion and failure to recognize the significance of the diagnostic characters. The resemblance of the globose pollen grains with pilate exine ornamentation to those of section *Nothoclema* G. L. Webster clearly supports placement of section *Hylaeanthus* in subgenus *Conami* (Webster & Carpenter, 2002).

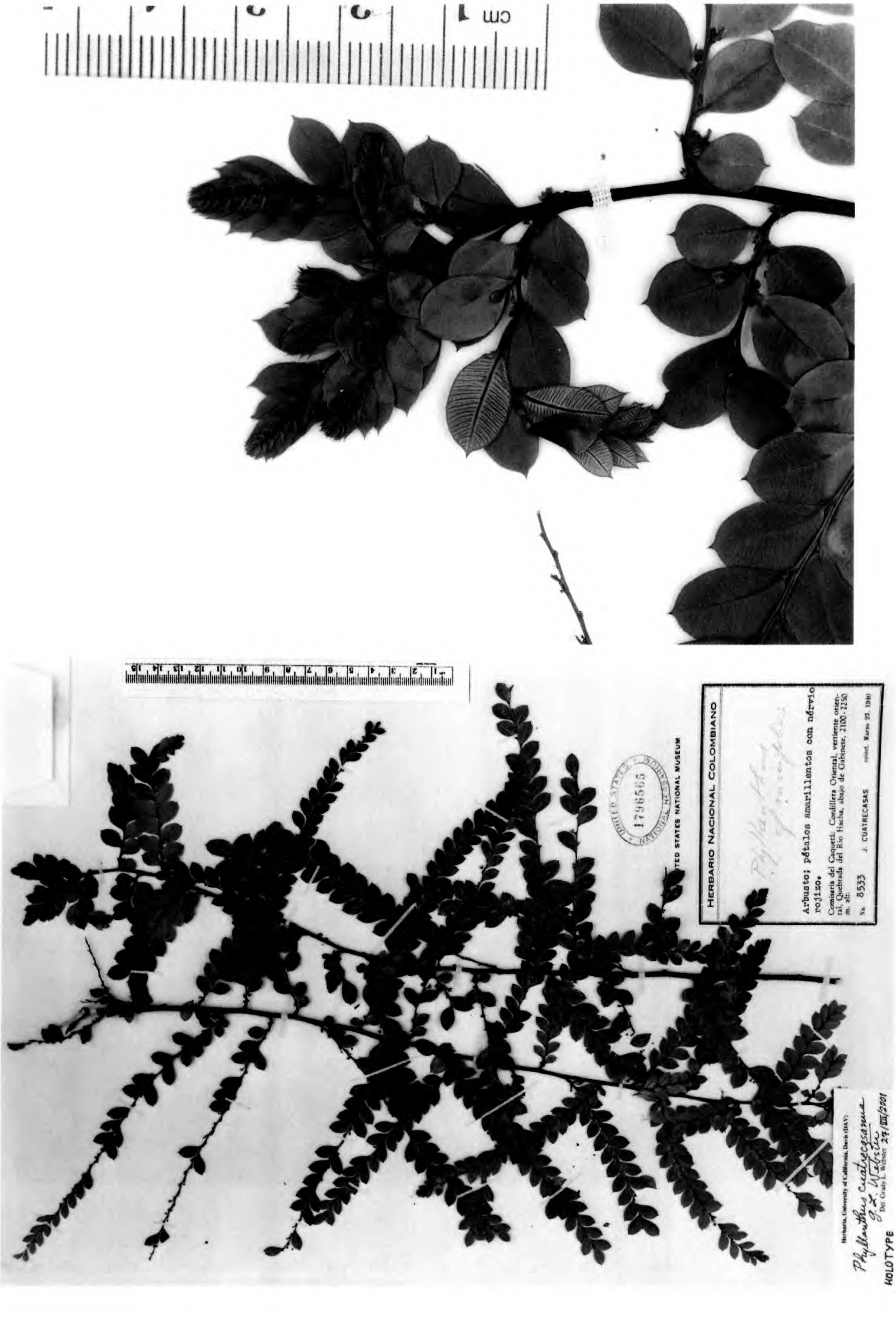
Müller (1866, 1873) created much of the confusion with regard to the new section *Hylaeanthus* when he mistakenly identified the type species, *Phyllanthus attenuatus* Miquel, with *P. aubletianus* Radcliffe-Smith (2001; name replacing *Meborea guianensis* Aublet). The affinities of Aublet's *Meborea* remain uncertain, but it seems possibly a species of section *Brachycladus.* At present, section *Hylaeanthus* includes 6 species, although additional species remain unpublished. It is biogeographically parallel to section *Pityrocladus* in its mainly South American distribution, but with one species in Costa Rica.

KEY TO THE SPECIES OF *PHYLLANTHUS* SECT. *HYLAEANTHUS*

1a. Ovary 3-locular; styles bifid; monoecious or dioecious.
2a. Leaves completely glabrous; dioecious.
  3a. Leaf blades lanceolate, abruptly acuminate; styles connate . . . . 1. *P. skutchii*
  3b. Leaf blades usually ovate or elliptic, blunt; styles free . . . . 2. *P. manausensis*
2b. Leaves hirtellous at least on petiole; monoecious or dioecious.
  4a. Fruiting pedicels 2–4 mm long; styles free, bifid or unlobed.
    5a. Dioecious; styles bifid; ♂ disk entire . . . . 3. *P. attenuatus*
    5b. Monoecious; styles unlobed; ♂ disk dissected . . . . 4. *P. bernardii*
  4b. Fruiting pedicels 6–7 mm long; styles connate, twice-bifid . . . . 5. *P. callejasii*
1b. Ovary 4–5-locular; styles unlobed; filaments connate; monoecious . . . . 6. *P. madeirensis*

1. Phyllanthus skutchii Standley, Publ. Field Mus. Nat. Hist., Bot. 22: 346. 1940. TYPE: Costa Rica. San José: El General, *A. Skutch 4375* (holotype, F).

Evergreen forests, 20–900 m, southern Costa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UNITED STATES NATIONAL MUSEUM
HERBARIO NACIONAL COLOMBIANO
Phyllanthus
Arbusto; pétalos amarillentos con nérvio rojizo.
Comisaría del Caquetá: Cordillera Oriental, vertiente oriental, Quebrada del Río Hacha, abajo de Gabinete, 2100-2250 m. alt.
No. 8533 J. CUATRECASAS colect. Marzo 23, 1940
Herbaria, University of California, Davis (DAV)
Phyllanthus cuatrecasanus G. L. Webster
Det. Grady L. Webster 27/III/2001
HOLOTYPE

Rica (Pacific slope); possibly occurring in Colombia.

2. Phyllanthus manausensis W. A. Rodrigues, Acta Amazonica 1: 17, fig. 1. 1971. TYPE: Brazil. Amazonas: Manaus, *W. A. Rodrigues 7520* (holotype, INPA 16822).

Lowland Amazonian rain forest, mostly on terra firme, 100–200 m, Brazil (Amazonas, Pará, Roraima, Amapá).

3. Phyllanthus attenuatus Miquel, Linnaea 21: 479. 1848. TYPE: Suriname. *F. W. R. Hostman & A. Kappler 305* (holotype, L; isotype, W).

Terra firme or occasionally inundated rain forest, 0–1000 m, Colombia, Venezuela, the Guayanas, Brazil, and Peru.

4. Phyllanthus bernardii Jablonski, Mem. New York Bot. Gard. 17: 112. 1967. TYPE: Venezuela. Mérida: Aricagua, *L. Bernardi 6258* (holotype, NY).

Andean forests, > 2000 m, western Venezuela (Mérida). The species deviates from others in *Phyllanthus* sect. *Hylaeanthus* in its character combination of monoecious flower production, winged pedicels, and small seeds (< 2 mm long). It has not yet been possible to examine the pollen, and it may prove not to belong to the section.

5. Phyllanthus callejasii G. L. Webster, sp. nov. TYPE (pistillate): Colombia. Antioquia: Mun. Frontino, Corr. La Blanquita, región de Murrí, Alto de Cuevas, 1850 m, 14 July 1988, *R. Callejas, A. L. Arbeláez, J. Betancur & I. D. Castaño 6864* (holotype, HUA 52926; isotype, DAV). Figure 2.

Ab aliis speciebus sectionis differt stylis connatis bis bifidis, sepalis fructiferis majoribus, ramulis crassioribus.

Dioecious tree 6–8 m high; branchlets terete, smooth (minutely papillate), 15–25 cm long, 1.5–2.5 mm thick, with 6–9 leaves; leaf blades ovate to elliptic, 7–12 cm long, 3.5–7 cm broad, glabrous except for the incised midrib adaxially and midrib and major lateral veins abaxially, veins 5–7 pairs, curving; veinlet reticulum prominulous beneath; petiole 5–7 × 1–1.5 mm, copiously scabrid-hirtellous; stipules blackish, triangular, 2–3 mm long. Flowers in axillary glomerules, the pistillate mostly 2–5 per axil; bracts and bractlets blackish, persistent. Staminate flowers seen only in bud; sepals 6; disk undivided; stamens 3, filaments connate, anthers dehiscing horizontally. Pistillate flowers with pedicel glabrous or sparsely and minutely hirtellous, 5.5–7 mm long in fruit; fruiting sepals (5)6, 3–3.8 mm long, 2–2.2 mm broad; disk patelliform, ca. 1.5 mm broad; ovary 3-locular; styles connate into a column ca. 1.5 × 0.7 mm; style branches 0.5–0.7 mm long, ± twice-bifid. Fruits baccate, 7–9 mm diam. (dried); seeds somewhat compressed, acute, truncate at base, 2.5–3 × 2–2.7 mm; testa smooth, brownish.

←

Figure 1. *Phyllanthus cuatrecasanus* G. L. Webster. —Left-hand photo. Type specimen (*Cuatrecasas 8533*, US). —Right-hand photo. Enlarged view of branch apex with deciduous branchlets.

Cloud forest, 1600–1850 m, Cordillera Occidental, Colombia. *Phyllanthus callejasii* is clearly related to *Phyllanthus attenuatus* Miquel by its bifid styles and dioecious flower production, but is easily distinguished by its larger leaf blades and longer petioles, thicker branchlet axes, and longer fruiting pedicels and sepals. It differs from the lowland *P. attenuatus* and *P. manausensis* in its upper montane cloud forest habitats. *Phyllanthus bernardii*, the only other upland species of *Phyllanthus* sect. *Hylaeanthus*, has hirtellous branchlet axes, winged pedicels, and smaller seeds.

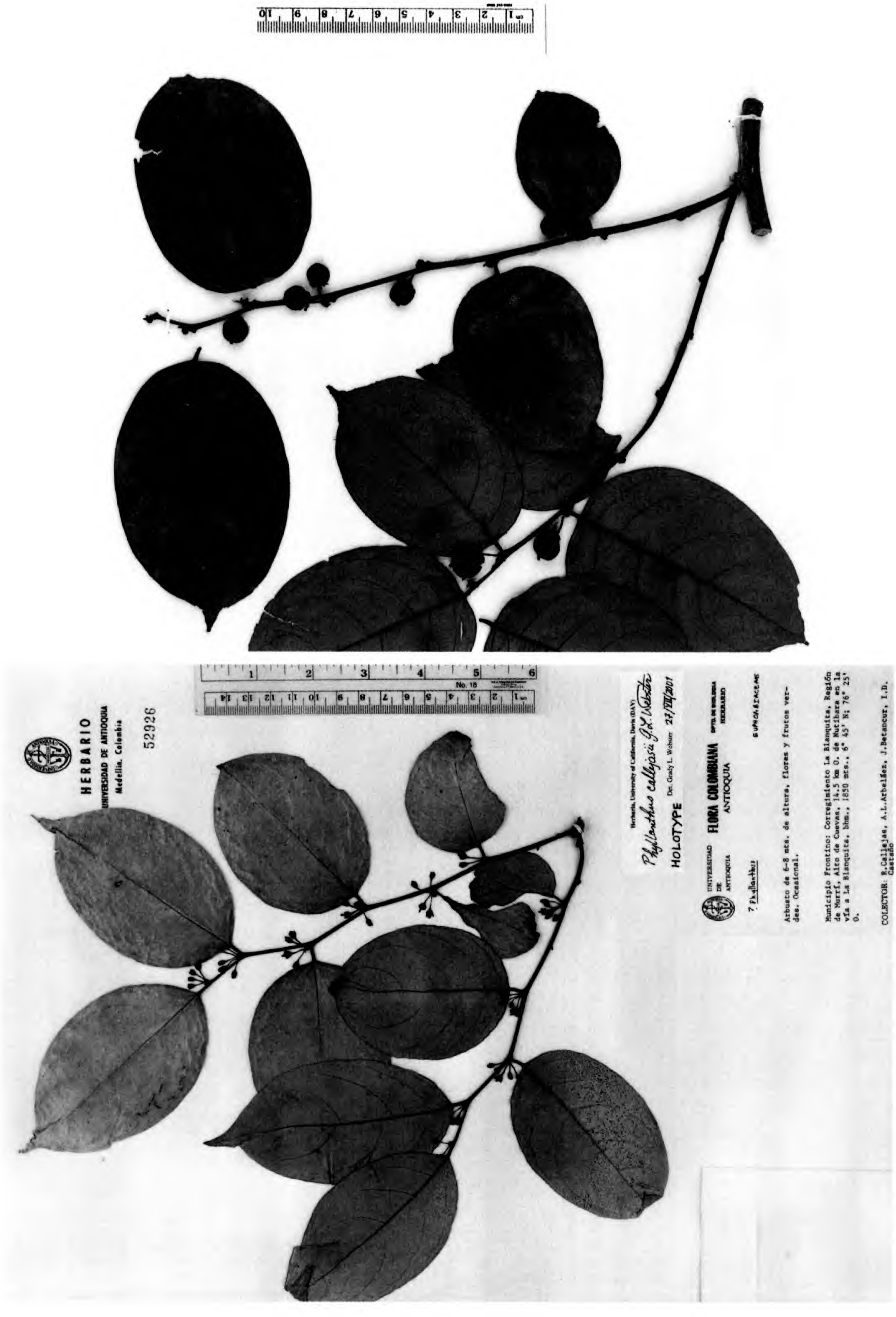
Additional collections. COLOMBIA. **Antioquia:** Mun. Frontino, Corr. Nutibara, zona de Murrí, 5–8 km S de Alto de Cuevas, 1000–1850 m, 14 Feb. 1991, *R. Callejas, F. J. Roldán & M. V. Arbeláez 9940* (staminate paratype: HUA 79857). **Nariño:** Mun. Piedraancha, Correg. Chucunez, Reserva La Planada, 1650–1800 m, 18 May 1991, *J. Betancur, S. Churchill & F. J. Roldán 2576* (HUA).

6. Phyllanthus madeirensis Croizat, Trop. Woods 78: 7. 1944. TYPE: Brazil. Amazonas: Mun. Humaitá, between Rio Livramento and Rio Ipixuna, *B. A. Krukoff 7163* (holotype, A; isotype, NY).

Amazonian rain forest, mostly on terra firme, ca. 200–300 m, Brazil (Amazonas, Pará). This species is sharply separated by a number of characters from the other species of the section, but the distinctive pollen sculpturing supports placement in *Phyllanthus* sect. *Hylaeanthus*.

Phyllanthus subg. **Cyclanthera** G. L. Webster, subg. nov. TYPE: *Phyllanthus lindenianus* Baillon.

Herbae monoicae, ramificatione more sectionis *Phyllanthi*; flores solitarii, axillares; sepala ♂ 5 vel 6; disci segmentis plerumque discretis; stamina 2 vel 3, connata; antherae discretae vel connatae, horizontaliter dehiscen-


HERBARIO
UNIVERSIDAD DE ANTIOQUIA
Medellín, Colombia
52926
Herbaria, University of California, Davis (DAV)
Phyllanthus callejasii G.L. Webster
Det. Grady L. Webster 27/VIII/2001
HOLOTYPE
UNIVERSIDAD DE ANTIOQUIA
FLORA COLOMBIANA
ANTIOQUIA
DPTO. DE BIOLOGIA HERBARIO
? Phyllanthus
EUPHORBIACEAE
Arbusto de 6-8 mts. de altura, flores y frutos verdes. Ocasional.
Municipio Frontino: Corregimiento La Blanquita, Región de Murrí, Alto de Cuevas, 14.5 km O. de Nutibara en la vía a La Blanquita, bhm., 1850 mts., 6° 45' N; 76° 25' O.
COLECTOR: R.Callejas, A.L.Arbeláez, J.Betancur, I.D. Castaño

tes; pollinis grana exinio clypeato; sepala ♀ 6; discus dissectus; ovarium 3-loculare; styli bifidi; fructus capsularis; semina scabridula vel verruculosa.

Monoecious annual or perennial herbs; branchlets pinnatiform or with one iterative lateral axis; flowers axillary, solitary; staminate sepals 5 or 6; disk dissected; stamens 2 or 3, filaments connate; anthers discrete or completely connate into a synandrium, dehiscing horizontally; pollen grains spheroidal, clypeate, the exine shields banded or circular; pistillate sepals 6; disk dissected, often purplish; ovary 3-locular, styles bifid; fruit capsular; seeds scabridulous or verruculose.

Phyllanthus subg. *Cyclanthera* includes two sections, section *Callitrichoides* G. L. Webster and section *Cyclanthera* G. L. Webster, both endemic to the Greater Antilles. When these sections were first treated (Webster, 1956–1958), they were included in subgenus *Phyllanthus*, but it was noted that they have extraordinary pollen grains somewhat comparable to the clypeate pollen grains (with exine shields) in subgenus *Xylophylla* (Halbritter & Hesse, 1995). Recent studies of pollen morphology (Webster & Carpenter, 2002) graphically indicate the divergence of the pollen grains in section *Cyclanthera* from all other taxa of *Phyllanthus*. It therefore seems necessary to remove these odd West Indian plants from subgenus *Phyllanthus* into a separate subgenus. The relationships of subgenus *Cyclanthera* still remain uncertain, although the distinctive pollen shows some resemblance to the pollen of subgenus *Emblica*.

Sect. 1. **Phyllanthus** sect. **Callitrichoides** G. L. Webster, Contr. Gray Herb. 176: 51. 1955. TYPE: *Phyllanthus carnosulus* Müller Argoviensis.

One species endemic to eastern Cuba; apparently related to *Phyllanthus tenuicaulis* Müller Argoviensis (in sect. *Cyclanthera*). This curious plant is vegetatively distinctive in its crisp-succulent leaves and stems rooting at the nodes. The pollen grains, in contrast to those of section *Cyclanthera*, have elongated exine shields (or perhaps could be interpreted as stephanocolporate). *Phyllanthus carnosulus* appears not to have been collected since it was found by Ekman over 70 years ago, so it is not certain whether it still survives.

←

Figure 2. *Phyllanthus callejasii* G. L. Webster. —Left-hand photo. Type specimen with pistillate flowers (*Callejas et al. 6864*, HUA). —Right-hand photo. Specimen with fruits (*Betancur et al. 2576*, HUA).

Sect. 2. **Phyllanthus** sect. **Cyclanthera** G. L. Webster, Contr. Gray Herb. 176: 47. 1955. TYPE: *Phyllanthus lindenianus* Baillon.

Phyllanthus sect. *Cyclanthera* includes four species (and some subspecies) of Hispaniola, two of which also occur in eastern Cuba (Webster, 1956–1958). The section is very isolated within *Phyllanthus* by its highly modified androecium with unique clypeate pollen grains (illustrated by Webster & Carpenter, 2002).

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Resurrection of Segregates of the Polyphyletic Genus *Zigadenus* s.l. (Liliales: Melanthiaceae) and Resulting New Combinations

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ABSTRACT. Reinstatement of segregate genera and the accompanying recombinations for species in the former polyphyletic *Zigadenus* complex allow for a revised, practical taxonomy that defines monophyletic groups and reflects phylogenetic relationships within tribe Melanthieae (Melanthiaceae). Nine new species combinations result from recircumscription of *Zigadenus* Michaux and *Stenanthium* (A. Gray) Kunth and from recognition of *Anticlea* Kunth and *Toxicoscordion* Rydberg. The genus *Stenanthella* Rydberg and the basionyms for *Stenanthium leimanthoides* (A. Gray) Zomlefer & Judd (*Amianthium leimanthoides* A. Gray) and *Anticlea sachalinensis* (F. Schmidt) Zomlefer & Judd (*Stenanthium sachalinense* F. Schmidt) are lectotypified.

Key words: *Amianthium*, Liliales, Melanthiaceae, *Stenanthium*, *Zigadenus*.

The Melanthiaceae sensu the Angiosperm Phylogeny Group (APG, 1998) comprise 11 to 16 genera (ca. 154–201+ spp.; Zomlefer et al., 2001) of predominately woodland and/or alpine perennial herbs occurring mainly in the temperate to arctic zones of the Northern Hemisphere (with one species of *Schoenocaulon* extending into South America). Of concern here are certain taxa of the tribe Melanthieae (Zomlefer et al., 2001): *Amianthium* (1 sp.), *Stenanthium* (3–5 spp.), and *Zigadenus* (19 spp.). The poorly defined genus *Stenanthium* s.l. has sometimes been divided into two genera: *Stenanthella* (2–4 spp.) and a monotypic *Stenanthium* (*S. gramineum*; see Rydberg, 1900; Gleason, 1952; Utech, 1987a, b). Taxonomists have divided *Zigadenus* into several segregate genera (summaries in Rydberg, 1903; Gates, 1918; Preece, 1956; Zomlefer, 1997). However, contemporary botanists have typically accepted only one segregate—a monotypic *Amianthium* (Utech, 1986)—with the remaining species maintained in *Zigadenus* s.l. (as in Walsh, 1940; Preece, 1956; Schwartz, 1994, 2002).

As part of a study on the tribe Melanthieae (Zomlefer et al., 2001), the circumscription of the *Zigadenus* complex was evaluated using parsimony analyses of ITS (nuclear ribosomal) and *trn*L-F (plastid) DNA sequence data. Based on the cladograms resulting from this study, *Stenanthium* is biphyletic (and embedded within *Zigadenus*), the traditional *Zigadenus* s.l. is polyphyletic, and *Amianthium* is a distinct entity only distantly related to the other *Zigadenus* species. The species of these genera form five strongly supported clades that correlate with geographical distribution, chromosome number, and certain morphological characters (Table 1). Therefore, we recognize five genera (some with novel circumscription): (1) *Amianthium* (monotypic: *A. muscitoxicum*), (2) *Anticlea* (including *Stenanthella*; ca. 11 spp.), (3) *Stenanthium* (*Stenanthium gramineum*, *Zigadenus densus*, and *Z. leimanthoides*), (4) *Toxicoscordion* (ca. 8 spp.), and (5) *Zigadenus* s. str. (monotypic: *Z. glaberrimus*).

The nomenclatural consequences of these results include reinstatement of two segregate taxa (*Anticlea* and *Toxicoscordion*), redefinition of *Zigadenus* and *Stenanthium*, and nine recombinations. For convenience, we include a key and concise treatment of all five genera, as well as a list of species (Table 2). Although a complete revision of these genera and an investigation of species-level issues are not the focus of this paper, some problematic species complexes are mentioned in the generic commentaries. Table 3 cross-indexes the combinations accepted in this paper with familiar *Zigaden-*

Table 1. Characters defining the five segregates of the *Zigadenus* complex. Modified from Zomlefer et al. (2001); chromosome numbers from numerous references cited in Zomlefer (1997). * = possible autapomorphies.

	Amianthium	*Anticlea*	*Stenanthium*	*Toxicoscordion*	*Zigadenus* s. str.
Species no.	1	ca. 11	2 or 3	ca. 8	1
Distribution	SE U.S. (Coastal Plain and mountains)	Asia; North America to Guatemala	SE U.S. (Coastal Plain and mountains)	Midwestern U.S. and western North America	SE U.S. (Coastal Plain)
Habitat	Acidic coniferous forests and bogs	Acidic and/or alpine coniferous forests, prairies, calcareous shores and fens	Acidic coniferous forests and bogs	Acidic and/or alpine coniferous forests, prairies, desert, chaparral, serpentine vegetation	Acidic coniferous forests and bogs
Base chromosome number (x)	8	8	10*	11*	26(?)* (unconfirmed; see discussion)
Rootstock	Broadly ovoid bulb	Narrowly ovoid bulb	Slender (cylindrical) bulb*	Ovoid bulb	Rhizome*
Tepal base	Obtuse and slightly tapered	Cuneate to gradually tapered	Cuneate to gradually tapered	Conspicuously clawed*	Slightly tapered
Gland(s) per tepal; shape	1, reduced/absent*	1; bilobed*	1; obscure (or absent)*	1; obovate*	2; ovate*
Ovary position	Partly inferior	½-inferior	Superior to ½-inferior	Superior	Superior
Other significant characters	Large seeds with sarcotesta* Unique alkaloids*				Unusual anatomical features*
Additional commentary	Historically considered closely related to (or included within) *Zigadenus* s.l.	Wide distribution Includes *Stenanthella* Rydberg	Includes *Oeanoros* Small, *Tracyanthus* Small *Zigadenus densus* and *Z. leimanthoides* perhaps conspecific	Includes the well-known poisonous *Zigadenus* spp. ("death camas")	Type species

Table 2. Segregate genera of the *Zigadenus* complex reflecting the clades supported by morphological and molecular data (Zomlefer et al., 2001). This list includes nine new combinations indicated here with an asterisk.

1. *Amianthium* A. Gray
   A. muscitoxicum (Walter) A. Gray
2. *Anticlea* Kunth
   A. elegans (Pursh) Rydberg
   **A. frigida* (Schlechtendal & Chamisso) Zomlefer & Judd
   **A. hintoniorum* (B. L. Turner) Zomlefer & Judd
   **A. mogollonensis* (W. J. Hess and Sivinski) Zomlefer & Judd
   **A. neglecta* (Espejo, A. R. López-Ferrari & Ceja) Zomlefer & Judd
   **A. occidentalis* (A. Gray) Zomlefer & Judd
   **A. sachalinensis* (F. Schmidt) Zomlefer & Judd
   A. sibirica (L.) Kunth
   A. vaginata Rydberg
   A. virescens (Kunth) Rydberg
   A. volcanica (Bentham) J. G. Baker
3. *Stenanthium* (A. Gray) Kunth
   S. gramineum (Ker Gawler) Morong
   **S. densum* (Desrousseaux) Zomlefer & Judd
   **S. leimanthoides* (A. Gray) Zomlefer & Judd
4. *Toxicoscordion* Rydberg
   T. brevibracteatus (M. E. Jones) R. R. Gates
   T. exaltatum (Eastwood) A. Heller
   **T. fontanum* (Eastwood) Zomlefer & Judd
   T. fremontii (Torrey) Rydberg
   T. micranthum (Eastwood) A. Heller
   T. nuttallii (A. Gray) Rydberg
   T. paniculatum (Nuttall) Rydberg
   T. venenosum (S. Watson) Rydberg
5. *Zigadenus* Michaux
   Z. glaberrimus Michaux

us and *Stenanthium* species names (in alphabetical order) used in current literature.

1. Amianthium A. Gray, Ann. Lyceum Nat. Hist. New York 4: 121. 1837, nom. cons. TYPE: *Amianthium muscitoxicum* (Walter) A. Gray, typ. cons. [basionym: *Melanthium muscaetoxicum* Walter].

Chrosperma Rafinesque, Neogenyton 3. 1825, nom. rej. TYPE: *Melanthium laetum* W. Aiton.

Endocles Salisbury, Gen. Pl. 51. 1866. TYPE: not designated.

Salient features. Ovoid bulb, obtuse (slightly narrowed but not clawed) tepal bases, reduced/absent tepal glands, partly inferior ovary, large seeds with a reddish to purple sarcotesta, distinctive alkaloids; base chromosome number $x = 8$.

Distribution. Southeastern United States (coastal plain and mountains) in acidic coniferous forests and bogs.

Beyond the lack of glands (Utech, 1986) and the distinctive seeds, this genus is characterized by amianthine, a unique alkaloid, and also jervine, a veratrum alkaloid, evidently not found in other species of the *Zigadenus* complex (Neuss, 1953; Kupchan et al., 1961). *Amianthium* has been considered closely related to *Zigadenus* s.l. (see Zomlefer, 1997); however, molecular data (Zomlefer & Perkins, 1999; Zomlefer et al., 2001) strongly support the separation of *Amianthium* as only distantly related to other *Zigadenus* species. As circumscribed here (and in most current literature), this genus comprises one species, *Amianthium muscitoxicum* (Walter) A. Gray. The preferred spelling "*muscitoxicum*" rather than "*muscaetoxicum*" for the specific epithet is supported by the ICBN (Greuter et al., 2000), Article 60, Recommendation 60G.

2. Anticlea Kunth, Enum. Pl. 4: 191. 1843. *Geiseleria* Kunth, Abh. Königl. Akad. Wiss. Berlin 3. 1842, nom. illeg., non *Geiseleria* Klotzsch 1843 (Euphorbiaceae). TYPE: *Anticlea sibirica* (L.) Kunth (lectotype, designated by Pfeiffer, 1873: 219).

Stenanthella Rydberg, Bull. Torrey Bot. Club 27: 530. 1900. Syn. nov. TYPE: *Stenanthella occidentalis* (A. Gray) Rydberg (lectotype, designated here).

Although Rydberg (1900) included two species in his new genus *Stenanthella*, *Stenanthella occidentalis* (A. Gray) Rydberg and *Stenanthella sachalinensis* (F. Schmidt) Rydberg, he based his description of *Stenanthella* on cited specimens of

Table 3. The species of the polyphyletic genera *Zigadenus* s.l. and *Stenanthium* s.l., typically employed in contemporary floras (e.g., Ahles, 1968; Hitchcock et al., 1969; Cronquist et al., 1977; Gleason & Cronquist, 1991; McNeal, 1993; Kartesz, 1994; Schwartz, 2002), are listed in alphabetical order with the recombination advocated in this paper (**boldface**), including nine new combinations. For completeness, the monotypic genus *Amianthium*, a segregate of the *Zigadenus* complex, is also included; its segregate status is supported by Zomlefer et al. (2001). Only three species (*Amianthium muscitoxicum*, *Stenanthium gramineum*, and *Zigadenus glaberrimus*) are retained in their traditional genera; *Amianthium* and *Zigadenus* are monospecific.

Amianthium muscitoxicum (Walter) A. Gray
Stenanthium frigidum (Schlechtendal & Chamisso) Kunth = ***Anticlea frigida*** (Schlechtendal & Chamisso) Zomlefer & Judd
Stenanthium gramineum (Ker Gawler) Morong
Stenanthium occidentale A. Gray = ***Anticlea occidentalis*** (A. Gray) Zomlefer & Judd
Stenanthium sachalinense F. Schmidt = ***Anticlea sachalinensis*** (F. Schmidt) Zomlefer & Judd
Zigadenus brevibracteatus (M. E. Jones) H. M. Hall = ***Toxicoscordion brevibracteatus*** (M. E. Jones) R. R. Gates
Zigadenus densus (Desrousseaux) Fernald = ***Stenanthium densum*** (Desrousseaux) Zomlefer & Judd
Zigadenus elegans Pursh = ***Anticlea elegans*** (Pursh) Rydberg
Zigadenus exaltatus Eastwood = ***Toxicoscordion exaltatum*** (Eastwood) A. Heller
Zigadenus fontanus Eastwood = ***Toxicoscordion fontanum*** (Eastwood) Zomlefer & Judd
Zigadenus fremontii (Torrey) Torrey ex S. Watson = ***Toxicoscordion fremontii*** (Torrey) Rydberg
Zigadenus glaberrimus Michaux
Zigadenus hintoniorum B. L. Turner = ***Anticlea hintoniorum*** (B. L. Turner) Zomlefer & Judd
Zigadenus leimanthoides (A. Gray) A. Gray = ***Stenanthium leimanthoides*** (A. Gray) Zomlefer & Judd
Zigadenus micranthus Eastwood = ***Toxicoscordion micranthum*** (Eastwood) A. Heller
Zigadenus mogollonensis W. J. Hess & Sivinski = ***Anticlea mogollonensis*** (W. J. Hess & Sivinski) Zomlefer & Judd
Zigadenus neglectus Espejo, A. R. López-Ferrari & Ceja = ***Anticlea neglecta*** (Espejo, A. R. López-Ferrari & Ceja) Zomlefer & Judd
Zigadenus nuttallii (A. Gray) S. Watson = ***Toxicoscordion nuttallii*** (A. Gray) Rydberg
Zigadenus paniculatus (Nuttall) S. Watson = ***Toxicoscordion paniculatum*** (Nuttall) Rydberg
Zigadenus sibiricus (L.) A. Gray = ***Anticlea sibirica*** (L.) Kunth
Zigadenus vaginatus (Rydberg) J. F. Macbride = ***Anticlea vaginata*** Rydberg
Zigadenus venenosus S. Watson = ***Toxicoscordion venenosum*** (S. Watson) Rydberg
Zigadenus virescens (Kunth) J. F. Macbride = ***Anticlea virescens*** (Kunth) Rydberg
Zigadenus volcanicus Bentham = ***Anticlea volcanica*** (Bentham) Baker

S. occidentalis. Therefore, we select this species as the lectotype.

Salient features. Narrowly ovoid bulb, cuneate to gradually narrowed (but not clawed) tepal bases, one bilobed gland per tepal, half-inferior ovary; base chromosome number $x = 8$.

Distribution. Asia, North America south to Guatemala in acidic and/or alpine coniferous forests, prairies, calcareous shores and fens.

The segregate genus *Anticlea* (Kunth, 1843; Rydberg, 1903) has been more recently considered as *Zigadenus* sect. *Anticlea* (Kunth) Bentham by Preece (1956) and Schwartz (2002). The one bilobed gland per tepal is an autapomorphy for this taxon. Resurrection of *Anticlea* involves six new combinations with species formerly placed in *Stenanthella* and *Zigadenus* s.l. (Table 2). *Stenanthella*, a *Stenanthium* segregate (Rydberg, 1900), shares little morphologically with *Stenanthium* s. str. but has the diagnostic features of *Anticlea*, including the distinctive nectaries and half-inferior ovary. In addition, *Stenanthella occidentalis* (*Stenanthium occidentale*) resolves in the *Anticlea* clade in the molecular study by Zomlefer et al. (2001).

Anticlea includes the only Asian species in the *Zigadenus* complex (*A. sibirica* and *A. sachalinensis*), the Guatemalan *A. volcanica*, and the widespread and variable North American species *A. elegans* and *A. virescens* and their segregates (*A. vaginata* and *A. hintoniorum*, *A. mogollonensis*, and *A. neglecta*, respectively). The latter are discussed in detail by Turner (1992), Hess and Sivinski (1995), and Frame et al. (1999). Further study of these taxa is needed to evaluate the current specific and infraspecific delimitations and to suggest biologically meaningful taxon circumscriptions. *Stenanthium rhombipetalum* (never formally transferred to *Stenanthella*) has been reduced in synonymy under *Anticlea occidentalis* by Utech (1987a). In addition, the North American *A. occidentalis* and the Asian *A. sachalinensis* may be conspecific (Kupchan et al., 1961), a situation that merits further study.

Anticlea frigida (Schlechtendal & Chamisso) Zomlefer & Judd, comb. nov. Basionym: *Veratrum frigidum* Schlechtendal & Chamisso, Linnaea 6: 46. 1831. *Zigadenus frigidus* (Schlechtendal & Chamisso) D. Don, Edinburgh New Philos. J. 13(26): 233. 1832. *Stenanthium frigidum* (Schlechtendal & Chamisso) Kunth, Enum. Pl. 4: 190. 1843. TYPE: Mexico. Veracruz: Mt. Orizaba, *F. Deppe & C. J. W. Schiede 983* (holotype, HAL; isotypes, HAL, MO).

Utech (1987b: 207) listed "fragment GH!" as a "type" specimen (category of type not specified). However, the handwritten notation on this fragment packet, "*Veratrum frigidum* Cham.! & Schlech." followed by "Schiede" lacks detail to positively identify it as *Deppe & Schiede 983.*

Anticlea hintoniorum (B. L. Turner) Zomlefer & Judd, comb. nov. Basionym: *Zigadenus hintoniorum* B. L. Turner, Phytologia 72: 378. 1992. TYPE: Mexico. Nuevo León: Mpio. Galeana, Cerro Potosí, *G. B. Hinton 17200* (holotype, TEX).

Anticlea mogollonensis (W. J. Hess & Sivinski) Zomlefer & Judd, comb. nov. Basionym: *Zigadenus mogollonensis* W. J. Hess & Sivinski, Sida 16: 390. 1995. TYPE: U.S.A. New Mexico: Catron Co., Mogollon Mts., Gila National Forest, *W. J. Hess 2212* (holotype, MOR; isotypes, NY; also ARIZ, NCU, NMC, OKLA, SMU, US not seen).

Anticlea neglecta (Espejo, A. R. López-Ferrari & Ceja) Zomlefer & Judd, comb. nov. Basionym: *Zigadenus neglectus* Espejo, A. R. López-Ferrari & Ceja, in D. M. Frame et al., Acta Bot. Mex. 48: 47. 1999. TYPE: Mexico. Guanajuato: Mpio. Xichú, Puerto del Manzanar, Sierra de Xichú, *E. Ventura & E. López 9560* (holotype, UAMIZ not seen; isotype, IEB.)

Anticlea occidentalis (A. Gray) Zomlefer & Judd, comb. nov. Basionym: *Stenanthium occidentale* A. Gray, Proc. Amer. Acad. Arts 8: 405. 1873. *Stenanthella occidentalis* (A. Gray) Rydberg, Bull. Torrey Bot. Club 27: 531. 1900. TYPE: Rocky Mountains, Palliser's British North American Exploratory Expedition, 1858, *E. Bourgeau s.n.* (lectotype, designated by Utech (1987a), GH; isolectotypes, NY; also B, K not seen).

Stenanthium rhombipetalum Suksdorf, Werdenda 1: 6. 1923. TYPE: U.S.A. Washington: Skamania Co., Cape Horn, *W. Suksdorf 10,466* (lectotype, designated by Utech (1987a), GH; isolectotypes, MO, NY; also DS, UC, WTU not seen).

Anticlea sachalinensis (F. Schmidt) Zomlefer & Judd, comb. nov. Basionym: *Stenanthium sachalinense* F. Schmidt, Reis. Amur-Land., Bot. 188. 1868. *Stenanthella sachalinensis* (F. Schmidt) Rydberg, Bull. Torrey Bot. Club 27: 530. 1900. TYPE: Russia. "Ins. Sachalin" [Sakhalin Island]: Ktausi, 11 July 1860, *F. Schmidt s.n.* (lectotype, designated here, LE; photograph of lectotype, GA).

In his protologue, Schmidt (1868: 188) cited four collections from different localities on Sakhalin Island in 1860: "Dui" (June, flowering), "Adngiwo" (July, flowers withered/fallen), "Ktausi" (11 July, immature fruit), and "Manue" (August, flowers withered/fallen). We have selected a specimen at LE, the principal depository of his collections (Stafleu & Cowan, 1985). Other probable isolectotypes (at GH, LE, and NY) have only "Ins. Sachalin, Exped Fr. Schmidt" on the labels.

3. Stenanthium (A. Gray) Kunth, Enum. Pl. 4: 189. 1843, nom. cons. *Veratrum* subg. *Stenanthium* A. Gray, Ann. Lyceum Nat. Hist. New York 4: 119. 1837. *Anepsa* Rafinesque, Fl. Tellur. 2: 31. 1836 [1837]. TYPE: *Stenanthium angustifolium* (Pursh) Kunth [basionym: *Veratrum angustifolium* Pursh].

Stenanthium gramineum (Ker Gawler) Morong is synonymous with, and has priority over, *S. angustifolium* (Pursh) Kunth. *Veratrum angustifolium*, described by Pursh (1814) and transferred to *Stenanthium* by Kunth (1843), is the same plant previously described by Gawler (1813), *Helonias graminea* Ker Gawler, subsequently transferred to *Stenanthium* by Morong (Britton et al., 1894). There is also some confusion in the literature concerning *Anepsa*. Rafinesque (1836) based *Anepsa* on four species—two transferred from *Veratrum* and *Stenanthium* (synonyms indicated by Rafinesque, 1836: 2: 31), as well as two others with unknown affinity (see Cowley et al., 2001): (1) *Anepsa carinata* Rafinesque [*Veratrum angustifolium* Pursh = *Stenanthium gramineum* (Ker Gawler) Morong; see Zomlefer, 1997]; (2) *Anepsa latifolia* Rafinesque (*Veratrum parviflorum* Michaux); (3) *Anepsa spicata* Rafinesque (species of unknown affinity); and (4) *Anepsa graminifolia* (species of unknown affinity). *Anepsa*, a genus of mixed elements, has consequently been considered a nomenclatural synonym of *Stenanthium* (Greuter et al., 2000) and of *Veratrum* (Cowley et al., 2001). However, when Rafinesque (1836: 4: 27) stated in a later part of the same work ". . . his [Gray's] *Stenanthium* S. G. [subgenus] of *Veratrum* is my G. [genus] *Anepsa*," he provided a nom. and stat. nov. for *Veratrum* subg. *Stenanthium*, and the type of this subgenus (*V. angustifolium*) is, therefore, the type of *Anepsa* (K. Gandhi, pers. comm.).

Tracyanthus Small, Fl. S.E. U.S. 250. 1903. Syn. nov. TYPE: *Tracyanthus angustifolius* (Michaux) Small.
Oceanoros Small, Fl. S.E. U.S. 252. 1903. Syn. nov. TYPE: *Oceanoros leimanthoides* (A. Gray) Small.

Salient features. Slender bulb, cuneate to gradually and slightly narrowed (but not clawed) tepal bases, 1 obscure (or lacking) gland per tepal, superior to half-inferior ovary; base chromosome number $x = 10$ (reported only for *S. gramineum*).

Distribution. Southeastern United States (coastal plain and mountains) in acidic coniferous forests and bogs.

Until the molecular investigation (Zomlefer et al., 2001), the relationship of *Stenanthium* s.l. to *Zigadenus* s.l. was unknown, although in phenetic analyses by Ambrose (1975, 1980) *S. gramineum* clustered with several *Zigadenus* species. The results of Zomlefer et al. (2001) strongly support a markedly different circumscription of the traditional *Stenanthium*: the type element, *Stenanthium gramineum*, forms a clade with *Zigadenus densus* and *Z. leimanthoides* (while the species of the *Stenanthium* segregate *Stenanthella* resolve with *Anticlea*). Autapomorphies for this expanded concept of *Stenanthium* are a slender (cylindrical) bulb, loss/reduction of the tepal glands, and possibly also a base chromosome number of $x = 10$ (reported only for *S. gramineum*; Miller, 1930; Satô, 1942).

Therefore, this new definition of *Stenanthium* necessitates the transfer of two former *Zigadenus* species, *Stenanthium densum* and *S. leimanthoides*. These taxa have been separated from the rest of the *Zigadenus* complex as segregate genera (*Oceanoros* and *Tracyanthus*; Small, 1903) and considered within *Zigadenus* as "section *Oceanoros*" (Preece, 1956; Schwartz, 2002). (As of this writing, this sectional name has not been validly published.) Traditionally, plant size and inflorescence type have been used to distinguish these two sympatric and closely related species: specimens of *Stenanthium leimanthoides* at FLAS, GA, GH, MO, and NY are strikingly much more robust plants with compound racemose inflorescences in comparison to the more delicate *S. densum* with unbranched racemes (W. Zomlefer, pers. obs.). However, field studies of intergrading populations by McDearman (1984) suggest that these two taxa are likely conspecific (summary in Zomlefer, 1997). Some authors have placed *S. leimanthoides* in synonymy with *S. densum* (M. MacRoberts, pers. comm.; Schwartz, 2002; Sorrie & Weakley, 2001); varietal status of *S. leimanthoides* has also been suggested (R. Wunderlin, pers. comm.). The status of *S. leimanthoides* merits additional systematic study, as well as determination of the chromosome number.

Stenanthium densum (Desrousseaux) Zomlefer & Judd, comb. nov. Basionym: *Melanthium densum* Desrousseaux, in Lamarck, Encycl. 4: 26. 1796 [1797]. *Zigadenus densus* (Desrousseaux) Fernald, Rhodora 42: 254. 1940. TYPE: U.S.A. Carolina: no date, *J. Fraser s.n.* (holotype, P-LA, microfiche 6207.654: III.3).

Helonias angustifolia Michaux, Fl. Bor.-Amer. 1: 212. 1803. *Amianthium angustifolium* (Michaux) A. Gray, Ann. Lyceum Nat. Hist. New York 4: 124. 1837. *Zigadenus angustifolius* (Michaux) S. Watson, Proc. Amer. Acad. Arts 14: 280. 1879. *Tracyanthus angustifolius* (Michaux) Small, Fl. S.E. U.S. 251. 1903. TYPE: U.S.A. "Basse Carolina" [South Carolina]: "in herbosis et fruticetis sylvarum humidis Carolinae inferioris," no date, *J. Fraser s.n.* (holotype, P-MICHX, microfiche 6211.48: I.2).

See Fernald (1940) for details about the types for both basionyms.

Stenanthium leimanthoides (A. Gray) Zomlefer & Judd, comb. nov. Basionym: *Amianthium leimanthoides* A. Gray, Ann. Lyceum Nat. Hist. New York 4: 125. 1837. *Zigadenus leimanthoides* (A. Gray) A. Gray, Manual (ed. 2) 476. 1856. *Oceanoros leimanthoides* (A. Gray) Small, Fl. S.E. U.S. 252, 1328. 1903. TYPE: U.S.A. New Jersey: Camden Co., "the other side of Haddington," 20 July 1837, *E. M. Durand s.n.* (lectotype, designated here, GH; isolectotype, NY).

Gray (1837) cited three collections in his protologue (see discussion of these paratypes in Walsh, 1940, and Preece, 1956). Preece (1956) chose the Durand specimen at GH as a "lectotype" in his unpublished dissertation, and we here follow his decision.

Paratypes. U.S.A. **North Carolina:** Burke Co., Table Mountain, 1835, *M. A. Curtis s.n.* (GH, NY). **Louisiana:** Orleans Co., New Orleans, 1834, [Dr.] *Ingalls s.n.* (NY).

4. **Toxicoscordion** Rydberg, Bull. Torrey Bot. Club 30: 272. 1903. TYPE: *Toxicoscordion intermedium* (Rydberg) Rydberg.

Chitonia Salisbury, Gen. Pl. 51. 1866, nom. illeg., non *Chitonia* D. Don 1823 (Melastomataceae).

Chitonia has often been cited as a synonym for *Zigadenus* s.l. (Walsh, 1940; Preece, 1956; Cowley et al., 2001). Baker (1880) adopted this name as the basis for erecting *Zigadenus* sect. *Chitonia* (Salisbury) Baker and included species of *Toxicoscordion* and *Stenanthium*. Salisbury (1866) did not mention any species in the protologue or in his discussion of the genus. No specimens are labeled *Chitonia* or *Zigadenus* among Salisbury's few remaining collections at BM (R. Vickery, pers. comm.), the repository of his collections (Stafleu & Cowan, 1985). Although the tepal glands are not mentioned, the description of the plant (Salisbury, 1866: 51) from the "west coast of North America" with "petals attenuated into a . . . claw" best agrees with the characteristics of *Toxicoscordion*.

Salient features. Ovoid bulb, conspicuously clawed tepal bases, 1 obovate gland per tepal, superior ovary; base chromosome number $x = 11$.

Distribution. Midwestern United States and western North America in acid and/or alpine coniferous forests, prairies, desert, chaparral, or serpentine vegetation.

Molecular and morphological data resolve *Toxicoscordion* as distinct from the rest of the *Zigadenus* complex (Zomlefer et al., 2001). In their unpublished dissertations, both Preece (1956) and Schwartz (1994) treated this taxon as *Zigadenus* sect. *Chitonia* (Salisbury) Baker (see also Schwartz, 2002). The resurrection of *Toxicoscordion* requires one new combination (*T. fontanum*), a species described within *Zigadenus* by Eastwood (1937), long after Rydberg (1903) had erected the segregate *Toxicoscordion* and had transferred the appropriate contemporary *Zigadenus* species (Table 2). Autapomorphies include conspicuously clawed tepals (especially the inner three), one obovate gland per tepal, and a base chromosome number of 11 (Zomlefer et al., 2001). A citation of $2n = 32$ for *T. nuttallii* (Fedorov, 1969; Moore, 1971, 1973), originally reported by Zakharieva and Makushenko (1969), is based on an undescribed and unvouchered plant then growing at the Munich Botanical Garden (original source not cited); this "*Zigadenus*" species was likely an *Anticlea* ($x = 8$).

The species of *Toxicoscordion* (Table 2), restricted to midwestern–western North America, include the well known poisonous "death camas" plants of the rangelands such as *T. nuttallii*, *T. paniculatum*, and *T. venenosum* (see Marsh et al., 1915, 1926). Further study is needed to determine appropriate specific and infraspecific limits within the variable *T. micranthum–T. fremontii* species complexes, as well as the overlapping *T. paniculatum–T. venenosum* complex. For example, in an isozyme study of these species (Schwartz, 1994), the monophyly of *T. paniculatum* is suspect because the five sampled populations were separated from each other in UPGMA cluster analyses and distance Wagner trees.

Toxicoscordion fontanum (Eastwood) Zomlefer & Judd, comb. nov. Basionym: *Zigadenus fontanus* Eastwood, Leafl. W. Bot. 2: 41. 1937. *Zigadenus micranthus* Eastwood var. *fontanus* (Eastwood) O. S. Walsh ex McNeal, Phytologia 73: 308. 1992. TYPE: U.S.A. California: Marin Co., Bootjack, Mt. Tamalpais, *J. T. Howell 12656* (holotype, CAS).

5. **Zigadenus** Michaux, Fl. Bor.-Amer. 1: 214, t. 22. 1803. TYPE: *Zigadenus glaberrimus* Michaux.

Salient features. Rhizome (no bulb), slightly (and more or less gradually) narrowed tepal bases, 2 ovate glands per tepal, superior ovary, unusual anatomical features; base chromosome number $x = 26$(?).

Distribution. Southeastern United States (coastal plain) in acidic coniferous forests and bogs.

Zigadenus, as defined here, comprises only *Zigadenus glaberrimus* (the type and the only species in the protologue), a circumscription advocated historically by several botanists (e.g., Rydberg, 1903; Small, 1903, 1933; Gates, 1918). Molecular data (Zomlefer & Perkins, 1999; Zomlefer et al., 2001) confirm a monospecific circumscription of *Zigadenus* and its divergent and isolated position as the sister taxon of the remaining members of the tribe Melanthieae. Autapomorphies of this distinctive taxon (discussed in Zomlefer, 1997) include an unusual chromosome number ($n = 26$, tentatively reported by Preece, 1956), a rhizome lacking a bulb, two ovate glands per tepal, and several anatomical features (foliar stomata with two aperture lips, distinct root exodermis, bracteolate pedicels, and dense tannin-like inclusions; Ambrose, 1975).

The original spelling of the genus has priority over the orthographic variant "*Zygadenus*" (from Endlicher, 1836), commonly used in herbaria and some older floras (e.g., Small, 1903, 1933; Gleason, 1952). *Cyanotris* Rafinesque, nom. rej. against *Camassia* Lindley (Agavaceae), is miscited as a synonym of *Zigadenus* in Preece (1956).

TAXA INCERTAE SEDIS

Monadenus R. A. Salisbury, Gen. Pl. 51. 1866.

This taxon is often cited as a synonym of *Zigadenus* s.l. (e.g., Walsh, 1940; Preece, 1956; Cowley et al., 2001), and therefore is presumably a synonym for one of the genera in this paper. Salisbury (1866) did not, however, mention any species or make any species combinations. No specimens are labeled *Monadenus* or *Zigadenus* among Salisbury's few remaining collections at BM (R. Vickery, pers. comm.), the repository of his collections (Stafleu & Cowan, 1985). The description of the plant (from somewhere in America and cultivated at a nursery in England) is ambiguous: the partly inferior ovary may indicate placement in *Anticlea* (rather than other segregates of *Zigadenus*), but each tepal has "one melliferous semi-circular cavity" at the base (Salisbury, 1866: 52) and not the characteristic conspicuous bilobed gland of *Anticlea*. Another possibility is *Stenanthium gramineum*, characterized by a large paniculate inflorescence with "fine slender branches" (as Salisbury mentioned) and a partly inferior ovary—but this species lacks any glandular tissue or cavities on the tepals. Therefore, the description of *Monadenus* cannot be matched with certainty to any species or segregate of the *Zigadenus* assemblage.

Gomphostylis Rafinesque, Fl. Tellur. 2: 30. 1836 [1837].

This taxon has been associated with elements in the *Zigadenus* complex (Walsh, 1940; Zimmerman, 1958; Cowley, 2001), considered here in *Anticlea*, *Toxicoscordion*, and *Zigadenus* s. str. Rafinesque (1836: 30) based *Gomphostylis* on three mixed elements, two of them indicated as ambiguously placed with a "?": *G. bracteata* Rafinesque [= "*Helonias bracteata* Brereton mpt."], "*Gomphostylis? paniculata*" Rafinesque [= *Toxicoscordion paniculatum* (Nuttall) Rydberg], and "*Gomphostylis?* or *Z. fuscatus*" Rafinesque [an unidentified name; see Preece, 1956]. The "?" notation for the two latter species indicates that Rafinesque was unsure of their placement in *Gomphostylis*, and therefore, *G. bracteata* (which lacks a "?") would be the type of the genus (K. Gandhi, pers. comm.). However, the identity of this species is unclear. The short and vague description for this Virginian plant is not sufficient to distinguish the species. Three species of the *Zigadenus* complex occur in Virginia: *Anticlea elegans* (Pursh) Rydberg, *Stenanthium leimanthoides* (A. Gray) Zomlefer & Judd, and *Zigadenus glaberrimus* Michaux; all lack the spicate inflorescence described by Rafinesque (racemose panicles in *Anticlea elegans* and *Stenanthium leimanthoides*, and spreading paniculate inflorescences in *Z. glaberrimus*). *Helonias bracteata* Sims is *Zigadenus glaberrimus* (rhizome with no bulb, two glands per tepal; see Sims, 1815), and Preece (1956) included "*G. bracteata* Raf." [properly *G. bracteata* (Sims) Rafinesque, since cited in synonymy with Sims's name] as a synonym for *Z. glaberrimus*. However, "*Helonias bracteata* Brereton mpt." cited by Rafinesque is a manuscript name with no nomenclatural standing. Therefore, the name *Gomphostylis* cannot be applied with certainty to any known taxon.

The following key utilizes field characters and institutes a new taxonomy of the former *Zigadenus* complex.

KEY TO SEGREGATE GENERA OF THE FORMER *ZIGADENUS* COMPLEX

1a. Plants with rhizome (lacking bulb), 2 conspicuous glands per tepal . . . . *Zigadenus* Michaux
1b. Plants with bulb, 1 gland per tepal or nectaries obscure or absent.
  2a. Tepal glands obscure to absent.
    3a. Bulb ovoid, ovary superior, seeds with red to purple sarcotesta . . . . *Amianthium* A. Gray
    3b. Bulb slender (cylindrical), ovary superior to half-inferior, seeds brown and lacking sarcotesta . . . . *Stenanthium* (A. Gray) Kunth
  2b. Tepal glands conspicuous.
    4a. Tepals conspicuously clawed, tepal glands obovate, ovary superior . . . . *Toxicoscordion* Rydberg
    4b. Tepals cuneate to gradually narrowed at base (not clawed), tepal glands bilobed, ovary half-inferior . . . . . . *Anticlea* Kunth

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New Species of *Alyssum*, *Aphragmus*, *Arabis*, and *Sinosophiopsis* (Brassicaceae) from China and India

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ABSTRACT. The new species *Alyssum klimesii* and *Aphragmus ladakiana* from Ladak (northwestern India), *Arabis setosifolia* from Xizang (China), and *Sinosophiopsis furcata* from Sichuan (China) are described, and their relationships to the most closely related species of their respective genera are discussed.

Key words: *Alyssum*, *Aphragmus*, *Arabis*, Brassicaceae, China, India, *Sinosophiopsis*.

The following four new species are based on material collected from Ladak (India) by Leos Klimeš (Institute of Botany, Section of Plant Ecology, Třeboň, Czech Republic) and on Chinese herbarium specimens at KUN examined during my visit in August 2001. The paper represents part of the author's ongoing research on the Brassicaceae of the Himalayan flora.

Alyssum klimesii Al-Shehbaz, sp. nov. TYPE: NW India. Ladak: Rupshu, Lapgo River Valley, 5600 m, 32°59′N, 78°28′E, 12–13 July 2000, *Leos Klimeš s.n.* (holotype, MO #5317019).

Herba perennis, subpulvinata, tomentosa, canescens, pilis subdendriticis, longe stipitatis. Folia dense rosulata, persistentia, carnosa, sessilia, obovata vel spathulata, 3–10 × 1–2 mm, dense tomentosa. Racemi 2–4-flori, ebracteati. Petala rosea vel alba cum unguibus roseis, spathulata, 2–3 × 0.8–1 mm. Ovula 4, subapiculata. Siliculae ovoideae, inflatae, dense tomentosae, 2–3 × 1.5–2 mm, apice acuto-acuminatae; stylus 0.5–0.8 mm longus. Semina oblonga, 1.2–1.5 × 0.4–0.5 mm.

Herbs perennial, somewhat pulvinate, 1–3 cm tall, silvery canescent and tomentose throughout; trichomes long-stalked, subdendritic, with finely branched rays. Stems much abbreviated, distinct and leafless sometimes in infructescence, terminating caudex branches. Leaves grouped in compact rosettes, persistent, fleshy, sessile; leaf blade obovate to spatulate, 3–10 × 1–2 mm, uniformly densely tomentose on both surfaces, base attenuate, apex obtuse. Raceme 2–4-flowered; peduncle distinct and fruits borne to 1 cm above leaf rosette, sometimes obsolete and fruits hardly exserted above rosette. Fruiting pedicels ascending, 0.5–2 mm long, slender, densely tomentose all around. Sepals oblong, 1.5–2 × 1–1.5 mm, persistent, stellate. Petals pink throughout or white with pink claws, spatulate, 2–3 × 0.8–1 mm, glabrous outside, caducous, apex rounded; claw pink, not papillate at base. Filaments 1.5–2 mm long, dilated and glabrous at base, neither winged nor appendaged; anthers ovate, 0.2–0.4 mm long. Ovules 4 per ovary, subapical, pendulous on long funicles. Fruit ovoid, 2–3 × 1.5–2 mm; valves not veined, inflated, densely tomentose outside, glabrous inside, base rounded, apex acute-acuminate; style 0.5–0.8 mm long, slender, glabrous, pink, exserted. Seeds oblong, 1.2–1.5 × 0.4–0.5 mm; cotyledons obliquely accumbent.

Alyssum klimesii is named in honor of Leos Klimeš, collector of the holotype who is conducting ecological studies in the alpine areas of Ladak (India). The species is most closely related to *A. canescens* DC. of China, Kashmir, Kazakstan, Mongolia, and Russia (Cheo et al., 2001). They resemble each other in being pulvinate, canescent

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perennials and in having fleshy leaves and similar flower, fruit, and seed size. *Alyssum klimesii* is easily distinguished by having long-stalked subdendritic trichomes, fruiting pedicels 0.5–2 mm long, persistent sepals, spatulate petals 0.8–1 mm wide, glabrous bases of petal claws and staminal filaments, and inflated, ovoid fruits. By contrast, *A. canescens* has subsessile or short-stalked stellate trichomes, fruiting pedicels (3–)4–7 mm long, deciduous sepals, obovate petals 1.5–2.5(–3) mm wide, papillate bases of claws and filaments, and slightly flattened fruits.

In the Chinese paratypes listed below, the petals have white blades and pinkish claws much like those of *A. canescens*. However, in the collections from Ladak the petals are pink throughout. Because of the limited number of collections examined, it is not possible to determine whether or not such a difference merits taxonomic recognition.

Because of its pulvinate habit, canescent, densely tomentose leaves, and few-seeded ovoid fruits, one might confuse *Alyssum klimesii* with some species of *Draba*. However, none of the Himalayan species of *Draba* has ovaries with 4 subapical ovules pendulous on long funicles, pink petals or petal claws, and fruit valves as densely tomentose as the rest of the plant, whereas many species of *Alyssum* have the very same combination of characters.

Paratypes. CHINA. **Xizang (Tibet):** Zhongba Xian, Longgeqi, *Qinghai-Tibet Team 6591* (KUN, PE). NW INDIA. **Ladak:** Rupshu, ca. 5800 m, 33°10′N, 78°12.5′E, 9 July 2000, *Leos Klimeš s.n.* (MO); Rupshu, Kamdar La, 5700 m, 33°10.5′N, 78°14′E, 9 July 2000, *Leos Klimeš s.n.* (MO); Rupshu, ca. 5900 m, 32°59′N, 78°29.5′E, 14 July 2000, *Leos Klimeš s.n.* (MO).

Aphragmus ladakiana Al-Shehbaz, sp. nov. TYPE: NW India. Ladak: Rupshu, Parang Valley, 4860 m, 32°30′N, 78°06′E, 25 July 2000, *Leos Klimeš s.n.* (holotype, MO # 5317023).

Herba perennis, 1–3 cm alta, puberula, pilis simplicibus usque 0.5 mm longis. Folia basalia rosulata, subcarnosa, oblanceolata, 5–12 × 1.5–2 mm, integra, retrorse puberula. Racemi 3–6-flori, corymbosi, ebracteati. Petala alba, late spathulata, 2.5–3 × 0.7–0.9 mm. Ovula 28–32. Siliquae lineares, teretes, 15–17 × 1–1.2 mm, laeves; gynophorum 0.2–0.7 mm longum; stylus 0.5–0.8 mm longus; septum longitudinaliter secedens. Semina oblonga, uniseriata, 0.6–0.8 × 0.3–0.4 mm.

Herbs perennial, 1–3 cm tall; caudex few-branched. Stems erect, simple, puberulent with simple trichomes to 0.5 mm long. Basal leaves rosulate, subfleshy; petiole-like base not expanded; leaf blade oblanceolate, 5–12 × 1.5–2 mm, retrorsely puberulent, base attenuate, margin entire, apex obtuse. Cauline leaves absent. Racemes 3–6-flowered, corymbose, ebracteate, slightly elongated in fruit. Fruiting pedicels ascending, 2–3 mm long, puberulent all around. Sepals 1.5–2 × ca. 0.6 mm, puberulent. Petals white, broadly spatulate, 2.5–3 × 0.7–0.9 mm, apex rounded. Filaments 1–1.5 mm long; anthers oblong, ca. 0.5 mm long. Ovules 28 to 32 per locule. Fruit linear, 15–17 × 1–1.2 mm, terete, smooth; valves distinctly veined along proximal half, glabrous; gynophore 0.2–0.7 mm long; septum split longitudinally, hyaline; style 0.5–0.8 mm long; stigma entire. Seeds yellow-brown, oblong, uniseriate, 0.6–0.8 × 0.3–0.4 mm. Cotyledons incumbent.

Aphragmus ladakiana is closely related to *A. obscurus* (Dunn) O. E. Schulz, a species restricted to Sonamarg, Kashmir (Al-Shehbaz, 2000a). From that species, *A. ladakiana* is easily distinguished by having a distinct caudex, leafless stems, smooth fruits, hyaline septum split longitudinally, 28- to 32-ovuled ovaries, ebracteate racemes, fruiting pedicels puberulent all around, and smaller seeds 0.6–0.8 × 0.3–0.4 mm. *Aphragmus obscurus* has slender rhizomes, leafy stems, torulose fruits, no septum, 5- to 10-ovuled ovaries, fully bracteate racemes, adaxially puberulent and abaxially glabrous fruiting pedicels, and seeds 1.2–1.5 × 0.7–0.8 mm. With the discovery of *A. ladakiana*, *Aphragmus* now includes six species, the previous five of which are dealt with by Al-Shehbaz (2000a).

Paratype. NW INDIA. **Ladak:** Rupshu, ca. 5800 m, 32°43′N, 77°55.5′E, 31 July 2000, *Leos Klimeš s.n.* (MO).

Arabis setosifolia Al-Shehbaz, sp. nov. TYPE: China. Tibet (Xizang): Chaya Xian, Jitang, rocky roadside, 3700 m, 13 July 1976, *Qinghai-Tibet Team 12388* (holotype, KUN; isotype, KUN). Figure 1.

Herba perennis scaposa, 4–7 cm alta. Caules, pedicelli et sepala puberula, pilis furcatis brevi-stipitatis, 0.1–0.4 mm longis. Folia basalia rosulata, oblanceolata, 2–3.5 cm × 3–6.5 mm, pilis simplicibus setosis usque 1.5 mm longis. Folia caulina carentia vel unum. Racemi ebracteati. Sepala 2.5–3 mm longa. Petala rosea, oblanceolata, 5–6 × 2–2.5 mm. Ovula 11–14. Siliquae lineares, compressae, 1.8–2.3 cm × 1–1.2 mm, glabrae; stylus usque 0.3 mm longus. Semina oblonga 1.3–1.5 × ca. 0.7 mm, uniseriata.

Scapose perennial herbs 4–7 cm tall, without leaf remains of previous years. Trichomes on stems, pedicels, and sepals short-stalked, forked, 0.1–0.4 mm long. Stems erect, puberulent. Basal leaves rosulate, oblanceolate, 2–3.5 cm × 3–6.5 mm, setose with simple trichomes to 1.5 mm long, base attenuate, margin entire, apex obtuse. Cauline leaf 1 or

Figure 1. *Arabis setosifolia* Al-Shehbaz. —A. Plant. —B. Portion of leaf margin with setose trichomes. —C. Trichomes of stems and pedicels. —D. Petal. —E. Fruit and fruiting pedicel. Scale: A = 1 cm; B, E = 5 mm; C = 0.2 mm; D = 1 mm. Drawn by Al-Shehbaz: A–D from the holotype, *Qinghai-Tibet Team 12388* (KUN); F from the paratype, *Yan Jinsheng 91-492* (KUN).

absent, oblong, sessile, not auriculate, 7–13 × 1–2 mm. Raceme ebracteate. Fruiting pedicels 3.5–7 mm long, ascending, densely puberulent, straight or curved upward. Sepals oblong, 2.5–3 × ca. 1.5 mm, purple tinged, sparsely puberulent to subglabrous, base not saccate, margin membranous. Petals pink, oblanceolate, 5–6 × 2–2.5 mm, obtuse, undifferentiated into blade and claw. Filaments 2.5–3 mm long; anthers ovate-oblong, ca. 0.7 mm long. Ovules 11 to 14 per locule. Fruits linear, compressed, 1.8–2.3 cm × 1–1.2 mm; valves glabrous, with a prominent midvein extending full length; style obsolete or minute and to 0.3 mm long. Seeds oblong, 1.3–1.5 × ca. 0.7 mm, uniseriate, oblong; cotyledons accumbent.

Of the 14 species of *Arabis* L. recognized by Cheo et al. (2001) in China, none has a combination of setose basal leaves, puberulent stems and pedicels with minutely forked trichomes, stems only 3.5–7 cm tall, and wingless seeds. The Chinese endemic *A. alaschanica* Maximowicz (Gansu, Nei Mongol, Ningxia, Qinghai, Shanxi, and Sichuan Provinces) also has setose basal leaves, but these

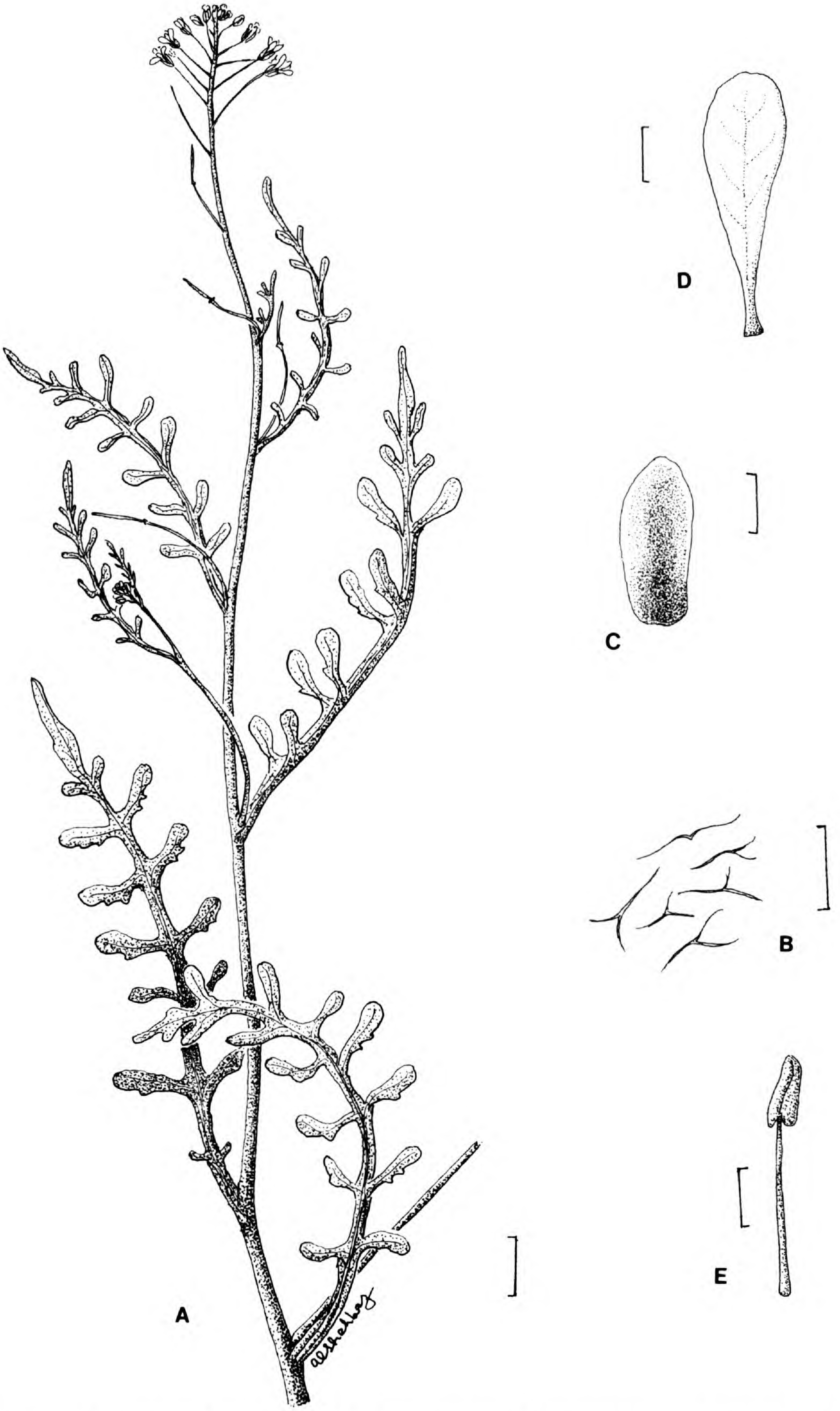

Figure 2. *Sinosophiopsis furcata* Al-Shehbaz. —A. Portion of plant. —B. Leaf trichomes. —C. Sepal. —D. Petal. —E. Median stamen. Scale: A = 1 cm; B = 0.4 mm; C–E = 1 mm. Drawn by Al-Shehbaz from the holotype, *Jian Shu 5031* (KUN).

hairs are mixed with short-stalked forked ones. It also differs from *A. setosifolia* by having caudices covered with stramineous, persistent petioles of previous years, slender styles 1–3 mm long, and larger seeds (1.4–2.5 × 0.8–1.4 mm) that are winged distally. *Arabis setosifolia* is probably most closely related to *A. saxicola* Edgeworth (Afghanistan, India, Kashmir, Pakistan), from which it differs by having erect, subappressed fruits and entire leaves hirsute on both surfaces with simple, subsetose trichomes. *Arabis saxicola* has divaricate to divaricate-ascending fruits and serrulate basal leaves pubescent only abaxially with short-stalked, 4-rayed stellate trichomes, and glabrous adaxially or sparsely pubescent with stellate or forked trichomes.

Paratype. CHINA. **Tibet:** eastern part of Gongjue Xian, 3650 m, 30 June 1991, *Yan Jinsheng 91-492* (KUN).

Sinosophiopsis furcata Al-Shehbaz, sp. nov. TYPE: China. Sichuan: Kanding Xian, Sha De Qu Ma Ti, sunny dry areas near stream, 2700 m, 29 May 1961, *Jian Shu 5031* (holotype, KUN). Figure 2.

Herba annua vel biennis, ultra 30 cm alta. Caules glabri. Folia basalia ignota; folia caulina pinnatisecta, lobis lateralibus 5–7 jugis, anguste oblongis, 0.7–1.5 cm × 1–3 mm, basis subdecurrentibus, pilis sessilis, furcatis et malpighiaceis praeditis. Pedicelli floriferi tenues, divaricato-adscendentes, 1.3–2 cm longi. Sepala 3–4 mm longa, glabra. Petala alba, spathulata, 4–5 × ca. 2 mm. Siliquae et semina ignota.

Annual or biennial herbs, more than 30 cm tall, lower part unknown. Trichomes restricted to leaves and young stems, sessile, 2- or 3-forked, mixed with fewer malpighiaceous ones. Stems erect, glabrous. Cauline leaves pinnatisect; petiole 1–2.5 cm long, glabrous, grooved; lateral leaf lobes 5 to 7 on each side of midvein, narrowly oblong, 0.7–1.5 cm × 1–3 mm, base slightly decurrent, proximal margin often minutely 1- or 2-toothed, otherwise entire, apex subacute; terminal lobe longer than lateral, linear-lanceolate, sessile, decurrent with distal pair of lateral lobes. Raceme with only lowermost few flowers bracteate. Flowering pedicels slender, divaricate-ascending, glabrous or sparsely pilose, 1.3–2 cm long. Sepals oblong, 3–4 × ca. 1.5 mm, erect, glabrous, base nonsaccate. Petals white, spatulate, 4–5 × ca. 2 mm. Stamens strongly tetradynamous; median filaments ca. 3 mm long; lateral filaments ca. 1.5 mm long; anthers oblong, ca. 1.5 mm long. Pistil glabrous; style distinct; stigma capitate, entire. Fruits and seeds unknown.

Two species of *Sinosophiopsis* Al-Shehbaz were previously recognized (Al-Shehbaz, 2000b), and the Chinese-endemic genus is characterized by the annual or biennial habit, white flowers, nonsaccate sepals, branched trichomes, and pinnatisect leaves. *Sinosophiopsis furcata* is most closely related to *S. heishuiensis* (W. T. Wang) Al-Shehbaz, from which it differs by having sessile, forked trichomes mixed with fewer malpighiaceous ones, glabrous stems, 5 to 7 lateral leaf lobes on each side of midvein, sepals 3–4 mm long, and oblong anthers ca. 1.5 mm long. By contrast, *S. heishuiensis* has a mixture of simple and short-stalked forked trichomes, pilose stems, 2 to 4 lateral lobes on each side of midvein, smaller sepals 1.5–2.3 mm long, and ovate anthers 0.4–0.5 mm long. Both species are readily distinguished from the third species of the genus, *S. bartholomewii* Al-Shehbaz, by having ebracteate racemes or only basally bracteate racemes, and much longer pedicels (0.7–2 cm long) and petals (4–5 mm long). This last species has fully bracteate racemes, and shorter pedicels (1–3(–4) mm long) and petals (2–2.5 mm long).

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Six New Species of *Draba* (Brassicaceae) from the Himalayas

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ABSTRACT. *Draba nylamensis*, *D. kongboiana*, and *D. sunhangiana* from Tibet (Xizang), China, *D. macbeathiana* from Nepal, *D. bagmatiensis* from Nepal and adjacent Sikkim (India), and *D. himachalensis* from India are described, and their distinguishing characters from the nearest relatives are discussed.

Key words: Brassicaceae, China (Tibet), *Draba*, India, Nepal.

During recent visits to various herbaria and continuing work on the treatment of Brassicaceae (Cruciferae) for the flora of Nepal, I discovered the following six new species of *Draba*. They are described herein to make their names available for the *Flora of Nepal* and other works in progress. Illustrations of these species and scanning-electron microscopy of the trichomes will be published in a forthcoming revision of *Draba* for the Himalayas and Central Asia.

Draba nylamensis Al-Shehbaz, sp. nov. TYPE: China. Xizang (Tibet): Nylam Xian, Nylam, rocky slopes, 3800 m, 23 June 1975, *Qinghai-Xizang Team 5820* (holotype, KUN; isotypes, KUN, PE).

Herba biennis, 12–30 cm alta. Caules erecti, distaliter glabri, basaliter dense hispidi, pilis simplicibus usque 2 mm longis. Folia basalia rosulata, subsessilia, oblanceolata vel oblongo-oblanceolata, 0.6–3 cm × 2–8 mm, subtus pilis stipitato-stellatis praeditis, supra pilis plerisque simplicibus hispidis minoribus stipitato-stellatis praeditis. Folia caulina (8–)10–13, sessilia, nonauriculata, oblonga vel lanceolata. Pedicelli fructiferi 1–2 cm longi, pilis stipitato-stellatis, sparsis. Sepala 2.5–3 mm longa. Petala flava, spathulata, 6–7.5 × 2–2.5 mm. Ovarium glabrum, 60–70-ovulatum. Fructus immaturi lineares, glabri, 2.5–3 cm longi, compressi. Semina ignota.

Biennial herbs 12–30 cm tall. Stems solitary or rarely few from base, erect, simple at base, branched distally, densely hispid basally with subsetose simple trichomes to 2 mm long, these sometimes mixed with fewer, smaller, stalked forked trichomes, glabrescent distally. Basal leaves forming dense rosettes, subsessile; leaf blade oblanceolate to oblong-oblanceolate, 0.6–3 cm × 2–8 mm, abaxially densely pubescent with stalked, 4-rayed stellate trichomes with simple rays, sometimes these mixed along midvein with much coarser, fewer, simple or forked trichomes, adaxially with predominantly simple trichomes mixed with fewer, much smaller stalked forked ones, base cuneate, margin entire or 1–3-toothed, ciliate with simple trichomes to 2 mm long, apex subobtuse. Cauline leaves 10 to 13, rarely as few as 8, sessile, not auriculate, oblong-lanceolate to oblong, with indumentum similar to basal leaves, margin minutely 1–3-toothed, apex obtuse to subacute. Racemes 6–15-flowered, ebracteate, elongated considerably in fruit; rachis straight. Fruiting pedicels 1–2 cm long, divaricate-ascending, slightly curved upward or straight, slender, sparsely pubescent with stellate stalked trichomes. Sepals oblong, 2.5–3 × 1–1.5 mm, erect, abaxially pubescent with stalked stellate trichomes and fewer simple ones, base of lateral pair not saccate, margin narrowly membranous. Petals yellow, spatulate, 6–7.5 × 2–2.5 mm, apex obtuse to subemarginate. Median filaments 3.5–4 mm long, lateral filaments 2–3 mm long; anthers ovate, ca. 0.5 mm long. Ovules 60 to 70 per ovary. Immature fruit linear, 2.5–3 cm × ca. 1 mm, not inflated, latiseptate, not twisted, straight; valves glabrous, with obscure midvein, base and apex subobtuse; style obsolete. Mature seeds not seen. Flowering June.

Rocky slopes, grassy slopes; 3650–3800 m.

Draba nylamensis is most closely related to *D. stenocarpa* J. D. Hooker & Thomson (Afghanistan, China, India, Kashmir, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkmenistan, Uzbekistan), which it resembles in habit, flower color, and indumentum. However, it is readily distinguished by having (8–)10–13-leaved stems, glabrous fruits, sepals 2.5–3 mm long, petals 6–7.5 mm long, and fruiting pedicels sparsely pubescent with stellate trichomes. By contrast, *D. stenocarpa* has 2–4(–6)-leaved stems, antrorsely puberulent fruits, sepals 1.5–2 mm long, petals 3–4 mm long, and glabrous fruiting pedicels rarely with few scattered simple trichomes. Although only immature fruits of *D. nylamensis* have been examined, they appear to be distinctly longer (2.5–3 cm) and with more ovules per ovary (60 to 70) than those of *D. stenocarpa*, which has fruits (0.6–)0.9–2(–2.5) cm long and ovules 32 to 48 per ovary.

Paratypes. CHINA. **Xizang:** Nylam Xian, Nylam, 3760 m, 13 June 1966, *Zhang Yongtian & Lang Kaiyong 3949* (PE); Kharba, 11 June 1922, *E. J. Norton 85* (K).

Draba macbeathiana Al-Shehbaz, sp. nov. TYPE: Nepal. Thorong La, Marsyandi Valley, stable scree at the top of the pass, 17,300 ft., 25 July 1983, *R. J. D. McBeath 1484* (holotype, E).

Herba perennis, ca. 6 cm alta. Caules erecti, tomentosi, pilis furcatis et stellatis praeditis. Folia basalia rosulata, petiolata, oblanceolata, 5–15 × 2–5 mm, pilosa, pilis stipitato-stellatis, 3- vel 4-radiatis praeditis. Racemi 3–6-flori, ebracteati, laxi. Pedicelli fructiferi 1–2 cm longi, divaricati vel leviter reflexi. Sepala 1.5–2 mm longa. Petala flava, spathulata, ca. 3 × 1 mm. Ovula 12–14. Fructus oblongi, pubescentes, 8–10 × 3–4 mm, compressi, basi et apice obtusi. Semina oblonga, ca. 1 × 0.5 mm.

Perennial herbs ca. 6 cm tall, laxly branched. Caudex covered with leaf remains of previous years, many branched, ultimate branches terminated in few rosettes. Stems erect, simple, tomentose with stalked, forked and stellate trichomes. Basal leaves rosulate, persistent; petiole to 10 mm long, ciliate with simple and stalked forked trichomes; leaf blade oblanceolate, 5–15 × 2–5 mm, pilose with stalked, 3- or 4-rayed stellate trichomes with simple, soft rays, base cuneate to attenuate, margin 1- or 2-toothed on each side, apex acute. Cauline leaves few, similar to basal leaves. Racemes 3–6-flowered, ebracteate, elongated in fruit. Fruiting pedicels 1–2 cm long, horizontal to slightly reflexed, straight, slender, tomentose all around; adaxially with a well-developed axillary gland. Sepals oblong, 1.5–2 × ca. 1 mm, erect, abaxially sparsely pubescent with stalked stellate trichomes, base of lateral pair not saccate, margin not membranous. Petals yellow, spatulate, ca. 3 × 1 mm, apex subemarginate. Filaments 1.5–2 mm long; anthers ovate, ca. 0.4 mm long. Ovules 12 to 14 per ovary. Fruit oblong, 8–10 × 3–4 mm, compressed, latiseptate, twisted; valves pubescent, not veined, base and apex obtuse; style 0.5–0.6 mm long. Seeds brown, oblong, ca. 1 × 0.5 mm.

Draba macbeathiana, which is named after the collector of the holotype, is known only from the type collection above. It is closely related to *D. humillima* O. E. Schulz (Xizang, China, and Sikkim, India), which it resembles in indumentum, flower color and size, and fruit shape. It is readily distinguished by being nonpulvinate and laxly branched and by having toothed, acute leaves, horizontal to slightly reflexed, slender fruiting pedicels 10–20 mm long and adaxially with a well-developed axillary gland, sepals with stellate trichomes, 12–14-ovuled ovaries, and compressed, twisted, pubescent fruits. By contrast, *D. humillima* is densely pulvinate with entire, obtuse leaves, divaricate-ascending, stout fruiting pedicels 2–5(–8) mm long and adaxially eglandular, sepals with simple trichomes, 16–24 -ovuled ovaries, and inflated, untwisted glabrous fruits.

Draba kongboiana Al-Shehbaz, sp. nov. TYPE: China. Tibet [Xizang]: Kongbo, Nyima La, 14,500 ft., 29°28′N, 94°52′E, 28 June 1947, *F. Ludlow, G. Sherriff & H. H. Elliot 15329* (holotype, BM; isotypes, E, TI).

Herba perennis, 3–11 cm alta, caespitosa, scaposa. Caules erecti, dense pubescentes, basi pilis simplicibus et stellatis. Folia basalia rosulata, persistentia, spathulata vel oblanceolata, 5–15 × 1.5–4 mm, inferne pilis stellatis, sessilibus vel brevi-stipitatis, 3- vel 4-radiatis, superne pilosi pilis simplicibus; petiolis (5–)10–20 mm longis, ciliatis, suberosis. Folia caulina carentia. Racemi 8–17-flori, ebracteati. Pedicelli fructiferi 7–15 cm longi, pilis stellatis. Sepala 2–3 mm longa. Petala flava, late obovata, 5–7 × 3–5 mm, apice emarginata. Ovula 12–16. Fructus oblongi vel oblongo-ovati, puberuli, 4–6 × 1.5–2 mm, compressi; stylus 0.4–0.6 mm longus. Semina ovata, ca. 1 × 0.6 mm.

Perennial herbs 3–11 cm tall, densely caespitose, scapose. Caudex covered with petioles of previous years, few branched, ultimate branches terminated in rosettes. Stems erect, simple, densely pubescent throughout with stellate trichomes mixed at least basally with simple ones. Basal leaves rosulate, persistent; petiole (5–)10–20 mm long, persistent, thickened, corky, ciliate with simple trichomes; leaf blade spatulate or oblanceolate, 5–15 × 1.5–4 mm, abaxially densely pubescent with sessile or short-stalked, 3- or 4-rayed stellate trichomes with unbranched rays, adaxially pilose with primarily simple trichomes, margin not ciliate, without setose or subsetose trichomes, base attenuate, margin entire, apex obtuse. Cauline leaves absent. Racemes 8–17-flowered, ebracteate, elongated considerably in fruit. Fruiting pedicels 7–15 mm long, ascending, straight, densely pubescent with stellate trichomes. Sepals oblong-ovate, 2–3 × 1–1.5 mm, erect, abaxially sparsely pubescent with simple and forked trichomes, base of lateral pair not saccate, margin narrowly membranous. Petals deep yellow, broadly obovate, 5–7 × 3–5 mm, apex emarginate; claw 1–2 mm long. Filaments 2–3 mm long; anthers oblong, 0.6–0.8 mm long. Ovules 12 to 16 per ovary. Fruit oblong to oblong-ovate, 4–6 × 1.5–2 mm, not inflated, latiseptate, not twisted; valves puberulent with simple trichomes sometimes mixed with much fewer forked ones, not veined, base and apex obtuse to subacute; style 0.4–0.6 mm long. Seeds brown, ovate, ca. 1 × 0.6 mm. Flowering May and June.

Grassy slopes, alpine grasslands, rocky areas at altitudes 4400 to 4900 m.

Draba kongboiana is mostly closely related to *D. olgae* Regel & Schmalhausen (China, Kyrgyzstan, Pakistan, Tajikistan) from which it differs by having stems densely pubescent throughout with stellate and fewer simple trichomes, well-developed, persistent petioles (5–)10–20 mm long that become thickened and corky, abaxial leaf surface pubescent with 3- or 4-rayed stellate trichomes with unbranched rays, non-ciliate leaf margins, densely pubescent fruiting pedicels, deep yellow petals, and oblong anthers 0.6–0.8 mm long. *Draba olgae* has stems glabrous throughout or only sparsely pubescent basally, sessile leaves or with petioles to 1 mm long that never become thickened or corky, basal leaves abaxially pubescent with 3–5-rayed stellate trichomes at least one ray of which is branched, leaf margins distinctly ciliate with setose or subsetose simple trichomes, glabrous fruiting pedicels, pale yellow petals soon turning whitish, and ovate anthers 0.3–0.4 mm long.

Because of similarities in habit (scapose perennials with leafless stems) and flower color and size, it is easy to confuse *Draba kongboiana* with *D. oreades* Schrenk, a species widely distributed in the Himalayas and western China, west into Central Asia, and north into Russia and Mongolia. However, the new species has abaxial leaf surfaces pubescent with stellate instead of primarily simple trichomes, fruiting pedicels densely pubescent all around instead of glabrous adaxially, oblong instead of ovate anthers, and puberulent instead of glabrous fruits. *Draba kongboiana* also resembles *D. jucunda* W. W. Smith, a Chinese endemic known only from southeastern Xizang and northwestern Yunnan, in having yellow petals 5–7 mm long and puberulent fruits, but it differs in having thick, nonsurculose instead of surculose caudices, petiolate instead of sessile basal leaves, short (0.4–0.6 mm long) instead of long (1.5–2.5 mm) styles, and fruiting pedicels pubescent all around instead of glabrous adaxially.

Paratypes. CHINA. **Xizang:** Lang La, Kymidong Dzong, Lilung, *F. Ludlow & G. Sherriff 1842* (BM, E); Lang La, 28°58′N, 93°42′E, *F. Ludlow, G. Sherriff & G. Taylor 4284* (BM).

Draba sunhangiana Al-Shehbaz, sp. nov. TYPE: China. SW Tibet [Xizang]: Burang Xian, Kangrinboque Feng, grassland on slope, 4700 m, 25 Aug. 1990, *Y. Fei, H. Sun [Sung Hang], D. Z. Li & B. Bai 447* (holotype, KUN 584594; isotype, KUN).

Herba perennis, 5–15 cm alta, caespitosa. Caules erecti, ramosi, pilis crispis, simplicibus, furcatis, stellatis, radiis inaequalibus. Folia basalia rosulata, lanceolata, 4–10 × 1–3 mm, inferne pilis stellatis, stipitatis, 3–5-radiatis, crispis, superne pilosi pilis simplicibus, crispis; petiolis 1–4 mm longis, ciliatis. Folia caulina 2–6, ovata vel anguste oblonga, 4–8 × 1.5–4 mm. Racemi 3–25-flori, ebracteati, fructiferi subumbellati. Pedicelli fructiferi 0.5–1.5(–2.4) mm longi, glabri. Sepala ca. 0.7 × 0.4 mm. Petala alba, oblanceolata, ca. 1.5 mm longa. Ovula 14–20. Fructus ovati vel ovato-lanceolati, puberuli, 2.5–4(–5) × 1.5–2 mm, glabri, basi inflati, obtuse, apice acuti; stylus 0.1–0.3 mm longus. Semina ovata, 0.4–0.5 × 0.2–0.4 mm.

Perennial herbs 5–15 cm tall, caespitose. Caudex slender, covered with leaf remains of previous years, branched, ultimate branches terminated in rosettes. Stems erect, branched above, pubescent with a mixture of crisped, simple, forked, and short-stalked stellate trichomes with unequal rays. Basal leaves rosulate; petiole 1–4 mm long, ciliate; leaf blade lanceolate, 4–10 × 1–3 mm, abaxially pilose with short-stalked, 3–5-rayed stellate trichomes the rays of which are unequal, simple, and crisped, adaxially pilose with simple, crisped trichomes, base attenuate, margin entire, not ciliate, apex subacute. Cauline leaves 2 to 6, sessile; leaf blade ovate to narrowly oblong, 4–8 × 1.5–4 mm, pubescent as basal leaves, base obtuse, margin entire or obscurely denticulate, not ciliate, apex subobtuse. Racemes 3–25-flowered, ebracteate, subumbellate, not elongated in fruit; rachis straight. Fruiting pedicels 0.5–1.5(–2.4) mm long, divaricate, straight, glabrous. Sepals oblong, ca. 0.7 × 0.4 mm, erect, sparsely pilose. Petals white, oblanceolate, ca. 1.5 mm long. Filaments ca. 0.7 mm long; anthers ovate, ca. 0.1 mm long. Ovules 14 to 20 per ovary. Fruit ovate to ovate-lanceolate, 2.5–4(–5) × 1.5–2 mm, basally inflated, latiseptate, not twisted; valves glabrous, not veined, base obtuse, apex acute; style 0.1–0.3 mm long. Seeds brown, ovate, 0.4–0.5 × 0.2–0.4 mm.

Draba sunhangiana is named in honor of Sun Hang, one of the collectors of the type gathering and director of the KUN herbarium. It is readily distinguished from all of the Chinese, Central Asian, and Himalayan species by having crisped trichomes and subumbellate fruiting racemes. The type collection of *D. sunhangiana* consists of two plants with fully mature fruits and only a few flowers, the color of which was not recorded. The two species of Himalayan, Chinese, and Central Asian *Draba* that resemble the new species in fruit shape and size are the white-flowered *D. glomerata* Royle (China, India, Kashmir, Nepal, Pakistan) and yellow-flowered *D. korshinskyi* (O. Fedtschenko) Pohle

(Afghanistan, China, Kashmir, Pakistan, Tajikistan). From these two species *D. sunhangiana* is easily distinguished by having stellate trichomes with unequal, unbranched, crisped rays, adaxial leaf surface pilose with crisped simple trichomes, 14–20-ovulate ovaries, and smaller seeds 0.4–0.5 × 0.2–0.4 mm. From *D. glomerata*, *D. sunhangiana* also differs by having glabrous fruiting pedicels and basally inflated fruits, and from *D. korshinskyi* it differs by having leafy stems pubescent throughout. In *Draba glomerata* both leaf surfaces are uniformly tomentose with sessile or subsessile, 4-rayed stellate trichomes the rays of which are straight and with 1 or 2 lateral branches on each side, the fruiting pedicels are tomentose all around with stellate trichomes, the ovaries are (6–)8–12-ovuled, the fruits are not inflated basally, and the seeds are 0.7–1 × 0.5–0.7 mm. In *D. korshinskyi* the stems are leafless and glabrous throughout or at least along the distal half, the leaves are tomentose with a mixture of simple trichomes and stellate ones with straight, not crisped rays, the ovaries are 8–12-ovuled, and the seeds are 1–1.2 × 0.6–0.7 mm.

Draba himachalensis Al-Shehbaz, sp. nov. TYPE: India. Himachal Pradesh: above Chandratal Lake, exposed mt. ridge in scree, 5100 m, 18 Aug. 1988, *R. McBeath 2154* (holotype, E).

Herba perennis, 0.5–1 cm alta, pulvinata, scaposa, tomentosa, canescens; pilis stellatis, 4–6-radiatis, radiis tenuibus, ramosis. Folia basalia rosulata, obovata vel spathulata, 2–4 × 1–1.5 mm, tomentosa, integra. Folia caulina carentia. Racemi 2–4-flori, ebracteati, racemi fructiferi folia paulo longiores. Pedicelli fructiferi 1–2.5 mm longi, tomentosi vel apice glabri. Sepala ca. 1.2 × 0.7 mm. Petala alba, obovata, 1.2–1.5 × ca. 0.9 mm. Ovula 10–14. Fructus orbiculares, glabri, 2–3 mm diametro, compressi, basi et apice rotundati; stylus ca. 0.1 mm longus. Semina ovata, 0.5–0.6 × 0.3–0.4 mm.

Perennial herbs 0.5–1 cm tall, pulvinate, scapose, canescent, tomentose throughout with short-stalked, 4–6-rayed stellate trichomes with finely branched rays. Caudex covered with leaves of previous years, many branched, ultimate branches terminated in rosettes. Stems erect, simple, tomentose. Basal leaves rosulate; petiole 2–3 mm long, ciliate with coarse, forked trichomes; leaf blade obovate to spatulate, 2–4 × 1–1.5 mm, uniformly tomentose on both surfaces, base attenuate, margin entire, apex obtuse. Cauline leaves absent. Racemes 2–4-flowered, ebracteate, somewhat elongated, in fruit only slightly taller than rosette. Fruiting pedicels 1–2.5 mm long, divaricate, straight, tomentose all around or glabrescent distally. Sepals oblong, ca. 1.2 × 0.7 mm, erect, abaxially sparsely tomentose, base of lateral pair not saccate, margin narrowly membranous. Petals white, obovate, 1.2–1.5 × ca. 0.9 mm, apex rounded. Filaments 0.7–1 mm long; anthers ovate, ca. 0.4 mm long. Ovules 10 to 14 per ovary. Fruit orbicular, 2–3 mm diam., not inflated, latiseptate, not twisted; valves glabrous, not veined, base and apex rounded; style ca. 0.1 mm long. Seeds brown, ovate, 0.5–0.6 × 0.3–0.4 mm.

Draba himachalensis is most closely related to *D. glomerata*, which it resembles in habit, indumentum, flower color, and fruit size. However, it differs by having leafless scapes, 2–4-flowered racemes, obovate, apically rounded petals 1.2–1.5 mm long, orbicular fruits rounded at apex, and smaller seeds 0.5–0.6 × 0.3–0.4 mm. *Draba glomerata* has 1–3(–5)-leaved scapes, (3–)5–10-flowered racemes, spatulate, apically subemarginate petals (1.8–)2–2.7(–3) mm long, ovate or rarely oblong-ovate fruits acute at apex, and seeds 0.7–1 × 0.5–0.7 mm.

The flowering raceme in *Draba himachalensis* hardly emerges from the basal rosette, and only when the fruits mature does it become slightly taller than the rosette. By contrast, in *D. glomerata* the raceme is distinctly taller than the rosette both in flower and fruit.

Draba bagmatiensis Al-Shehbaz, sp. nov. TYPE: Nepal. Ganesh Himal, Bagmati Zone, Rasuwa District, Paldol Base Camp, 4400 m, sandy soil, 3 Aug. 1994, 28°13′N, 85°12′E, *F. Miyamoto, K. R. Rajbhandari, S. Akiyama, M. Amano, H. Ikeda & H. Tsukaya 9400056* (holotype, TI; isotype, MO).

Herba perennis, 1–6 cm alta, caespitosa; pilis stellatis, 4-radiatis, radiis tenuibus, ramosis. Folia basalia rosulata, oblanceolata vel oblonga, 2–10 × 0.5–3 mm, tomentosa, integra vel dentata. Folia caulina 2–5, sessilia, ovata vel oblonga, 2–7 × 1–3 mm. Racemi 5–13-flori, floribus basibus bracteatis. Pedicelli fructiferi 1–5 mm longi, tomentosi, saepe recurvati. Sepala 0.8–1 × 0.4–0.5 mm. Petala alba, spathulata, 1.2–2 × 0.5–1 mm. Ovula 16–20. Fructus anguste elliptici, puberuli, 3–5 × 1.2–1.7 mm, compressi; stylus 0.1–0.4 mm longus. Semina ovata, 0.5–0.7 × 0.3–0.5 mm.

Perennial herbs 1–6 cm tall, caespitose. Caudex slender, covered with petiolar remains of previous years, few to many branched, ultimate branches terminated in rosettes. Stems several to many, simple, ascending, tomentose with subsessile stellate trichomes. Basal leaves rosulate; petiole to 3 mm long; leaf blade oblanceolate to oblong, 2–10 × 0.5–3 mm, tomentose with sessile, 4-rayed stellate trichomes the rays of which with 2 lateral branches, base cuneate, margin entire or 1-toothed on each side, often ciliate at least near base, apex obtuse. Cauline leaves 2 to 5, sessile; leaf blade ovate to oblong, 2–7 × 1–3 mm, pubescent as basal leaves, obtuse, margin entire, not ciliate at base, apex subacute. Racemes 5–13-flowered, lowermost flowers bracteate. Fruiting pedicels 1–5 mm long, horizontal, often recurved, forming a distinct angle with fruit, tomentose all around with subsessile, stellate trichomes. Sepals oblong, 0.8–1 × 0.4–0.5 mm, erect, caducous, abaxially pilose, base of lateral pair not saccate, margin membranous. Petals white, spatulate, 1.2–2 × 0.5–1 mm, caducous, apex subemarginate or rounded; claw absent. Filaments 0.8–1 mm long, caducous; anthers ovate, 0.1–0.2 mm long. Ovules 16 to 20 per ovary. Fruit narrowly elliptic, 3–5 × 1.2–1.7 mm, not appressed to rachis, latiseptate, untwisted; valves puberulent with simple trichomes; style 0.1–0.4 mm long. Seeds ovate, 0.5–0.7 × 0.3–0.5 mm.

Draba bagmatiensis is most closely related to *D. lasiophylla* Royle (Bhutan, China, India, Kashmir, Kazakhstan, Kyrgyzstan, Nepal, Tajikistan, Uzbekistan), from which it is easily distinguished by having horizontal, often recurved fruiting pedicels forming a distinct angle with fruit, sepals 0.8–1 mm long, petals 1.2–2 mm long, elliptic, untwisted fruits not appressed to rachis, puberulent fruit valves with simple trichomes, and seeds 0.5–0.7 mm long. By contrast, *D. lasiophylla* has erect to ascending fruiting pedicels often subappressed to rachis and forming a straight line with fruit, sepals 1.2–1.8 mm long, petals 2–3.5 mm long, lanceolate to lanceolate-oblong twisted fruits often subappressed to rachis, tomentose fruit valves with branched trichomes, and larger seeds 0.8–1.1 mm long. The fruits in *D. lasiophylla* are twisted two or three turns and rarely are they twisted one or half a turn. Both *D. lasiophylla* and *D. bagmatiensis* are closely related to *D. oaricarpa* O. E. Schulz (Pakistan, Nepal, Tibet, Sikkim) and differ in having caducous floral parts. The last species is easily distinguished by having persistent sepals, petals, and stamens that often persist well after fruit dehiscence.

Paratypes. INDIA. **Sikkim:** west district, opposite Lambi, above Thangshing, 4130 m, 27°31′N, 88°11′E, 20 July 1992, fine scree by stream, *D. G. Long, R. McBeath, H. Noltie & M. Watson 540* (CAS, E).

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Lesquerella is United with *Physaria* (Brassicaceae)

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ABSTRACT. *Lesquerella* (Brassicaceae) is united with the earlier-published *Physaria* following an unsuccessful attempt to conserve the more speciose *Lesquerella*. Molecular, morphological, distributional, and ecological data strongly support the union of the two genera. Ninety-one names in *Lesquerella*, including 75 at the specific rank, are transferred to *Physaria*. The new names *P. nelsonii* and *P. reediana* are proposed to avoid the creation of later homonyms in *Physaria*.

Key words: Brassicaceae, *Lesquerella*, North America, *Paysonia*, *Physaria*.

The genus *Physaria* (Nuttall ex Torrey & A. Gray) A. Gray was initially described in Torrey and Gray (1838) as a section of the Old World genus *Vesicaria* Adanson and was later raised to the generic rank by Gray (1848). As presently circumscribed (Rollins, 1993), *Physaria* consists of 22 species distributed from North Dakota south into Nebraska, Colorado, and New Mexico, and west through the Mountain and Pacific states, with the range of one species, *P. didymocarpa* (Hooker) A. Gray, extending into southern Alberta, Canada. With the exception of *P. alpestris* Suksdorf, *P. geyeri* (Hooker) A. Gray, and *P. oregona* S. Watson, most of the remaining 19 species occur in Colorado, Utah, or Wyoming. Both *P. didymocarpa* and *P. geyeri* were originally described in *Vesicaria*, but this generic name is illegitimate because it included the type of the earlier published *Alyssoides* Miller. As many as 37 taxa of North American Brassicaceae (see Rollins & Shaw, 1973; Rollins, 1993) were originally described in *Vesicaria*, but the vast majority of those were later transferred to *Lesquerella* S. Watson (Watson, 1888).

Lesquerella was established by Watson (1888) as a North American genus distinguished from the exclusively Mediterranean *Vesicaria* by having edentate versus dentate filaments and veined instead of veinless septa. Watson (1888) and Payson (1922) recognized 33 and 52 species in *Lesquerella*, respectively. Rollins (1993) recognized 83 species of *Lesquerella* in North America, with the range of one, *L. arctica* (Wormskjöld ex Hornemann) S. Watson, extending into Greenland, northern Canada, Alaska, and Arctic Russia (Rollins & Shaw, 1973; Tolmachev, 1975). Five additional North American species were subsequently described (Rollins, 1995; Rollins et al., 1996; Anderson et al., 1997; O'Kane, 1999). Although Boelcke and Romanczuk (1984) recognized a single species from Argentina (and Bolivia), we believe that an additional four or five new species grow in southern South America. The taxonomy of the South American species of *Physaria* will be published at a later date.

In his *Cruciferae of Continental North America*, Rollins (1993) separated *Physaria* from *Lesquerella* primarily on the basis of *Physaria* having strongly didymous fruits with deep sinuses between the valves distally (apically), and often proximally (basally) as well, as compared to *Lesquerella*, which has non-didymous fruits with no, or shallow, distal sinuses. Additionally, *Physaria* was said to have siliques compressed perpendicular to the replum while *Lesquerella* has fruits compressed parallel to the replum or not at all, a dichotomy that is violated in several taxa. *Lesquerella* and *Physaria* are indistinguishable in basically every other morphological aspect, including leaf morphology, trichome type, inflorescence, flower color, fruiting pedicels, and all aspects of seed-coat sculpture and embryo type. This remarkable similarity was expressed by Rollins (1939: 393), who stated, "The natural relationship between *Physaria* and *Lesquerella* is very marked. These two genera have almost exactly the same floral pattern, habit of growth, and trichome morphology. The siliques too are very similar." With the exception of the South American species and the auriculate-leaved species of *Lesquerella* of the southeastern United States, *Physaria* and *Lesquerella* have a coherent geographical distribution.

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The geographic range of *Physaria* falls perfectly within that of *Lesquerella*, which is widespread in the dry western United States and northern Mexico. Furthermore, species of both genera primarily occupy arid substrates supporting sparse vegetation. In some cases, a species of *Physaria* or *Lesquerella* may be the only, or one of a very few, species on a site. Many of the species of these genera are rare, and some are included on the United States list of Endangered and Threatened Species.

The degree of development of the apical and/or basal sinuses among species of *Lesquerella* and *Physaria*, and therefore, whether the fruit becomes didymous or not, is a quantitative character that shows continuity from one end of the spectrum to the other. All workers who studied these two genera were unable to draw a natural line between them. For example, Payson (1922: 221), who critically examined the boundaries between these genera, stated, "So striking, indeed, is this similarity that one is a little perplexed at times to know to which genus a given plant should be referred," and "The bridge connecting the two genera is nearly complete." Furthermore, Rollins (1950: 46) indicated that "The evidence now assembled shows a continuous morphological gradation from the genus *Physaria* into *Lesquerella*. This evidence has been accumulating almost since the time Watson (1888) founded *Lesquerella* as a genus distinct from *Vesicaria*," and "Thus the assumed gap between these genera has been completely closed insofar as the morphology of the various entities involved is concerned." Maguire (1942) and Maguire and Holmgren (1951) also expressed their dissatisfaction about the delimitation of both genera, as did Mulligan (1968), who critically examined borderline species and transferred three species from *Physaria* to *Lesquerella*.

All the authors above have clearly indicated that there are no adequate morphological grounds to support the maintenance of *Lesquerella* and *Physaria* as separate genera. Although Rollins and Rüdenberg (1971) hinted that chromosome size of *Physaria* might be different from that of *Lesquerella*, subsequent studies (Rollins & Rüdenberg, 1977, 1979) did not support that assumption. Two main reasons explain why both genera have been maintained by previous authors. First, authors have followed tradition and ignored the lack of convincing morphologies separating the two genera. Second, authors simply avoided the transfer of the numerous species of *Lesquerella* to the much smaller and earlier-published *Physaria*. Such arguments were presented by Rollins and Shaw (1973: 5) who, paradoxically, stated that "Nothing is gained for the classification of either *Lesquerella* or *Physaria* by abandoning the *traditional line of demarcation* between them" (italics, ours) and "We interpret the evidence . . . as once again emphasizing the step-by-step continuity between these genera. The line to be drawn between the genera is an arbitrary one, and for this reason we think it should remain as it has been accepted for many years." Such reasoning does not justify the maintenance of both genera, especially when molecular data are taken into consideration.

One of the present authors (SLO) has been working on the phylogeny of the *Physaria–Lesquerella* complex for the past four years using molecular tools. The molecular data clearly show that *Physaria* is nested within and evolved more than once from *Lesquerella*. These results are primarily from DNA sequences of the internal transcribed spacer (ITS; Baldwin et al., 1995) of nuclear ribosomal DNA. Less complete data from length variation of the region between microsatellite loci, called inter-simple sequence repeat regions (ISSR; Zietkiewicz et al., 1994), support these conclusions. Regardless of the number of derivations of *Physaria* from *Lesquerella*, the former genus is polyphyletic and the latter is definitely paraphyletic. Molecular data (O'Kane, unpublished) do not support any regrouping of the species that would allow the recognition of both *Physaria* and *Lesquerella*. The two genera can no longer be maintained on molecular, morphological, cytological, biogeographic, and ecological grounds. *Lesquerella* and *Physaria* (hereafter combined as *Physaria*), together with *Dimorphocarpa* Rollins, *Dithyrea* Harvey, *Lyrocarpa* Hooker & Harvey, *Nerisyrenia* Greene, and *Synthlipsis* A. Gray, are characterized by having 4–10-colpate pollen grains (Rollins, 1979; Rollins & Shaw, 1973; Rollins & Banerjee, 1979), a synapomorphy that distinguishes these genera from the rest of the family, which have tricolpate pollen grains. Molecular data (O'Kane, unpublished) also support the monophyly of this *Physaria* alliance.

In order to avoid the massive transfer of species from the later-published *Lesquerella* to the earlier-published *Physaria*, O'Kane et al. (1999) proposed to conserve *Lesquerella* with a conserved type. By conserving *Lesquerella*, one avoids the transfer of 91 names from *Lesquerella* to *Physaria*. Only 20 species names in *Physaria* would have been transferred to *Lesquerella*. It is rather unfortunate that the Committee for Spermatophyta (Brummitt, 2000) did not take the above overwhelming arguments into consideration when it decided by a vote of ten to five to reject the proposal because (p. 804) "The feeling of a majority of the Committee is that in the present case the name *Physaria* is already well known and the advantages of conservation are not sufficient to justify over-ruling the principle of priority." We disagree with this reasoning and are forced to take one of two actions. First, maintain both genera, which would mean that a paraphyletic *Lesquerella* and polyphyletic *Physaria* should be recognized. However, this solution would mean that taxonomy should be practiced without regard to evolutionary or phylogenetic considerations, a course of action unacceptable to us. Therefore, we are left with the second option, to unite the two genera. We certainly would have preferred to do so by the conservation of *Lesquerella*. The extensive transfer of species from *Lesquerella* to *Physaria* is here made so that names are available for floristic works in progress, including the *Flora of North America*, the *Flora of the San Juan Basin*, and the *Arizona Flora*.

The eight auriculate-leaved species previously included in *Lesquerella* are excluded from this treatment and will be transferred to a new genus in a separate publication (see this issue of *Novon*). The South American *Physaria* (previously *Lesquerella*) will also be treated in another publication. Nomenclatural adjustments made here, then, are only for North American species. Therefore, as presently circumscribed, the genus *Physaria* in North America consists of 98 species, including 22 maintained in that genus by Rollins (1993), 75 transferred herein from *Lesquerella* to *Physaria*, and 2, *P. cordiformis* Rollins and *P. montana* (A. Gray) E. L. Greene, originally described in or transferred to *Physaria*, respectively.

Following the new combinations and new names given below, the basionym and the synonym in *Lesquerella* (when applicable) are cited. The complete synonymy is given in Rollins and Shaw (1973) and Rollins (1993).

Physaria angustifolia (Nuttall ex Torrey & A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria angustifolia* Nuttall ex Torrey & A. Gray, Fl. N. Amer. 1: 101. 1838. TYPE: U.S.A. Oklahoma: Choctaw Co., Red River, *Thomas Nuttall s.n.* (lectotype, designated by Rollins (1956), BM; isolectotype, K).

Physaria arctica (Wormskjöld ex Hornemann) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Alyssum arcticum* Wormskjöld ex Hornemann, Fl. Dan. 9, Fasc. 26, 5, t. 1520. 1818. *Lesquerella arctica* (Wormskjöld ex Hornemann) S. Watson, Proc. Amer. Acad. Arts. 23: 254. 1888. TYPE: Greenland. Omenak, *C. L. Giesecke s.n.* (holotype, C).

Physaria arenosa (Richardson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria arenosa* Richardson, in Franklin, App. Narr. Journey Polar Sea 743. 1823. *Lesquerella arenosa* (Richardson) Rydberg, Bull. Torrey Bot. Club 29: 236. 1902. TYPE: Canada. Plains of Saskatchewan, *John Richardson 252* (holotype, K; isotype, GH).

Physaria arenosa subsp. **argillosa** (Rollins & Shaw) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella arenosa* var. *argillosa* Rollins & Shaw, Genus *Lesquerella* in N. Amer. 178. 1973. TYPE: U.S.A. South Dakota: Pennington Co., along bed of creek near Piedmont, *E. J. Palmer 37016* (holotype, GH).

Physaria argentea (Schauer) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria argentea* Schauer, Linnaea 20: 720. 1847. *Lesquerella argentea* (Schauer) S. Watson, Proc. Amer. Acad. Arts 23: 252. 1888, non *L. argentea* (Pursh) MacMillan, Metasp. Minnesota Valley 263. 1892. TYPE: Mexico. Without locality, *Aschenborn 278* (holotype, B).

Physaria argyraea (A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria argyraea* A. Gray, Bost. J. Nat. Hist. 6: 146. 1850. *Lesquerella argyraea* (A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 254. 1888. TYPE: U.S.A. Texas: Calhoun Co., banks of Green Lake, near Matagorda Bay, *F. Lindheimer 329* (lectotype, designated by Rollins & Shaw (1973), GH; isolectotype, MO).

Physaria argyraea subsp. **diffusa** (Rollins) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella diffusa* Rollins, J. Arnold Arbor. 21: 395. 1940. TYPE: Mexico. Nuevo León: Galeana, 5400 ft., *Chase 7750* (holotype, GH; isotypes, ARIZ, F).

Rollins (1993) reduced *Lesquerella diffusa* to a variety of *L. argyraea*, a position that we support at the subspecific rank under *Physaria*.

Physaria arizonica (S. Watson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella arizonica* S. Watson, Proc. Amer. Acad. Arts 23: 254. 1888. TYPE: U.S.A. Arizona: Yavapai Co., Juniper Mesa, near Prescott, Apr. 1876, *Edward Palmer 16* (lectotype, designated by Rollins & Shaw (1973), GH; isolectotypes, F, M, MO, NY, US).

Physaria aurea (Wooton) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella aurea* Wooton, Bull. Torrey Bot. Club 25: 260. 1898. TYPE: U.S.A. New Mexico: S fork of Tularosa Creek, 3 mi. E of Mescalero Agency, White Mts., 30 July 1897, *Elmer O. Wooton 245* (holotype, US; isotypes, B, K, MO, NDG, NMC, NY, RM, UC).

Physaria berlandieri (S. Watson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella berlandieri* S. Watson, Proc. Amer. Acad. Arts 23: 252. 1888. TYPE: Mexico. Tamaulipas: near Matamoros, *Berlandier 884* (lectotype, designated by Payson (1922), GH).

Physaria calcicola (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella calcicola* Rollins, Amer. J. Bot. 26: 419. 1939. TYPE: U.S.A. Colorado: Las Animas Co., 3 mi. E of San Francisco Creek, 8 mi. NW of Trinchera, 13 July 1937, *Reed C. Rollins 1861* (holotype, GH; isotypes, MO, NY, OKL, UC, US, UTC).

Physaria calderi (G. Mulligan & A. Porsild) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella calderi* G. Mulligan & A. Porsild, Canad. J. Bot. 47: 215. 1969. TYPE: Canada. Yukon Territory: Cathedral Rocks, Ogilvie Mts., 66°2′N, 138°44′W, 3500 ft., 29 June 1960, *J. A. Calder & J. M. Gillett 26016* (holotype, DAO; isotypes, CAN, GH).

Physaria carinata (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella carinata* Rollins, Contr. Gray Herb. 171: 42. 1950. TYPE: U.S.A. Idaho: Lemhi Co., Birch Creek, Range 29 East-Township 11 North, 3 July 1941, *Ray J. Davis 3801* (holotype, GH).

Lesquerella carinata var. *languida* Rollins, Cruciferae of Continental N. Amer. 611. 1993. Syn. nov. TYPE: U.S.A. Montana: Granite Co., Rattler Gulch, ca. 4 mi. NW of Drummond, T11N, R13W, Sec. 10, SW ¼, Sec. 9, SE ¼, 4050 ft., 12 June 1990, *Lisa Ann Schassberger 364 & Diane Pavek* (holotype, GH).

Physaria cinerea (S. Watson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella cinerea* S. Watson, Proc. Amer. Acad. Arts 23: 255. 1888. TYPE: U.S.A. Arizona: without locality, 1869, *Edward Palmer s.n.* (holotype, US).

Physaria congesta (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella congesta* Rollins, Contr. Gray Herb. 214: 8. 1984. TYPE: U.S.A. Colorado: Rio Blanco Co., Green River Formation, North Dudley Gulch, ca. 3/4 mi. NE of junction of Dudley Gulch and Piceance Creek, T2S, R97W, Sec. 4, 20 June 1893, *Reed C. & Kathryn W. Rollins 8394 with Scott Peterson, Aileen G. Roads, Karen Wiley-Eberle & Dieter Wilken* (holotype, GH; isotype, MO).

Physaria densiflora (A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria densiflora* A. Gray, Bost. J. Nat. Hist. 6: 145. 1850. *Lesquerella densiflora* (A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 251. 1888. TYPE: U.S.A. Texas: Gillespie Co., Fredericksburg, May 1847, *F. Lindheimer 577* (lectotype, designated by Rollins & Shaw (1973), GH; isolectotype, M).

Physaria douglasii (S. Watson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella douglasii* S. Watson, Proc. Amer. Acad. Arts 23: 255. 1888. TYPE: U.S.A. Columbia Valley, 1860, *Lyall s.n.* (lectotype, designated by Rollins & E. Shaw (1973), GH).

Physaria douglasii subsp. **tuplashensis** (Rollins, Beck & Caplow) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella tuplashensis* Rollins, Beck & Caplow, Rhodora 97: 203. 1996. TYPE: U.S.A. Washington: Franklin Co., White Bluffs, T13N, R27E, S11, W1/2, above Columbia River, 20 July 1994, *Kathryn A. Beck & Florence E. Caplow 94001* (holotype, GH; isotype, WTU).

Rollins et al. (1996) recognized that both *Lesquerella tuplashensis* and *L. douglasii* are quite similar morphologically, and that they differ primarily by the former having a raised instead of an appressed radiate portion of the trichomes. In our opinion, these differences do not justify the recognition of two distinct species.

Physaria engelmannii (A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria engelmannii* A. Gray, Gen. Amer. Bor.-Orient. Ill. 1: 162, pl. 70. 1848. *Lesquerella engelmannii* (A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 254. 1888. TYPE: U.S.A. Texas: shores of Guadaloupe, New Braunfels, May 1846, *F. Lindheimer 325* (holotype, GH; isotypes, B, GH, K, MO).

Physaria fendleri (A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria fendleri* A. Gray, Mem. Amer. Acad. Arts 4: 9. 1849. *Lesquerella fendleri* (A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 254. 1888. TYPE: U.S.A. New Mexico: around Santa Fe, 2 Apr. 1847, *A. Fendler 40* (holotype, MO).

Physaria filiformis (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella filiformis* Rollins, Rhodora 58: 201. 1956. TYPE: U.S.A. Missouri: Dade Co., Turnback, 5 May 1929, *Palmer 35604* (holotype, GH; isotypes, F, MO, NY, US).

Physaria fremontii (Rollins & E. Shaw) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella fremontii* Rollins & E. Shaw, Genus *Lesquerella* in N. Amer. 228. 1973. TYPE: U.S.A. Wyoming: Fremont Co., Wind River Mts., 5 mi. E of Atlantic City, 8200 ft., *Harry D. Ripley & Rupert C. Barneby 8931* (holotype, CAS; isotypes, NY, US).

Physaria garrettii (Payson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella garrettii* Payson, Ann. Missouri Bot. Gard. 8: 213. 1922. TYPE: U.S.A. Utah: Salt Lake Co., Big Cottonwood Canyon, 9700 ft., 28 June 1905, *Albert O. Garrett 1344* (holotype, MO; isotypes, GH, RM).

Physaria globosa (Desvaux) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria globosa* Desvaux, J. Bot. Agric. 3: 184. 1815. *Lesquerella globosa* (Desvaux) S. Watson, Proc. Amer. Acad. Arts 23: 252. 1888. TYPE: U.S.A. "Cette plante croit dans les lieux arides de l'Amérique septentrionale," without collector name (holotype, P).

Physaria gooddingii (Rollins & E. Shaw) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella gooddingii* Rollins & E. Shaw, Genus *Lesquerella* in N. Amer. 164. 1973. TYPE: U.S.A. New Mexico: Catron Co., along Tularosa Creek, 5 mi. SW of Apache Creek, 4 Sep. 1956, *Rupert C. Barneby 12923* (holotype, CAS).

Physaria goodrichii (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella goodrichii* Rollins, J. Arnold Arbor. 64: 503. 1983. TYPE: U.S.A. Utah: Millard Co., Desert Experimental Range, Tunnel Springs Mts., 21 mi. SE of Garrison, T24S, R17W, S9, 8000 ft., 16 June 1982, *Sherel Goodrich 16951* (holotype, GH; isotypes, BRY, NY, UTC).

Physaria gordonii (A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria gordonii* [as *gordoni*] A. Gray, Bost. J. Nat. Hist. 6: 149. 1850. *Lesquerella gordonii* S. Watson, Proc. Amer. Acad. Arts 23: 253. 1888. TYPE: U.S.A. New Mexico: Canadian River, Raton Mts., Apr. 1848, *A. Gordon 4* (holotype, GH; isotype, MO).

Physaria gordonii subsp. **densifolia** (Rollins) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella gordonii* var. *densifolia* Rollins, Cruciferae Continental N. Amer. 621. 1993. TYPE: U.S.A. New Mexico: Lincoln Co., ca. 2 mi. N of Lincoln, off US Hwy. 380, 13 Apr. 1990, *Reed C. & Kathryn W. Rollins 9046* (holotype, GH).

Physaria gracilis (Hooker) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria gracilis* Hooker, Curtis's Bot. Mag., n.s. 10: t. 3533. 1836. *Lesquerella gracilis* (Hooker) S. Watson, Proc. Amer. Acad. Arts 23: 253. 1888. TYPE: U.S.A. Texas: San Felipe, *Drummond III 13* (holotype, K; isotype, GH).

Physaria gracilis subsp. **nuttallii** (Torrey & A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria nuttallii* Torrey & A. Gray, Fl. N. Amer. 1: 101. 1838. *Lesquerella gracilis* subsp. *nuttallii* (Torrey & A. Gray) Rollins & E. Shaw, Genus *Lesquerella* in N. Amer. 53. 1973. TYPE: U.S.A. "Prairies of the Red River," *Melines C. Leavenworth s.n.* (lectotype, designated by Rollins & Shaw (1973), GH).

Physaria hemiphysaria (Maguire) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella hemiphysaria* Maguire, Amer. Midl. Naturalist 27: 466. 1942. TYPE: U.S.A. Utah: Sanpete Co., S side Middle Forks Park, Wasatch Plateau, 10,800 ft., 10 Aug. 1940, *Bassett Maguire 20053* (holotype, UTC; isotype, DS).

Physaria hemiphysaria subsp. **lucens** (Welsh & Reveal) O'Kane & Al-Shehbaz, comb. et stat. nov. *Lesquerella hemiphysaria* var. *lucens* Welsh & Reveal, Great Basin Naturalist 37: 338. 1977. TYPE: U.S.A. Utah: Carbon Co., 7 mi. NE of Sunnyside, Range Creek Canyon, 23 June 1977, *Stanley L. Welsh & K. Taylor 15139* (holotype, BRY).

Physaria hitchcockii (Munz) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella hitchcockii* Munz, Bull. Torrey Bot. Club 56: 163. 1929. TYPE: U.S.A. Nevada: Clark Co., Charleston Mts., 1 Sep. 1927, 10,500 ft., *E. C. Jaeger & C. Leo Hitchcock s.n.* (holotype, POM).

Physaria hitchcockii subsp. **rubicundula** (Rollins) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella rubicundula* Rollins, Contr. Dudley Herb. 3: 178. 1941. TYPE: U.S.A. Utah: Garfield Co., Red Canyon, ca. 12 mi. E of Bryce Junction, Sevier Forest (now Powell National Forest), 6 July 1912, *Willard W. Eggleston 8198* (holotype, NA).

The main differences given by Rollins (1993) to separate *Lesquerella hitchcockii* from *L. rubicundula* (e.g., racemes exserted vs. embedded among the basal leaves, smooth vs. tuberculate trichomes, and leaves attenuate at base vs. petiolate, respectively) are variable and often not correlated. While *L. rubicundula* does have some smooth trichomes, most trichomes are tuberculate and indistinguishable from those in *L. hitchcockii.* The two species are also indistinguishable molecularly (O'Kane, unpublished) and cytologically (Windham & O'Kane, unpublished). Maguire and Holmgren (1951) and Barneby (1966) treated *L. rubicundula* as a subspecies of *L. hitchcockii*, a position we agree with. Rollins also reduced *L. tumulosa* to synonymy of *L. rubicundula*, a relationship that is also not substantiated on molecular and cytological grounds.

Physaria humilis (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella humilis* Rollins, Contr. Gray Herb. 214: 9. 1984. TYPE: U.S.A. Montana: Ravalli Co., near summit of St. Mary's Peak, Bitterroot Range, 17 July 1983, *Reed C. & Kathryn W. Rollins 83300, with Klaus H. Lackschewitz, Peter Lesica & Aileen G. Roads* (holotype, GH).

Physaria inflata (Rollins & E. Shaw) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella inflata* Rollins & E. Shaw, Genus *Lesquerella* in N. Amer. 150. 1973. TYPE: Mexico. Nuevo León: between Saltillo and Monterrey, along Rte. 40, km 351, ca. 200 yards E of weighing station, 14 Feb. 1969, *Spetzman 1212* (holotype, GH).

Physaria intermedia (S. Watson) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella alpina* (Nuttall ex Torrey & A. Gray) S. Watson var. *intermedia* S. Watson, Proc. Amer. Acad. Arts 23: 251. 1888. TYPE: U.S.A. New Mexico: W of Sante Fe, *A. Fendler 38* (lectotype, designated by Rollins & Shaw (1973), GH).

Physaria johnstonii (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella johnstonii* Rollins, Contr. Dudley Herb. 3: 179. 1941. TYPE: Mexico. Coahuila: Sierra del Piño, ca. 10 mi. N of camp at La Noria, *Ivan M. Johnston & Cornelius H. Muller 556* (holotype, GH).

Physaria kingii (S. Watson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria kingii* S. Watson, Proc. Amer. Acad. Arts 20: 353. 1885. *Lesquerella kingii* (S. Watson) S. Watson, Proc. Amer. Acad. Arts 23: 251. 1888. TYPE: U.S.A. Nevada: Pershing Co., West Humboldt Mts., June 1868, *Sereno Watson 82* (lectotype, designated by Payson (1922), GH; isolectotype, NY).

The following subspecies of *Physaria kingii* were variously recognized by Rollins (1993) and Rollins and Shaw (1973) as varieties and/or subspecies under *Lesquerella kingii.*

Physaria kingii subsp. **bernardina** (Munz) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella bernardina* Munz, Bull. S. Calif. Acad. Sci. 31: 62. 1932. TYPE: U.S.A. California: San Bernardino Co., N side of Bear Lake, E end of Bear Valley, San Bernardino Mts., 16 May 1924, *Frank W. Peirson 4600* (holotype, POM; isotypes, GH, JEPS, RM, RSA).

Physaria kingii subsp. **cobrensis** (Rollins & E. Shaw) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella kingii* subsp. *kingii* var. *cobrensis* Rollins & E. Shaw, Genus *Lesquerella* in N. Amer. 255. 1973. TYPE: U.S.A. Nevada: Elko Co., 30 mi. E of Wells on Cobre old Hwy. paralleling Southern Pacific Railroad, *Percy Train 3665* (holotype, GH; isotypes, NY, UC).

Physaria kingii subsp. **diversifolia** (E. L. Greene) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella diversifolia* E. L. Greene, Pittonia 4: 309. 1901. TYPE: U.S.A. Oregon: Wallowa Co., Wallowa Mts., 7000 ft., 6 Aug. 1899, *Cusick 2304* (holotype, NDG; isotypes, F, GH, MO, UC, US, WS).

Physaria kingii subsp. **latifolia** (A. Nelson) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella latifolia* A. Nelson, Bot. Gaz. 42: 49. 1906. TYPE: U.S.A. Nevada: Lincoln Co., Karshaw, Meadow Valley Wash, 26 Apr. 1902, *Leslie N. Goodding 625* (holotype, RM; isotypes, GH, MO, US).

Physaria klausii (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella klausii* Rollins, Contr. Gray Herb. 214: 10. 1984. TYPE: U.S.A. Montana: Lewis and Clark Co., W side above Hwy. 200 at Rogers Pass, 5800 ft., 25 July 1982, *Klaus H. Lackschewitz & David Ramsden 10112* (holotype, MONTU).

Physaria lata (Wooton & Standley) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella lata* Wooton & Standley, Contr. U.S. Natl. Herb. 16: 126. 1913. TYPE: U.S.A. New Mexico: Lincoln Co., near Lincoln National Forest, 1903, *Fred G. Plummer s.n.* (holotype, US).

Physaria lesicii (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella lesicii* Rollins, Novon 5: 71. 1995. TYPE: U.S.A. Montana: Carbon Co., ridge W of Layout Creek, ½ mi. S of Mystery Cave, Pryor Mts., 7500 ft., T8S, R28E, S21, SW ¼, 20 June 1992, *Peter Lesica 5707 & Rob DeVelica* (holotype, GH).

Physaria lindheimeri (A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria lindheimeri* A. Gray, Bost. J. Nat. Hist. 6: 145. 1850. *Lesquerella lindheimeri* (A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 253. 1888. TYPE: U.S.A. Texas: lower Guadeloupe, E of Victoria, Feb. 1845, *F. Lindheimer 327* (holotype, GH; isotypes, B, GH, K, MO).

Physaria ludoviciana (Nuttall) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Alyssum ludovicianum* Nuttall, Gen. N. Amer. Pl. 2: 63. 1818; based on *Myagrum argenteum* Pursh, Fl. Amer. Septen. 2: 434. 1814, not *A. argenteum* Vitmann, Summa 4: 30. 1790. *Lesquerella ludoviciana* (Nuttall) S. Watson, Proc. Amer. Acad. Arts 23: 252. 1888. TYPE: U.S.A. Banks of the Missouri, *Thomas Nuttall s.n.* (lectotype, designated by Rollins & Shaw (1973), PH; isolectotype, BM).

Physaria macrocarpa (A. Nelson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella macrocarpa* A. Nelson, Bot. Gaz. 34: 366. 1902. TYPE: U.S.A. Wyoming: Sweetwater Co., Bush Ranch, 10 June 1900, *Aven Nelson 7081* (holotype, RM; isotypes, B, COLO, GH, K, MO, NY, US).

Physaria mcvaughiana (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella mcvaughiana* Rollins, Contr. Gray Herb. 171: 44. 1950. TYPE: U.S.A. Texas: Brewster Co., E of Mt. Ord, Sierra del Norte, ca. 10 mi. SE of Alpine, 7 Apr. 1947, *Rogers McVaugh 7862* (holotype, GH; isotype, A).

Physaria mexicana (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella mexicana* Rollins, Bol. Soc. Bot. México 23: 45. 1958. TYPE: Mexico. Coahuila: 43 mi. S of Monclova, 14 Aug. 1948, *Kenoyer & Crum 2625* (holotype, GH).

Physaria mirandiana (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella mirandiana* Rollins, Bol. Soc. Bot. México 23: 43. 1958. TYPE: Mexico. Nuevo León: Cañon de los Capulines, above San Enrique, Hacienda San José de Raíces, Municipio de Derrumbadero, 6 Aug. 1935, *C. H. Muller 2412* (holotype, GH; isotypes, F, MO).

Physaria multiceps (Maguire) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella multiceps* Maguire, Amer. Midl. Naturalist 27: 465. 1942. TYPE: U.S.A. Utah: Cache Co., vicinity of Tony Grove Lake, Bear River Range, 8300 ft., 4 Aug. 1838, *Bassett Maguire 16030* (holotype, UTC; isotypes, DS, GH, RM, UC).

Physaria navajoensis (O'Kane) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella navajoensis* O'Kane, Madroño 46: 88. 1999. TYPE: U.S.A. New Mexico: McKinley Co., ca. 2 air mi. NE of Thoreau on bench below and SE of Mt. Powell, 35°26′8″N, 108°12′26″W, 7600 ft. (2316 m), 23 May 1998, *Steve L. O'Kane, Jr. 4232 & Daniela Roth* (holotype, MO; isotypes, BRY, COLO, GH, ISTC, NMC, NY, RM, UNM).

Physaria nelsonii O'Kane & Al-Shehbaz, nom. nov. Replaced name: *Lesquerella condensata* A. Nelson, Bull. Torrey Bot. Club 26: 238. 1899, not *Physaria condensata* Rollins, Rhodora 41: 407. 1939. TYPE: U.S.A. Wyoming: Sweetwater Co., Tipton, *Aven Nelson 4797* (lectotype, designated by Payson (1922), RM; isolectotypes, GH, NY).

The species is named in honor of Aven Nelson (24 March 1859–31 March 1952) who described numerous novelties in the Brassicaceae of the Rocky Mountain flora. The transfer of *Lesquerella condensata* to *Physaria* would create a later homonym of *P. condensata* Rollins (Rollins, 1939).

Physaria obdeltata (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella obdeltata* Rollins, Cruciferae Continental N. Amer. 640. 1993. TYPE: U.S.A. Idaho: Binghuam Co., near Middle Butte, off road T-4, 3.5 mi. E of U.S. Hwy. 26, 24 June 1986, *Reed C. & Kathryn W. Rollins 8695* (holotype, GH).

Physaria occidentalis (S. Watson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria occidentalis* S. Watson, Proc. Amer. Acad. Arts 20: 353. 1885. *Lesquerella occidentalis* (S. Watson) S. Watson, Proc. Amer. Acad. Arts 23: 251. 1888. TYPE: U.S.A. California: Siskiyou Co., Humbug Hills, near Yreka, 30 June 1876, *Edward L. Greene 902* (lectotype, designated by Hitchcock et al. (1964), GH).

Physaria occidentalis subsp. **cinerascens** (Maguire & A. Holmgren) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella occidentalis* subsp. *diversifolia* (Greene) Maguire & A. Holmgren var. *cinerascens* Maguire & A. Holmgren, Madroño 11: 178. 1951. TYPE: U.S.A. Nevada: White Pine Co., White Pine Mts., NE of Hamilton, *Harry D. Ripley & Rupert C. Barneby 9295* (holotype, NE; isotypes, UC, UTC).

Physaria ovalifolia (Rydberg) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella ovalifolia* Rydberg, in Britton & A. Brown, Ill. Fl. N. U.S. 2: 137. 1897. TYPE: U.S.A. Nebraska: Kimball Co., hills of upper Lawrence Fork, 11 Aug. 1891, *Per A. Rydberg 22* (holotype, NY; isotypes, NY, US).

Physaria ovalifolia subsp. **alba** (Goodman) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella ovalifolia* var. *alba* Goodman, Rhodora 38: 239. 1936. TYPE: U.S.A. Oklahoma: Murray Co., Arbuckle Mts., 7 Apr. 1934, *George J. Goodman 2077* (holotype, OKL).

Physaria pallida (Torrey & A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria grandiflora* Hooker var. *pallida* Torrey & A. Gray, Fl. N. Amer. 1: 101. 1838. *Lesquerella pallida* (Torrey & A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 253. 1888. TYPE: U.S.A. Texas: San Augustine Co., near St. Augustine, *Melines C. Leavenworth s.n.* (holotype, NY).

Physaria palmeri (S. Watson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella palmeri* S. Watson, Proc. Amer. Acad. Arts 23: 255. 1888. TYPE: Mexico. Baja California: Topo Cañon, Lower California, 1884, *C. R. Orcutt 1099* (holotype, GH).

Physaria parviflora (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella parviflora* Rollins, J. Arnold Arbor. 64: 506. 1983. TYPE: U.S.A. Colorado: Rio Blanco Co., USGS Black Cabin Gulch Quadrangle, T3S, R100W, S13, 3/4 mi. S of spring in Tommy's Draw, 2595 m, 21 July 1982, *W. Baker & S. Sigstedt 82-308* (holotype, GH; isotype, CS).

Physaria parvula (Greene) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella parvula* Greene, Pittonia 4: 308. 1901. TYPE: U.S.A. Colorado: Grand Co., summit of Mt. Bross, Middle Park, 29 July 1876, *H. N. Patterson s.n.* (holotype, NDG; isotypes, F, MO, NY, US).

Physaria paysonii (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella paysonii* Rollins, Contr. Gray Herb. 171. 44. 1950. TYPE: U.S.A. Wyoming: Lincoln Co., mountains near Cottonwood Lake, E of Smoot, 13 Aug. 1923, *Edwin B. Payson & George M. Armstrong 3816* (holotype, GH; isotypes, COLO, MO).

Physaria pendula (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella pendula* Rollins, Cruciferae of Continental N. Amer. 647. 1993. TYPE: U.S.A. Nevada: White Pine Co., Snake Range, 3 km E of Murphy Wash road to Big Springs Wash, T10N, R68E, 6450 ft., 23 May 1985, *Arnold Tiehm 9480* (holotype, GH).

Physaria peninsularis (Wiggins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella peninsularis* Wiggins, Contr. Dudley Herb. 1: 166. 1933. TYPE: Mexico. Baja California: La Encantada, Sierra San Pedro Mártir, 18 Sep. 1930, *Ira L. Wiggins & L. Demaree 4919* (holotype, DS; isotypes, GH, UC, US).

Physaria pinetorum (Wooton & Standley) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella pinetorum* Wooton & Standley, Contr. U.S. Natl. Herb. 16: 126. 1913. TYPE: U.S.A. New Mexico: Lincoln Co., Gilmores Ranch on Eagle Creek, White Mts., 2200 m, 25 Aug. 1907, *Elmer O. Wooton & Paul C. Standley 3460* (holotype, US; isotype, NMC).

Physaria prostrata (A. Nelson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella prostrata* A. Nelson, Bull. Torrey Bot. Club 26: 124. 1899. TYPE: U.S.A. Wyoming: Uinta Co., Piedmont, 7 June 1898, *Aven Nelson 4564* (holotype, RM; isotypes, B, NY, US).

Physaria pruinosa (Greene) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella pruinosa* Greene, Pittonia 4: 307. 1901. TYPE: U.S.A. Colorado: Archuleta Co., Pagosa Springs, 21 July 1899, *Charles F. Baker s.n.* (holotype, NDG).

Physaria pueblensis (Payson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella pueblensis* Payson, Ann. Missouri Bot. Gard. 8: 169. 1922. TYPE: Mexico. Puebla: vicinity of San Luis Tultitlanapa, *Carl. A. Purpus 3389* (holotype, MO; isotypes, F, GH, NY, UC, US).

Physaria pulchella (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella pulchella* Rollins, Novon 5: 72. 1995. TYPE: U.S.A. Montana: Beaverhead Co., S-facing slope along Trapper Creek just S of Hecha Mines, Pioneer Mts., T3S, R11W, Sec. 32, 8600 ft., 25 July 1991, *Peter Lesica 5525 & Steve Cooper* (holotype, GH; isotype, MONTU).

Physaria purpurea (A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria purpurea* A. Gray, Smithsonian Contr. Knowl. (Pl. Wright.) 5: 14. 1853. *Lesquerella purpurea* (A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 253. 1888. TYPE: U.S.A. Texas: El Paso Co., near El Paso, *Wright 1320* (holotype, GH; isotypes, GH, MO).

Physaria rectipes (Wooton & Standley) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella rectipes* Wooton & Standley, Contr. U.S. Natl. Herb. 16: 127. 1913. TYPE: U.S.A. New Mexico: without locality, 6 June 1883, *C. C. Marsh 81* (holotype, US).

Physaria recurvata (Engelmann ex A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria recurvata* Engelmann ex A. Gray, Bost. J. Nat. Hist. 6: 147. 1850. *Lesquerella recurvata* (Engelmann ex A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 253. 1888. TYPE: U.S.A. Texas: near Cibolo River, between San Antonio and New Braunfels, Mar. 1846, *F. Lindheimer 330* (lectotype, designated by Rollins & Shaw (1973), GH; isolectotype, MO).

Physaria reediana O'Kane & Al-Shehbaz, nom. nov. Replaced name: *Vesicaria alpina* Nuttall ex Torrey & A. Gray, Fl. N. Amer. 1: 102. 1838. *Lesquerella alpina* (Nuttall ex Torrey & A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 251. 1888. TYPE: U.S.A. Wyoming: Natrona Co.?, Rocky Mt. range toward sources of the Platte, *Thomas Nuttall s.n.* (holotype, BM; isotypes, K, PH).

This is named in honor of Reed C. Rollins (7 December 1911–28 April 1998) for his lifetime of contributions on the North American Brassicaceae, especially in the genera *Lesquerella* and *Physaria*. The transfer of *Vesicaria alpina* to *Physaria* would create a later homonym of *P. alpina* Rollins (Rollins, 1981).

Physaria reediana subsp. **spatulata** (Rydberg) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella spatulata* Rydberg, Contr. U.S. Natl. Herb. 3: 486. 1896. TYPE: U.S.A. South Dakota: Lawrence Co., Deadwood, 1600 m, *Per A. Rydberg 534* (holotype, US; isotype, NY).

Lesquerella spatulata was reduced by Rollins and Shaw (1973) to synonymy of *L. alpina* and was treated by Rollins (1993) as a variety of the latter. It is maintained herein at the subspecific level in *Physaria*.

Physaria rosei (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella rosei* Rollins, Contr. Gray Herb. 214: 23. 1984. Based on *Synthlipsis lepidota* Rose, Contr. U.S. Natl. Herb. 8: 294. 1905, non *Physaria lepidota* Rollins, Brittonia 33: 335. 1981. TYPE: Mexico. Hidalgo: calcareous soil near Tula, 6800 ft., *Pringle 6899* (holotype, US; isotypes, B, GH, M, MO, NY, US).

Physaria rosei subsp. **perotensis** (Rollins) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella rosei* var. *perotensis* Rollins, Contr. Gray Herb. 214: 23. 1984. TYPE: Mexico. Veracruz: Bosque de Pinos, alrededores de Perote, 2700 m, 21 Apr. 1976, *Sergio Avendaño R. et al. 201* (holotype, GH).

Physaria schaffneri (S. Watson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria schaffneri* S. Watson, Proc. Amer. Acad. Arts 17: 320. 1882. *Lesquerella schaffneri* (S. Watson) S. Watson, Proc. Amer. Acad. Arts 23: 254. 1888. TYPE: Mexico. San Luis Potosí: San Luis Potosí, *J. G. Schaffner 150* (holotype, GH; isotype, F).

Physaria sessilis (S. Watson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella gracilis* (Hooker) S. Watson var. *sessilis* S. Watson, Proc. Amer. Acad. Arts 23: 253. 1888. *Lesquerella sessilis* (S. Watson) Small, Fl. SE U.S. 471. 1903. TYPE: U.S.A. Texas: Uvalde Co., Rio Frio and Leona, May 1851, *Wright 848* (lectotype, designated by Rollins & Shaw (1973), GH; ?isolectotypes, GH, NY).

Physaria sinuosa (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella sinuosa* Rollins, Contr. Gray Herb. 214: 23. 1984. TYPE: Mexico. Puebla: N of Tehuacan, 5650 ft., 19 Nov. 1966, *Harry D. Ripley & Rupert C. Barneby 14734* (holotype, GH; isotype, NY).

Physaria subumbellata (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella subumbellata* Rollins, Amer. J. Bot. 26: 420. 1939. TYPE: U.S.A. Utah: Uintah Co., foothills of Uinta Mts., 18 mi. N of Vernal, 17 June 1937, *Reed C. Rollins 1758* (holotype, GH).

Physaria tenella (A. Nelson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella tenella* A. Nelson, Bot. Gaz. 47: 426. 1909. TYPE: U.S.A. Nevada: Clark Co., Moapa, 8 Apr. 1905, *Leslie N. Goodding 2184* (holotype, RM; isotypes, GH, MO, UC).

Physaria thamnophila (Rollins & E. Shaw) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella thamnophila* Rollins & E. Shaw, Genus *Lesquerella* in N. Amer. 86. 1973. TYPE: U.S.A. Texas: Zapata Co., 3 mi. SE of Zapata, near US Hwy. 83, *Reed C. Rollins & Donovan S. Correll 5949* (holotype, GH; isotype, LL).

Physaria tumulosa (Barneby) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Lesquerella hitchcockii* Munz subsp. *tumulosa* Barneby, Leafl. West. Bot. 10. 313. 1966. TYPE: U.S.A. Utah: Kane Co., 6.5 mi. SE of Cannonville, just S of the Garfield County line, 5700 ft., 12 June 1966, *Rupert C. Barneby 14424* (holotype, NY; isotypes, BRY, CAS, GH, UC, US, UTC).

Reveal (1970) raised *Lesquerella hitchcockii* subsp. *tumulosa* to specific rank, but Rollins (1993) reduced it to synonymy of *L. rubicundula.* Because of its pulvinate habit and filiform-linear leaves 0.7–1 mm wide, we agree with Reveal in recognizing subspecies *tumulosa* as a distinct species. The remainder of the *Physaria hitchcockii* complex (except *L. navaoensis*) are more loosely caespitose and with leaves distinctly wider than those of *P. tumulosa.*

Physaria utahensis (Rydberg) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella utahensis* Rydberg, Bull. Torrey Bot. Club 30. 252. 1903. TYPE: U.S.A. Utah: Utah Co., American Fork Canyon, 31 July 1880, *Marcus E. Jones 1354* (holotype, NY; isotypes, ARIZ, DS, MO, US).

Physaria valida (Greene) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella valida* Greene, Pittonia 4: 68. 1899. TYPE: U.S.A. New Mexico: Gray, 1898, *Josephine Skehan s.n.* (holotype, NDG; isotypes, NY, US).

Physaria vicina (Anderson, Reveal & Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella vicina* Anderson, Reveal & Rollins, Novon 7: 9. 1997. TYPE: U.S.A. Colorado: Montrose Co., small flat-topped mesa overlooking Uncompahgre River just S of 66500 Kinikin Road, ca. 4 air mi. SE of Montrose, 6050 ft., sec. 10, T48N, R9W, 29 June 1995, *James L. Reveal 7492* (holotype, GH; isotypes, BM, BRY, COLO, MARY, MO, NY, RM, TEX, US, US).

Physaria wardii (S. Watson) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella wardii* S. Watson, Proc. Amer. Acad. Arts 23: 255. 1888. TYPE: U.S.A. Utah (as Arizona): Garfield Co., Aquarius Plateau, 11,000 ft., 16 Aug. 1875, *L. F. Ward 589* (holotype, GH; isotypes, F, MO, US).

Lesquerella kaibabensis Rollins, Contr. Gray Herb. 211: 110. 1982. Syn. nov. TYPE: U.S.A. Arizona: Coconino Co., Grand Canyon National park, 18.6 mi. S of Jacob Lake on road to N entrance of the park, 8 June 1979, *Reed C. & Kathryn W. Rollins 79191* (holotype, GH; isotype, MO).

A critical examination of the type collections of *Lesquerella wardii* and *L. kaibabensis* reveals that they are indistinguishable in every morphological aspect. The alleged differences in flower color and style length (Rollins, 1993) do not hold. On the Kaibab Plateau of northern Arizona, populations of *L. wardii* vary from all white flowered, to all yellow flowered, to mixed white and yellow.

Physaria wyndii (Rollins & E. Shaw) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella wyndii* Rollins & E. Shaw, Genus *Lesquerella* in N. Amer. 154. 1973. TYPE: Mexico. Coahuila: Sierra del Carmen, Cañon de Sentenela on Hacienda Piedra Blanca, *Wynd & Mueller 517* (holotype, GH; isotypes, ARIZ, MEXU, MO, NY, OKLA, US).

EXCLUDED SPECIES

The following taxa are excluded from *Lesquerella* and now placed in the new genus *Paysonia* (see O'Kane & Al-Shehbaz in this issue of *Novon*).

Lesquerella auriculata (Engelmann & A. Gray) S. Watson, Proc. Amer. Acad. Arts. 23: 250. 1888.
Lesquerella densipila Rollins, Rhodora 54: 186. 1952.
Lesquerella grandiflora (Hooker) S. Watson, Proc. Amer. Acad. Arts 23: 250. 1888.
Lesquerella lasiocarpa (Hooker ex A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 251. 1888.
Lesquerella lasiocarpa var. *berlandieri* (A. Gray) Payson, Ann. Missouri Bot. Gard. 8: 139. 1922.
Lesquerella lasiocarpa var. *heterochroma* (S. Watson) Rollins, Rhodora 57: 245. 1955.
Lesquerella lescurii (A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 250. 1888.
Lesquerella lyrata Rollins, Rhodora 57: 252. 1955.
Lesquerella perforata Rollins, Rhodora 54: 190. 1952.
Lesquerella stonensis Rollins, Rhodora 57: 255. 1955.

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Socotrella, a New Genus of Stapeliad (Apocynaceae–Asclepiadoideae) from the Island of Socotra

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ABSTRACT. A new monotypic genus, *Socotrella* (Apocynaceae–Asclepiadoideae–Ceropegieae), is described with a single species, *S. dolichocnema* Bruyns. This is known only from the western limestone plateau of the island of Socotra. *Socotrella* differs from *Caralluma* R. Brown by the lack of a differentiated leaf rudiment and its accompanying small marginal hairs, as well as the very different pollinaria. Although some features of the pollinaria suggest a relationship to *Ballyanthus* Bruyns, *Duvalia* Haworth, *Duvaliandra* M. G. Gilbert, *Huernia* R. Brown, and *Whitesloanea* Chiovenda, the fact that many inflorescences are produced toward the tips of the stems in *Socotrella* at once distinguishes it from all these genera.

Key words: Apocynaceae, Asclepiadoideae, Ceropegieae, Socotra, *Socotrella*, stapeliad.

Socotrella Bruyns & A. G. Miller, gen. nov. TYPE: *Socotrella dolichocnema* Bruyns, sp. nov.

A ceteris speciebus *Caralluma* absentia folii rudimentalis minuti et absentia dentium stipulaceorum distinguenda est, a *Duvalia*, *Duvaliandra*, *Ballyanthus*, *Huernia*, *Whitesloaneaque* caulis floriferis cum inflorescentiis multis prope apicem discedit.

Small, somewhat rhizomatous succulent. *Stems* decumbent, 50–150 mm long, 4–7 mm thick, dark green, smooth; *tubercles* arranged into 4 rows along stem, ± rectangular, with spreading tooth 1–2 mm long near upper end, without leaf rudiment or stipular denticles. *Inflorescences* several per stem near apex, each bearing 1–5 flowers opening successively, with acuminate bracts 1–2 mm long around bases of pedicels; *pedicel* 25–42 mm long, ± 1 mm thick, ascending and holding flower facing upward; *sepals* ± 1.5 mm long, 0.5 mm broad at base, ovate-lanceolate, acute. *Corolla* 18–22 mm diam., shallowly campanulate; outside pale yellow-green, glabrous and smooth; inside yellow with broad reddish longitudinal markings in tube, glabrous, finely papillate; *tube* 2 mm deep, 5–6 mm broad, cupular with flat base, without thickening in corolla around mouth; *lobes* 7–8 mm long, 3–4 mm broad at base, parallel-sided for much of length, obtuse, slightly convex inside. *Corona* 2 mm tall, 2 mm broad, raised up on stipe arising from swollen area in base of corolla tube, yellow; *outer lobes* reduced to minute flap beneath guide rails; *inner lobes* 0.5 mm long, erect and adpressed to backs of anthers, truncate-emarginate, with broad apically somewhat tuberculate and almost hemispherical dorsal appendage around base. *Anthers* erect alongside style head, margins shrinking slightly only on anthesis, almost deltate. *Pollinium* ellipsoidal, much longer than broad, pellucid margin exactly along outer edge toward apex, caudicle attached with small pad to ventral surface. *Follicles* unknown.

Socotrella dolichocnema Bruyns, sp. nov. TYPE: Socotra. Western Plateau, 660 m, Feb. 2000, *A. G. Miller 19110* (E). Figure 1.

Species unica, a *Duvaliandra dioscoridi* corona exteriore multum redacta et orificio nectareo parviore, a speciebus *Caralluma* polliniis parvis et corpuscula grandiore et alata differt.

When it was first collected, we suspected that this new species probably belonged to the genus *Caralluma*. The fairly large number of inflores-

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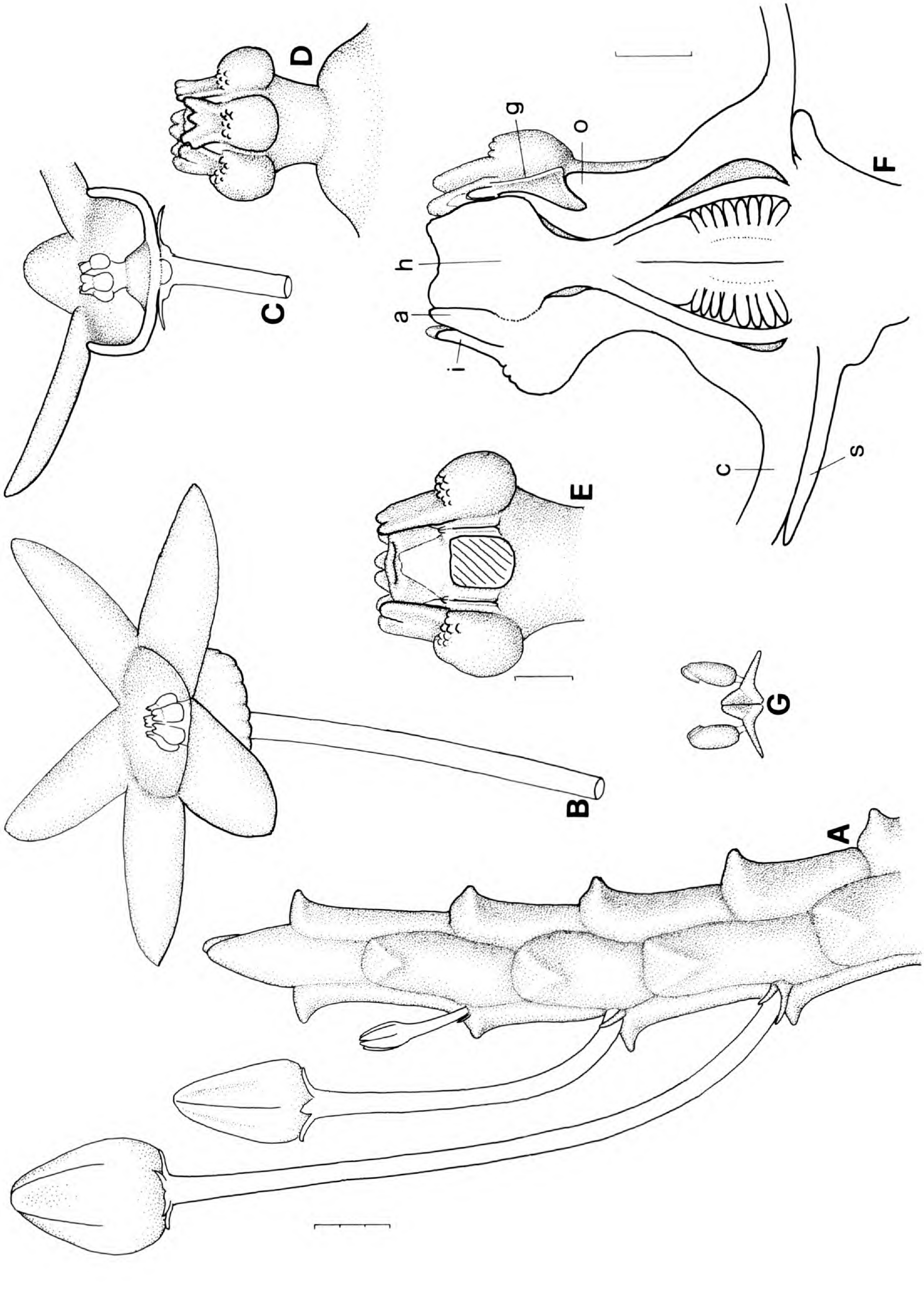
Figure 1. *Socotrella dolichocnema* Bruyns. —A. Upper portion of flowering stem with buds. —B. Side view of flower. —C. Side view of dissected flower. —D. Side view of gynostegium. —E. Side view of gynostegium with one inner corona lobe removed. —F. Half-flower showing center of flower only. —G. Pollinarium. a = anther; c = corolla; g = guide rail; h = style head; i = inner corona lobe; o = outer corona lobe; s = calyx. Scale bars: A–C, 3 mm (at A); D, 1 mm (at F); E, 0.5 mm; F, 0.5 mm; G, 0.25 mm (at F). Drawn from *Miller 19110*.

NOVON 12: 330–333. 2002.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cences produced toward the apices of the relatively slender stems tended to reinforce this view.

However, a closer examination revealed that this new species differs from all known species of *Caralluma* by the complete lack of a differentiated leaf rudiment at the tip of each tubercle. In *Caralluma* (in the sense of Gilbert, 1990) this leaf rudiment is accompanied by small marginal hairs, which are also present around and often on the stipular denticles. Both these hairs and the stipular denticles are entirely lacking in this new species. Here the tubercle comes to a rounded end (Fig. 1A) with no ornamentation of this area at all.

In the complete lack of a differentiated leaf rudiment on the tubercles, *S. dolichocnema* is somewhat reminiscent of various species of *Orbea* (in the new and expanded sense of Bruyns, 2001, 2002 in press). Many of these have tiny stipular denticles alongside the leaf rudiment, and the leaf tapers into a fine point. The stems are also usually distinctively mottled with dark green on a paler background.

The flowers of *S. dolichocnema* are borne on relatively long pedicels (whence the specific epithet), which place them at the level of the tops of the stems. They are pretty and strikingly colored inside, with bright yellow on the lobes and the same color in the tube. In the tube there are also slightly irregular reddish markings, which somewhat resemble color that has run down the tube. This, as well as the shape of the flowers, is somewhat reminiscent of *Tromotriche umdausensis* (Nel) Bruyns from the arid west of southern Africa, but this resemblance is undoubtedly purely coincidental.

When one examines the gynostegium of this species, there appears to be no outer corona. The swollen platform on the base of the corolla tube on which the gynostegium arises is clearly not a candidate since it shows no subdivision into five parts at any stage of its development. However, the vertical section of the flower (Fig. 1F) reveals that there is a small erect flap of tissue beneath the guide rails (indicated by an "o"), which is not visible easily from the outside but which is all that there is here of the outer corona. Behind this flap there is a slight "nectarial orifice." Such a reduced outer corona is not known in any other northeast African stapeliad, and one has to look to the southern African genus *Piaranthus* R. Brown to find similarly reduced structures in the outer coronal series (Bruyns, 1999). It was stated (Gilbert, 1980: 101) that the outer corona of *Duvaliandra dioscoridis* (Lavranos) M. G. Gilbert was absent. However, this is not the case. In this species the outer corona consists of a spreading lobe laterally fused to the sides of the rather more massive inner lobes as well as an erect ridge of tissue a little behind the bases of the guide rails and enclosing a more significant "nectarial orifice" than is present in *S. dolichocnema*. This is somewhat different from the situation in *S. dolichocnema*, where the spreading lobe is absent.

In *S. dolichocnema* the inner corona lobes are, as usual, adpressed to the backs of the anthers and, since the anthers are erect here, the inner corona lobes are erect, too. Each inner corona lobe has a noticeably swollen, tuberculate dorsal appendage. An examination of early stages of the flowers shows that these dorsal appendages are derived from the same meristem as the inner lobe itself and are not part of the outer series, as is the case, for example, in many species of *Piaranthus* (Bruyns, 1999).

The vertical section of the flower also shows the arrangement of the style head and the anthers. Here the style head projects well above the level of the corpuscles and the anthers are erect against it. This situation is unique among the stapeliads, where the top of the style head is generally around the level of the corpuscle and the anthers are normally horizontal on top of it (Bruyns, 2000a).

The pollinaria of this new species are also most unusual. The corpuscle is comparatively large and about equally long as broad, with inordinately long lateral wings. The pollinia are ellipsoidal and much longer than broad with a small insertion crest running for a short distance down the outer edge. The pollinia are unusually small relative to the size of the corpuscle. Pollinaria with this shape are not known in *Caralluma*, where the corpuscle is always comparatively small, with very small lateral wings, and the pollinia are large relative to the size of the corpuscle. Similarly, pollinaria like those of *S. dolichocnema* are unknown in *Orbea*, where the pollinium is always much larger and D-shaped with the insertion crest twisting from the outer edge to the upper surface of the pollinium.

The shape of the corpuscle is similar to what one finds generally in *Duvalia*, *Huernia*, as well as in the monotypic genera *Ballyanthus* and *Whitesloanea* from northern Somalia and *Duvaliandra* from Socotra. The ellipsoidal pollinia are also similar in these genera, though they are far smaller in the new species. *Socotrella* differs from *Ballyanthus*, *Duvalia*, *Duvaliandra*, *Huernia*, and *Whitesloanea* by the fact that several inflorescences are produced on each flowering shoot, and they all arise toward the tips of the stems, whereas in these other genera there is only one inflorescence per stem often toward the apex (*Ballyanthus*) or one inflorescence usually near the base of the stem only in *Duvalia*, *Duvaliandra*, *Huernia*, and *Whitesloanea*.

This new genus brings to two the number of monotypic genera of stapeliads that are known from Socotra, the other being *Duvaliandra*, whose single species, *D. dioscoridis*, is found in the granitic mountains of the northeast of the island. The present new genus and species was discovered in February 2000 in the west of Socotra on a limestone plateau with dwarf shrubland dominated by *Croton socotranus* Balfour f., *Pulicaria stephanocarpa*, *Buxus hildebrandtii* Baillon, and *Cissus hamaderohensis* A. R. Smith. It might seem peculiar that yet another monotypic genus of stapeliad is being described. The last one described in this journal (Bruyns, 2000b) occurred on the edge of the botanically little-known area of southern Angola. Many of the succulents of Socotra are related to others in Somalia, where botanical exploration is also not very advanced. Consequently, it is possible that further exploration may show that both these new taxa are not as isolated in their relationships among the stapeliads as they seem to be at present.

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Contributions toward a Monograph of *Petalophyllum* (Marchantiophyta)

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ABSTRACT. The simple thalloid liverwort genus *Petalophyllum* J. G. C. Lehmann is removed from the Fossombroniaceae and sequestered in the new family Petalophyllaceae along with *Sewardiella* S. R. Kashyap, a monotypic genus endemic to the Indian subcontinent. Unlike the Fossombroniaceae, the thallus in the Petalophyllaceae is never dissected, the archegonia are clustered rather than scattered, a pseudoperianth is formed rather than a caulocalyx, and the capsule wall is 3–4-layered with outer wall thickenings, which are lacking in the Fossombroniaceae. The North American representative of *Petalophyllum* previously considered conspecific with the European taxon *P. ralfsii* (W. M. Wilson) J. G. C. Lehmann is here described as a distinct species, *P. americanum*. This is based upon clear differences of the thallus, pseudoperianth, and the elater spirals. Furthermore, the application of the name *P. australis* Colenso to New Zealand plants is shown to be incorrect; those plants previously referred there represent a new species, *P. hodgsonii*. This species resembles *P. ralfsii*, but differs from it in the broad, strongly flattened thallus midrib and structure of the female inflorescence.

Key words: Austrofossombronia, Fossombroniaceae, liverworts, Marchantiophyta, New Zealand, North America, Petalophyllaceae, *Petalophyllum*, *Sewardiella*.

THE FAMILY PETALOPHYLLACEAE

The simple thalloid liverwort genus *Petalophyllum* C. G. D. Nees & Gottsche ex J. G. C. Lehmann (Lehmann, 1844) has been aligned with the genus *Fossombronia* Raddi since its publication. The inclusion of these two taxa and the genus *Sewardiella* S. R. Kashyap in the family Fossombroniaceae Hazlinszky has been generally unequivocal among hepaticologists, although Schuster (1953: 575) stated "... I would regard it [*Petalophyllum*] as a representative of a separate family, the Petalophyllaceae." This family was never validly published by him, but many years later he did segregate *Petalophyllum* and *Sewardiella* from *Fossombronia* and his recently validated genus, *Austrofossombronia* R. M. Schuster, at the subfamily rank when he named the Petalophylloideae (Schuster, 1991) within the Fossombroniaceae. The genera *Fossombronia* and *Austrofossombronia*, then, comprised the Fossombronioideae of this family.

During an ongoing monographic study of *Petalophyllum*, a number of structural and developmental features have been elucidated that justify elevation of the Petalophylloideae to the rank of family. In *Petalophyllum* the thallus is not dissected, and it develops unistratose dorsal lamellae. *Sewardiella* is composed of a very fragile unistratose thallus wing. Conversely, the thallus of all other members of the Fossombroniaceae is highly dissected, giving the plants a leafy appearance. The apical cell geometry of the Petalophyllaceae is reported as being tetrahedral in *Sewardiella* and either tetrahedral or lenticular in *Petalophyllum*, depending on the species (Leitgeb, 1877). In the Fossombroniaceae the geometry is strictly lenticular (Renzaglia, 1982). Archegonia develop in distinct clusters along the midrib in the Petalophyllaceae, not scattered along the stem or midrib as in the Fossombroniaceae. These archegonial clusters are surrounded, even in the earliest stages of development, by a unistratose pseudoperianth in the Petalophyllaceae. The pseudoperianth expands in typical fashion after fertilization to enclose the sporophyte, which is further encased by a thin shoot calyptra. In the Fossombroniaceae, the solitary, unfertilized archegonia are completely devoid of any type of enclosing structures; i.e., they are naked on the stem. After fertilization, concomitant with the early stages of embryo division, the stem tissue around the venter undergoes substantial cell division to form a fleshy enclosure around the basal part of the sporophyte. A leaf-like scale, which aris-

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es at the apex of this fleshy mound, enlarges as the sporophyte matures and forms a pseudoperianth-like enclosure. As originally concluded by Chalaud (1928), this structure is not, however, homologous to the true pseudoperianths of *Petalophyllum* and *Sewardiella* and is better termed a caulocalyx. Finally, the capsule wall in representatives of the Petalophyllaceae is 3–4-layered with cells in all layers having pigmented secondary wall thickenings. The capsule wall in *Fossombronia* is only 2-layered while that of *Austrofossombronia* is (3–)4(–5)-layered (Schuster, 1994; Crandall-Stotler et al., 1999). Regardless of the number of capsule wall layers, however, in the Fossombroniaceae the cells of the outer wall layer are always devoid of secondary wall thickenings.

Petalophyllaceae (R. M. Schuster) Stotler & Stotler-Crandall, fam. et stat. nov. Basionym: Petalophylloideae R. M. Schuster, J. Hattori Bot. Lab. 70: 148. 1991. TYPE: *Petalophyllum* J. G. C. Lehmann; type species, *P. preissii* J. G. C. Lehmann, Novarum et Minus Cognitarum Stirpium Pugillus 8: 30. 1844.

A New Species of *Petalophyllum* from North America

When encountered in the field, *Petalophyllum* is a conspicuously distinct simple thalloid liverwort not easily confused with other hepatic taxa. Because of its patchy occurrence, however, it is not frequently observed. The first report of the genus in North America was by Evans (1919), who identified two Texas specimens as *Petalophyllum ralfsii* (W. M. Wilson) C. G. D. Nees & Gottsche ex J. G. C. Lehmann, the "petal wort" common in the British Isles and the Mediterranean region. Since then, scattered reports can be found in the North American literature under that name or as *P. lamellatum* (C. G. D. Nees) S. O. Lindberg, a taxonomic synonym of *P. ralfsii* (Lindberg, 1874). Careful evaluation of the type specimen of *P. ralfsii* (= *Jungermannia ralfsii* W. M. Wilson), near Penzance, *Ralfs s.n.* (BM), and of European populations of this species have revealed several distinctions between this taxon and the North American populations of the genus. These morphological differences warrant the recognition of the North American populations as a new species, which may be contrasted with *P. ralfsii* by several distinguishing characters. Vegetatively, in North American plants both the wing and lamellar margins are entire, very rarely sinuate. In *P. ralfsii*, both the wing and lamellar margins are sinuate. Mature pseudoperianths in the North American plants are small, barely projecting above the lamellae, and unlobed, with the mouth margin being sinuate to dentate, but never ciliate. These features may be clearly seen in Schuster's (1992: 428) figure 849-1 from Texas plants. In *P. ralfsii*, the pseudoperianth is much larger and sometimes deeply lobed with the mouth margin always strongly toothed to ciliated or even laciniate. The elaters in both species are bi-spiraled (tri-spiraled) at their tips, but in our North American plants 2 to 4 (occasionally 5 or 6) spirals are found through most of the elater length. There are never more than 2 or 3 spirals formed in *P. ralfsii*. In North America, *Petalophyllum* has been confirmed from Arkansas, Louisiana, and Texas, where it often occupies recently disturbed areas of well-drained sandy soils that are generally exposed. In the British Isles, in contrast, it is typically found in stabilized sand dunes. Thus, these two species appear also to occupy very different habitats.

Petalophyllum americanum C. H. Ford & Stotler-Crandall, sp. nov. TYPE: U.S.A. Texas: Bastrop Co., Bueschner State Park, on red soil in moist depression, 13 Mar. 1997, *R. E. Stotler & B. J. Crandall-Stotler 4006* (holotype, ABSH; isotype, as dupl. in FAA).

Differt a *Petalophyllo ralfsii* marginibus thalli et lamellarum integris, ore pseudoperianthii sinuato-dentato, elateribus spiris 2–4(5–6).

Populations light green, occurring as isolated individuals or in small scattered patches on exposed, loose or somewhat firm gravely or sandy loam. Plants 3.9–11.2 mm long, 2.7–8 mm wide, simple or once (twice) furcate. Thallus elliptical to obovate, broadly undulate, with the wings lamelliferous. Wings flattened to erect, multistratose at the base, becoming unistratose at the margin, with the margin plane; the median thallus cells thin-walled, quadrate to elongate, averaging 68 × 41.2 μm, with the marginal cells distinct, tangentially elongate or quadrate, 36.1–39.9 μm long, 34.2–43.7 μm wide. Lamellae leaf-like, erect to suberect, running obliquely along the thallus wings, unistratose, multistratose at the base, up to 22 cells in height at the highest point, slightly undulate, with the lamellar margin plane; the marginal cells distinct, quadrate to tangentially elongate, averaging 36.3 × 43.5 μm. Midrib fleshy, with the dorsal surface flattened to slightly concave, with the ventral surface narrowly convex. Tubers apical, from microphyllous, geotropic apices. Rhizoids numerous, scattered along the ventral surface of the stem, hyaline. Dioicous, dimorphic. Male plants somewhat smaller than female plants. Antheridia maturing acropetally, in 2 or 3 scattered rows along the dorsal surface of the midrib and associated with the basal portion of the wings, overarched basipetally by lobed marginal extensions of the lamellae. Female plants with 5 to 9 archegonia in distinct clusters on the dorsal surface of the midrib, with each cluster surrounded by a pseudoperianth. Pseudoperianths at maturity campanulate, 1(2) medially positioned along the midrib, with the outer surface occasionally bearing leaf-like outgrowths; the mouth erect or recurved, with the margin broadly sinuate and dentate to subdentate, cilia lacking, with 1(2) sporophyte(s) maturing per pseudoperianth. Capsules spheroidal, 1.4–2.3 mm diam., dark olive brown to black; the epidermal cells quadrate, light yellow with scattered dark red-brown nodular thickenings; the cells of the inner layers gradating from quadrate to elongate, with dark red-brown thickening bands gradating from nodular to semiannular to annular, dehiscence irregular. Spores 40–52 μm diam., light brown to dark red-brown, disassociated when mature, areolate, with (4)5 or 6 areolae across the distal face; the areolae 10–12 μm wide; the proximal surface areolate, with a central depression. Elaters numerous, smooth, elongate, rarely to occasionally branched, with the outer wall light yellow, smooth, with 2 to 4 (occasionally 5 or 6) dark red-brown spirals. Gemmae absent.

Habitat. Exposed, compact or loose, sandy or gravely soil, often in disturbed areas, or near temporary ponds.

Distribution. Scattered locations in the Gulf Coastal Plain of North America, extending into the southern portion of the Interior Highlands; from southern Arkansas to southern Louisiana west to east and central Texas.

Paratypes. U.S.A. **Texas:** Bastrop Co., Bastrop State Park, well-drained sandy soil along roadside, 12 Mar. 1997, *Stotler & Stotler-Crandall 3980* (ABSH; dupl. in FAA); nr. Bueschner State Park, well-drained sandy soil, corner of CR 180 & Park Road 1C, 13 Mar. 1997, *Stotler & Stotler-Crandall 3998* (ABSH; dupl in FAA); Bueschner State Park, wet seep area under grass clumps, 13 Mar. 1997, *Stotler & Stotler-Crandall 4003* (MO; dupl. in FAA at ABSH).

A NEW SPECIES OF *PETALOPHYLLUM* FROM NEW ZEALAND

During the late 1800s, the Reverend William Colenso described two New Zealand species of *Petalophyllum*, namely *P. australe* Colenso as "*australis*" (Colenso, 1885) and *P. macrocalyx* Colenso (Colenso, 1886). No specimens of these two species have been located in the intervening years by any hepaticologist: not in WELT, which contains many of Colenso's types, nor in BM, which holds numerous of his bryophyte types that he had sent to Hooker (Galloway, pers. comm.), nor in G, where he sent specimens to Stephani. In a revision of Colenso's Hepaticae by Stephani (1893) neither of these two species was mentioned, but Stephani did state that there were other Colenso species published of which he had not received specimens. Hodgson (1967) appears to be the first to recognize the publication of these two Colenso species. She realized that several New Zealand specimens of *Petalophyllum* that she had studied were not assignable to *P. preissii*, a species described from Australia. She revived the oldest Colenso name, *P. australe*, to accommodate these and apparently in order to deal with the name *P. macrocalyx*, simply listed it as a synonym. This, of course, is contrary to nomenclatural rules. She stated that she had ". . . adopted Colenso's name for this species because Gottsche's description of *P. preissii* . . . does not quite fit New Zealand plants" (Hodgson, 1967: 192). Our initial hope was to designate one of the Hodgson specimens as a neotype for *P. australe*, but this was not possible since none of that material conformed to the protologue. The Hodgson plants are clearly not what Colenso had described as *P. australe*; rather, his description of plants with large, much lacinate pseudoperianths fits *P. preissii* fairly well. Nor can the Hodgson specimens be *P. macrocalyx*, which Colenso described as being small plants with leaves and red rhizoids. That description, in fact, fits a member of the genus *Fossombronia* rather than *Petalophyllum*. We found that the Hodgson material represents an undescribed species of the genus distinguished from all other species of *Petalophyllum* by a suite of diagnostic characters. It is here named in honor of E. Amy Hodgson, the amateur botanist who laid the foundation for modern New Zealand hepaticology.

Petalophyllum hodgsonii C. H. Ford & Stotler-Crandall, sp. nov. TYPE: New Zealand. North Island: Morere Bush, Wairoa, on bank along path to baths, Sep. 1947, *E. A. Hodgson 11297* (holotype, MPN).

Magnitudine *Petalophyllum ralfsii* simulans, differt a *P. ralfsii* costa lata complanata, archegoniis pigmentiferis, ore pseudoperianthii sinuato vel dentato, sine ciliis.

Populations not observed in nature; herbarium specimens light yellow green, occurring as isolated individuals, loose mats or in scattered small patches on sand and humus. Plants large, 9.5–13.3 mm long, 6.6–10.2 mm wide, often (once) twice or more furcate. Thallus elliptic to ovate, slightly to highly undulate, with the wings lamelliferous. Wings flattened to suberect, multistratose at the base, becoming unistratose at the margin, with the margin broadly sinuate; the median cells thin-walled, quadrate to elongate, with the marginal cells slightly distinct, quadrate to slightly tangentially elongate, 28.9–53.2 μm long by 24.7–55.1 μm wide. Lamellae leaf-like, suberect to erect, running obliquely along the thallus wings, tapering to or almost to the thallus wing margins, unistratose, multistratose at the base, up to 20 cells in height at the highest point, slightly to highly undulate. Midrib broad and fleshy, with the dorsal surface slightly compressed, with the ventral surface strongly flattened. Tubers 0(1), apical, from microphyllous, geotropic apices. Rhizoids numerous, scattered along the ventral surface of the stem, hyaline. ?Dioicous. Male plants not observed. Female plants with 8 to 15 dark red or unpigmented archegonia in distinct clusters along the dorsal surface of the midrib, with each cluster surrounded by a pseudoperianth. Pseudoperianth at maturity subcampanulate, 1 to 3 terminal or medially positioned along the midrib, with the outer surface lacking wings or leaf-like outgrowths; the mouth erect to incurved or recurved, with the margin undulate, dentate to sinuate, lacking cilia, with 1 sporophyte maturing per pseudoperianth. Capsules brown-black; the epidermal cells quadrate, light yellow with scattered dark red-brown nodular thickenings, with the cells of the inner layers gradating from quadrate to elongate, with dark red-brown nodular wall thickenings gradating from semiannular to annular, dehiscence irregular. Spores 39.9–51.3 μm diam., brown, disassociated when mature, areolate, with 3 or 4 areolae across the distal face, with the areolae 9–10 μm across; the proximal surface areolate, with a central depression. Elaters abundant, elongate, rarely to occasionally branched, attenuate, with the outer wall light yellow, smooth, with 2 or 3 red-brown spirals. Gemmae absent.

Habitat. Along stream banks among ferns and humus.

Distribution. New Zealand.

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A New Andean Species and a New Combination in *Oreobolopsis* (Cyperaceae)

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ABSTRACT. *Oreobolopsis inversa*, a new species of Cyperaceae from the Andes occurring in Ecuador and Peru, is fully described and illustrated. It differs from *Oreobolopsis tepalifera* Koyama & Guaglianone by its stiff erect leaves and tepals shorter than the achene. The habit of the new species is very similar to *Trichophorum rigidum* (Steudel) Goetghebeur, Muasya & Simpson, but there are some remarkable differences in floral morphology between the two. In addition, the combination *Oreobolopsis clementis* (M. E. Jones) Dhooge & Goetghebeur is made.

Key words: Andes, Cyperaceae, *Oreobolopsis*, *Trichophorum*.

The genus *Oreobolopsis* was described by Koyama and Guaglianone (1987) based on a single species, *Oreobolopsis tepalifera*. The well-developed, membranous tepals are the most conspicuous aspect of the genus. During our study of a number of scirpoid specimens from the Americas, the presence of two additional species became evident, one new taxon from the Andes, and another from California, U.S.A., which was initially described as *Scirpus clementis* M. E. Jones and recently transferred to *Trichophorum* Persoon by Smith (1995).

Oreobolopsis inversa Dhooge & Goetghebeur, sp. nov. TYPE: Ecuador. Azuay: Parque Nacional de Las Cajas, along road Soldados–Angas, ca. 13 km from Soldados, 79°17′W, 02°53′S, alt. 3900–4000 m, 2 May 1992, *S. Laegaard 102684* (holotype, GENT; isotypes, AAU, QCA, QCNE). Figure 1.

Herba perennis rigida. Folia erecta. Spicula solitaria terminalis. Glumae inferiores vacuae 3. Glumae floriferae 3–4. Flos bisexualis tepalis 3 + 3, squamiformibus, persistentibus, achenio brevioribus. Achenium brunneum, obovatum, trigonum.

Perennial, rhizomatous herb, forming dense tussocks (Fig. 1A). Roots up to 1 mm wide, brownish. Culm (4–)11–25 cm long, 0.5–0.9 mm wide, erect, terete with 8 to 10 ribs, rounded-trigonous below the inflorescence, scabrous distally. Leaves stiff and erect, shorter than longest culms; sheaths brown; blades (2–)5–11 cm long, 0.5–0.7 mm wide, green, acute, margins scabrous, upper part asymmetrical (surface of adaxial side is reduced to rib toward leaf tip). Ligule membranous, brown. Inflorescence of a single pseudolateral spikelet, 4–6 × 2–3 mm (Fig. 1B). Involucral bracts 2; lower bract pseudoterminal, 13–19 mm long, scabrous, with an awn 10–18 mm long; the upper bract 4–6 mm long, glumiform, scabrous, with an awn 1–3 mm long. Glumes spirally arranged, brown, elliptical, glabrous; lower glumes 3–3.5 mm long, empty, obtuse; fruit-bearing glumes 3 or 4, 3–4 mm long, obtuse, sometimes bifid at tip. Flowers bisexual. Tepals 3 + 3, scale-like, shorter than achene (Fig. 1C); outer whorl of tepals 1–1.4 × 0.5–0.9 mm, pale, obtuse or bifid; inner whorl of tepals 0.5–1 × 0.2–0.5 mm, irregularly lobed, pale, often with a central, reddish, acute tip. Stamens 3; anthers about 1 mm long, opening with 2 longitudinal slits, red-tinged; filaments pale brown. Ovary 3-carpellate; stigma branches 3, papillose. Achene 1.5–1.7 × 1–1.3 mm, obovate, trigonous, brown, glabrous (Fig. 1D).

Paratypes. ECUADOR. **Azuay:** paramos, in vicinity of Toreador, between Molleturo and Quinoas, alt. 3810–3930 m, 15 June 1943, *J. A. Steyermark 53173* (NY); paramo de Soldadas-Angas, at highest point of road, 79°17′W, 02°52′S, alt. 3950–4050 m, 14 Feb. 1988, *S. Laegaard 70109* (AAU, GENT, NY); paramo de Soldados, SW of Cuenca, 79°17′W, 2°53′S, alt. 3700–3800 m, 24 Oct. 1984, *S. Laegaard 53241* (AAU, GENT, NY); paramo de Soldadas, 79°18′W, 02°53′S, alt. 3700–4000 m, 28 Aug. 1985, *S. Laegaard 55106* (AAU, GENT, NY); near pass in Parque Nacional las Cajas, W of Cuenca, 79°14′W, 02°40′S, alt. 4150 m, 22 Oct. 1984, *S. Laegaard 53190* (AAU, GENT, NY). **Bolívar:** 6 km on road Salinas–los Arenales, grass paramo and open rocks, 79°0′W, 1°22′S, alt. 4000 m, 2 Oct. 1985, *S. Laegaard 55331* (AAU, GENT, NY). PERU. **Ancash:** Yungay, Huascarán National Park, 77°34′W, 8°59′S, alt. 4000–4300 m, 12 Jan. 1985, *D. N. Smith et al. 9124* (U); Huaylas, Huascarán National Park, 77°46′W, 8°53′S, alt. 3960–4400 m, *D. N. Smith et al. 9987* (U).

ANATOMICAL OBSERVATIONS (TERMINOLOGY ACCORDING TO METCALFE, 1971)

The transverse section of the lamina is thickly crescentiform, except at the apex where ellipsoidal.

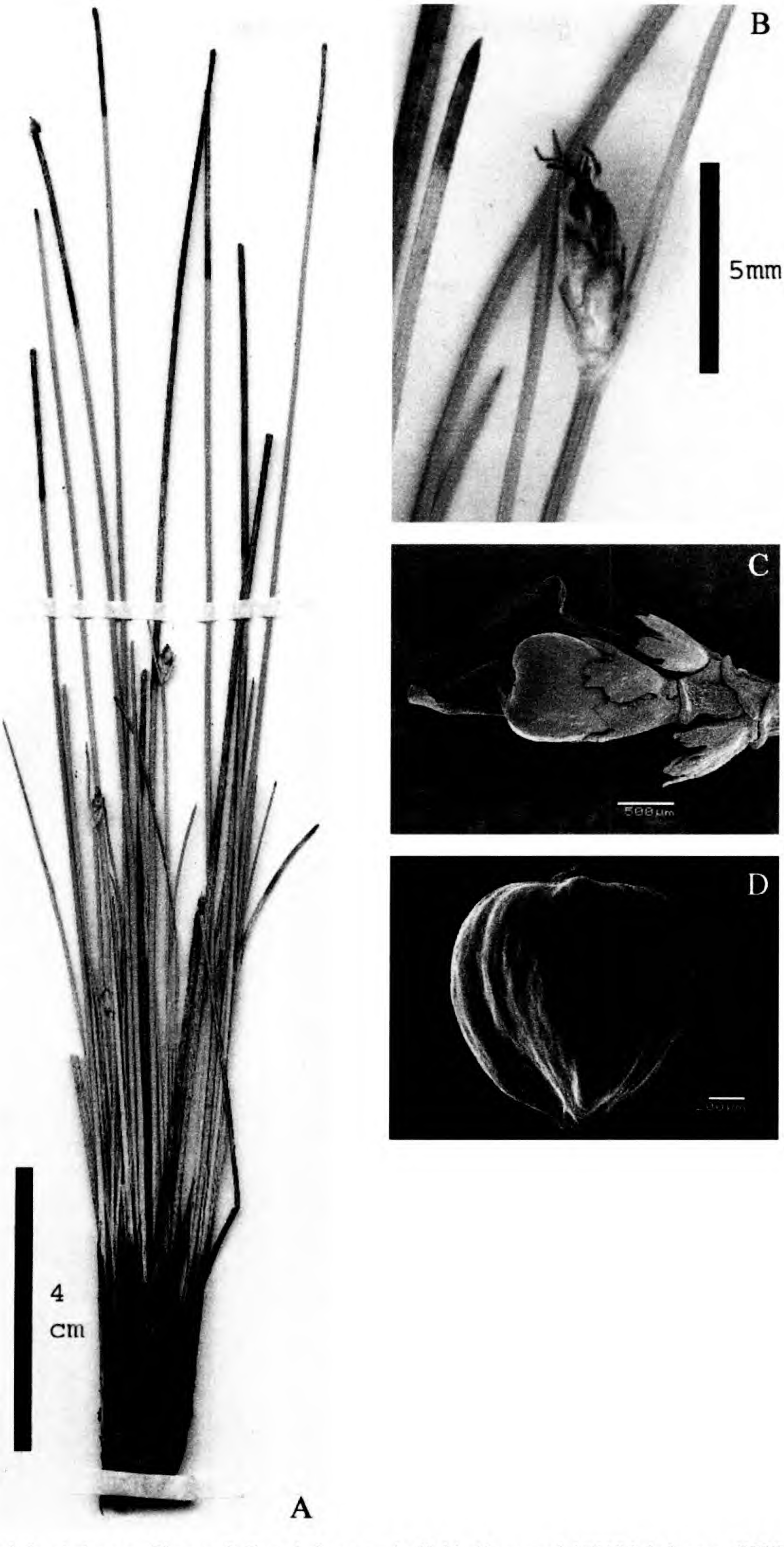

Figure 1. *Oreobolopsis inversa* Dhooge & Goetghebeur. —A. Habit (*Laegaard 102684*, holotype, GENT). —B. Detail of spikelet (*Laegaard 102684*, GENT). —C. Spikelet with glumes removed showing fruit and perigynous scales (*Laegaard 55331*, AAU). —D. Fruit (*Laegaard 55331*, AAU).

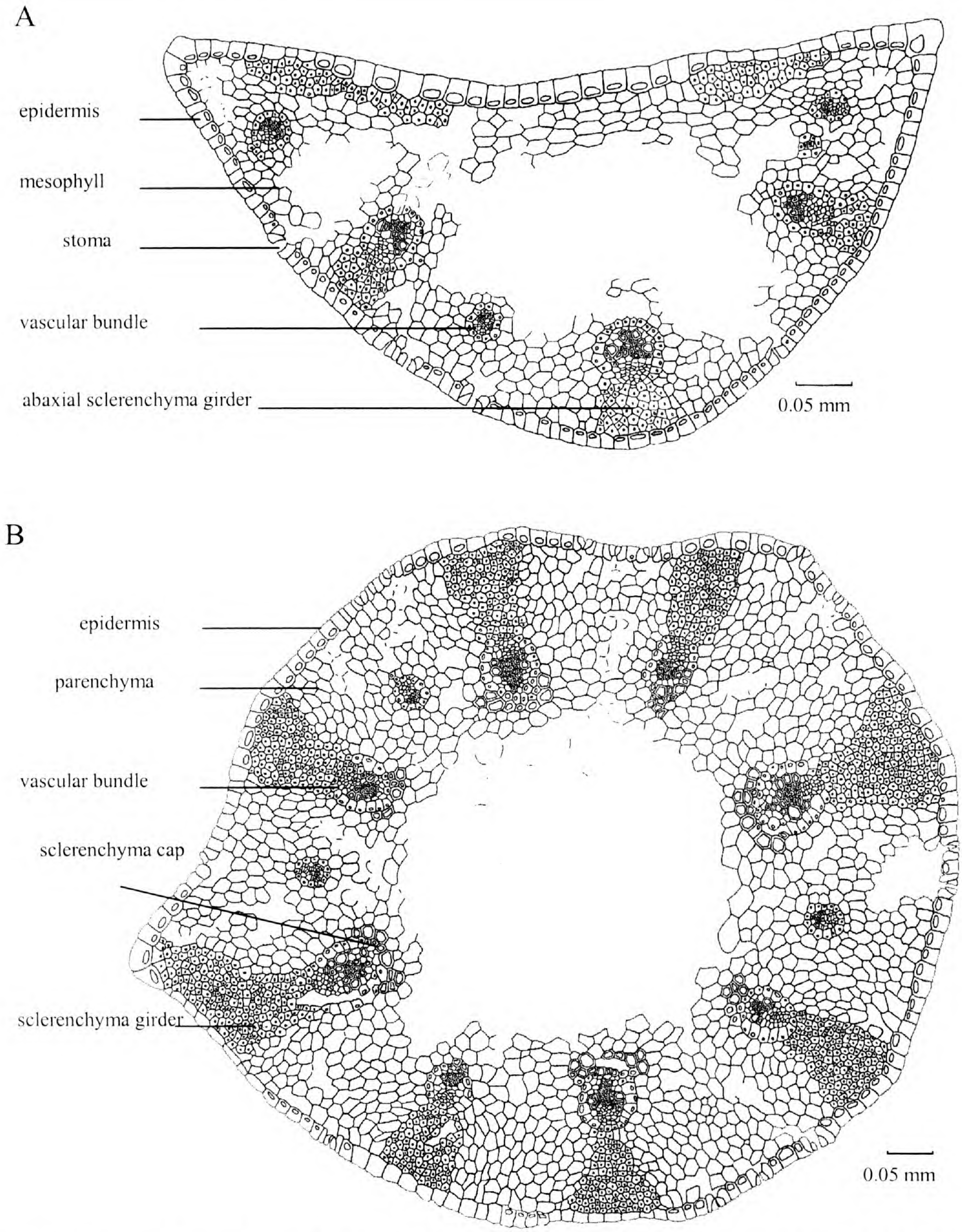

Figure 2. Anatomical section through the lamina (A) and culm (B) of *Oreobolopsis inversa* (*Laegaard 53190*). (Drawn by S. Dhooge.)

The lamina margins are continuously scabrous. *Epidermis*: Contrary to many Cyperaceae, the size of the epidermal cells on both surfaces is more or less alike. The outer periclinal wall of epidermal cells is strongly thickened. *Stomata* only abaxial. *Mesophyll*: a homogeneous tissue of parenchymatous cells. In the leaf center, lysigenous air cavities are present. At the periphery, the mesophyll is interrupted by strands of sclerenchyma opposite the vascular bundles. Adaxially, the sclerenchyma comprises only a few (2–3) columns resting against the epidermis. Abaxially, the sclerenchyma connects the epidermis with the largest vascular bundles, forming abaxial girders (Fig. 2A). Adaxial

Table 1. Main differences between *Oreobolopsis inversa* and *Trichophorum rigidum*.

	Oreobolopsis inversa	*Trichophorum rigidum*
Perianth segments	+	–
Fruit length (mm)	1.5–1.7	1.8–2
Fruit width (mm)	1.2	1
Fruit color	chestnut	dark brown–black
RHS colour chart	grayed orange group 165 A	brown group 200 A
Ligule form	straight	arched

caps often are associated with the vascular bundles. Vascular bundles (5 or 6) are surrounded by a *bundle sheath* consisting of two layers: an inner sheath composed of cells with U-shaped thickenings and an outer sheath of thin-walled cells. Bundle sheaths surrounding minor vascular bundles are more clearly marked than those surrounding the major vascular bundles. The vascular bundles are collateral and of two different shapes: the minor vascular bundles are circular; the major ones are elliptical. Xylem consists of xylem vessels and xylem parenchyma, phloem of sieve cells and phloem parenchyma.

The transverse section of the culm is circular, with or without a wavy outline, to rounded triangular under the inflorescence. *Epidermis*: Cells with a strongly thickened outer periclinal wall. The *parenchyma* of the culm is homogeneous but the central tissue is broken down and looks like a three-dimensional meshwork ("net" type, Metcalfe, 1971: 28). *Vascular bundles* (11 to 18) are in the periphery of the culm (Fig. 2B), supported by a sclerenchyma girder (at the phloem side, toward the epidermis) and a sclerenchyma cap at the xylem side. The minor vascular bundles are only provided with 2 caps. In the lower half of the culm, small air cavities appear between the vascular bundles. *Bundle sheath*: see description under lamina. The vascular bundles are collateral with endarch xylem and exarch phloem.

THE AFFINITY OF *OREOBOLOPSIS INVERSA* AND *TRICHOPHORUM RIGIDUM*

Koyama (in Koyama & Guaglianone, 1987: 84) reported the presence of scale-like perianth segments in the bisexual flowers of certain specimens identified by him as "*Scirpus rigidus.*" This species, invariably without perianth segments, was recently transferred to *Trichophorum*, as *Trichophorum rigidum* (Steudel) Goetghebeur, Muasya & D. A. Simpson (Muasya et al., 2000).

A number of specimens, earlier included under *Scirpus rigidus*, are here described as *Oreobolopsis inversa* based on the presence of perianth segments. The epithet alludes to its opposite characters (tepals shorter than the achene and the larger size of the plant) compared with the first described species, *Oreobolopsis tepalifera*. Specimens of *O. inversa* are contrasted with specimens of *Trichophorum rigidum* (without perianth segments), because in gross morphology they look very much alike. The fruit and the ligule, however, are conspicuously different in shape (Table 1). Future DNA studies could be used to support or refute our morphological interpretation.

A CALIFORNIAN SPECIES OF *OREOBOLOPSIS*

Mention should also be made of a small scirpoid species occurring in California (U.S.A.), *Scirpus clementis* M. E. Jones. This species recently was transferred to *Trichophorum* by S. G. Smith (1995: 102). However, this species is distinct from a typical *Trichophorum* due to the presence of scale-like perianth segments, which is the most striking feature of *Oreobolopsis.*

Oreobolus R. Brown looks superficially like *Oreobolopsis* because it also has scale-like perianth segments. The structure of the 1-flowered spikelet and the distichous leaves, however, make *Oreobolus* clearly distinct from *Oreobolopsis*. In addition, the embryos are different: *Oreobolus* has a caricoid embryo with a clear basal root cap, while the embryo of *Oreobolopsis* (inclusive of *O. clementis*) has a subbasal root cap (Van der Veken, 1964). Therefore, we assume that *Oreobolopsis* is the most appropriate generic name for *Scirpus clementis*.

Oreobolopsis clementis (M. E. Jones) Dhooge & Goetghebeur, comb. nov. Basionym: *Scirpus clementis* M. E. Jones, Contr. W. Bot. 14: 21. 1912. *Trichophorum clementis* (M. E. Jones) S. G. Smith, Novon 5: 102. 1995. TYPE: U.S.A. California: Rae Lake, King's River, alpine, 20 July 1910, *Mrs Clements s.n.* (lectotype, designated by Smith (1995), POM; isolectotypes, DS, POM).

Scirpus yosemitanus F. J. Smiley, Univ. Calif. Publ. Bot. 9:

108. 1921. TYPE: U.S.A. California: Yosemite National Park, Tuolumne Meadows, Soda Springs, 8 Aug. 1898, *J. W. Congdon s.n.* (holotype, GH).

KEY TO THE ANDEAN SCIRPOID GENERA

1a. Inflorescence a dense head of several spikelets, hypogynous bristles well developed . . *Phylloscirpus*

1b. Inflorescence of 1 terminal spikelet 2

  2a. Hypogynous scales absent 3

    3a. Leaves ligulate . . . . *Trichophorum*

    3b. Leaves eligulate . . . . . *Scirpus boliviensis* (generic allocation under study)

  2b. Hypogynous scales present 4

    4a. Spikelet 1-flowered, leaves distichous . . . . *Oreobolus*

    4b. Spikelet 3- or 4-flowered, leaves tristichous . . . . *Oreobolopsis*

KEY TO THE SPECIES OF *OREOBOLOPSIS*

1a. Slender, rigid plants, longer culms 10–25 cm tall . . . . *O. inversa*

1b. Plants < 9 cm tall.

  2a. Leaves acute; achene > 1.5 mm long, surface smooth . . . . *O. tepalifera*

  2b. Leaves muticous; achene ≤ 1.5 mm long, surface reticulate . . . . *O. clementis*

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Bombacaceae Neotropicae Novae vel Minus Cognitae III. Nuevas Especies de *Matisia* y *Quararibea* de Colombia

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RESUMEN. Se describen e ilustran cuatro nuevas bombacáceas de Colombia, pertenecientes a los géneros *Matisia* (*M. gentryi* y *M. racemifera*) y *Quararibea* (*Q. cryptantha* y *Q. rangelii*). Las dos especies de *Quararibea* descritas, corresponden a grupos muy distintivos no previamente conocidos en territorio colombiano. Una de las especies nuevas de *Matisia* presenta flores dispuestas en ramas cortas áfilas, formando racimos bracteados; este último carácter, único en todo el género, se describe aquí por primera vez.

ABSTRACT. Four new Bombacaceae from Colombia, two species of *Matisia* (*M. gentryi* and *M. racemifera*) and two of *Quararibea* (*Q. cryptantha* and *Q. rangelii*), are described and illustrated. The two new species of *Quararibea* belong to two distinctive groups, which have not been previously reported in Colombia. One of the new species of *Matisia*, *M. racemifera*, has flowers arranged in short leafless branches that form bracteate racemes; the latter character, unique in the genus, is here described for the first time.

Key words: Bombacaceae, Colombia, *Matisia*, *Quararibea*.

Continuando con los trabajos previos al tratamiento de la tribu Quararibeae para el territorio colombiano, iniciados hace ya varios años (Fernández-Alonso, 1992, 1996, 1999a, 1999b) y formando parte de la nueva serie "Bombaceae neotropicae novae . . ." (Fernández-Alonso, 2001a, 2001b), se describen en esta tercera entrega, cuatro bombacáceas nuevas provenientes de Colombia. Las plantas estudiadas corresponden a colecciones relativamente recientes efectuadas en el Chocó central, Valle medio del Magdalena y en la Sierra Nevada de Santa Marta.

Matisia gentryi Fernández-Alonso, sp. nov. TIPO: Colombia. Chocó: ca. 50 km al E de Las Ánimas, 4 km al E del río Pato, Carretera Panamericana, 250 m, 11 Ene. 1979 (fl, fr), *A. Gentry & E. Rentería 23984* (holótipo, COL 204320; isótipos, HUA-11533, MO 1281065). Figura 1.

Haec species *Matisiae cordatae* Bonpland affinis sed ab ea lamina foliari plerumque late obovata raro orbiculata, lobis brevioribus usque ad 15 mm longis, basi cordata trinervi et nervis duabus submarginalibus minoribus munita, nervis secundariis 5 ad 9 utrinsecus nervum medium atque fructu elipsoideo-fusiformi calyce majore craterformi margine uniformiter sinuato-lobato basi ad eum adpresso subtento distinguitur.

Árboles de hasta 30 m; yemas terminales con brácteas crasas, subcoriáceas, triangulares o anchamente triangulares de 3–4(7) × 2.5–3 mm, con indumento muy fino, equinado-tuberculado. Hojas laxamente agrupadas en el extremo de las ramas jóvenes; estípulas triangulares de hasta 7 mm de longitud; peciolo de (4.5)5.5–12 cm × 2–3 mm, pulvínulos proximal y distal notorios, de 3–4 mm de diámetro; láminas de anchamente obovadas a orbiculares, de (11–)13–23 × (9–)10–20 cm, cordadas en la base con senos cortos, de hasta 1.5 cm de longitud (profundidad), el ápice obtuso, redondo, a veces emarginado; el márgen levemente sinuoso-ondulado; nervios basales 3, siendo el central mas desarrollado y los adyacentes de escasa longitud en la lámina, generalmente con otros dos nervios submarginales, poco desarrollados; nervios secundarios de 5 a 8 (9) a cada lado del nervio medio principal; nerviación terciaria paralela, perpendicularmente dispuesta a los nervios secundarios; nerviación cuaternaria de tipo poligonal-reticulada, escasamente resaltada (Fig. 1B); indumento tanto en el pecíolo como en el envés diminutamente equinado-tuberculado, disperso y por la haz subglabra. Inflorescencias ramifloras dispuestas en formaciones nodosas; pedicelo de 15–18 mm, con 3 bractéolas dispuestas en la mitad basal del pedicelo, prontamente caducas; cáliz obcónico de 2–2.2 cm de longitud y 1.5–1.7 cm de diámetro en el margen distal, el margen irregularmente rasgado; tanto el pedicelo como la cara externa del cáliz (en seco), de color marrón, con indumento finamente equinado-tuberculado, la cara interna con indumento seríceo, blanquecino; pétalos de color crema, suberectos en la antesis, anchamente espatulados, de hasta 3.5 × 1.2 cm, obtusos en el ápice, la cara externa densamente recubierta con pelos estrellados cortos, la

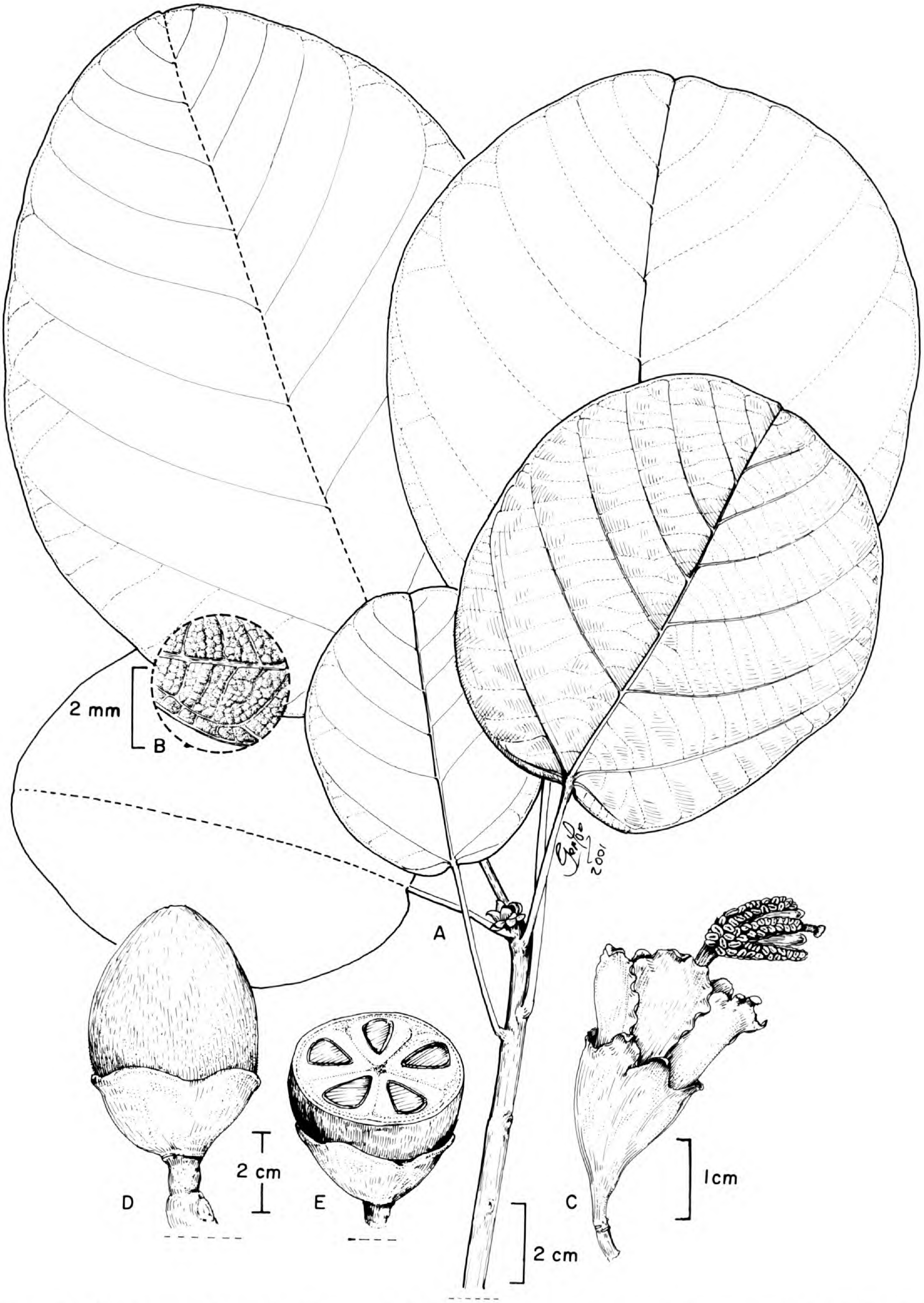

Figura 1. *Matisia gentryi* Fernández-Alonso. —A. Ápice de una rama con brácteas de la yema terminal. —B. Detalle de la superficie de la lámina por la haz. —C. Flor. —D. Fruto en vista lateral. —E. Fruto, sección transversal. (Dibujado a partir de la serie típica, *A. Gentry & E. Rentería 23984.*)

cara interna con indumento denso seríceo acostado; columna estaminal de 2.3–2.8 cm con indumento estrellado de radios muy cortos, ramas estaminales de hasta 1.2–1.4 cm × 2 mm de ancho, con abundante indumento glandular y con pelos largos sinuoso-aracnoides. Pedicelo fructífero de 1.8–2 cm × 5–7 mm; cáliz fructífero cupular, ceñido al fruto en el 1/3–1/4 basal, de ca. 2 cm de longitud × 4–4.5 cm de diámetro, con margen uniformemente (4)5-sinuado-lobado; frutos (Figs. 1D, E) marrones, de ovales a ovoide-fusiformes, de 6–7 × 4.5–5 cm, ligeramente truncados en el ápice, con apículo central inconspícuo; pericarpo recubierto por indumento fasciculado-estrellado, mesocarpo fibroso-carnoso con 5 pirenos corneo-leñosos, reniformes de ca. 3 × 1.5 × 1 cm, semilla farenocotilar.

Distribución y hábitat. Conocida solo por la colección tipo, proveniente de los bosques pluviales del Chocó central en la planicie del pacífico colombiano. Esta colección fue citada en el catálogo de las plantas del departamento del Chocó (Forero & Gentry, 1989) bajo el nombre *M. cordata* Bonpland, nombre con el que fueron distribuidos los duplicados.

Etimología. Especie nombrada en recuerdo de Alwyn H. Gentry, una de las personas que mejor conoció la composición y la estructura de los bosques del pacífico colombiano. Gentry colectó gran cantidad de bombacáceas en los transectos efectuados en el litoral pacífico y llamó la atención sobre una particularidad de los bosques del Chocó, la presencia de hasta 6 ó 7 especies de *Matisia* en parcelas de 0.1 hectárea (Gentry, 1986). Parte de sus colecciones (algunas infértiles), fueron el punto de partida para nuevas expediciones de colección, que permitieron completar la información descriptiva de algunas especies nuevas.

Discusión. *Matisia gentryi* es afín a *M. cordata*, especie ampliamente distribuida en el norte de Sudamérica y en menor medida, afín a *M. longitubulosa* (A. Robyns) Cuatrecasas de la Amazonía peruana (Robyns, 1968). De *M. cordata* se diferencia por presentar ésta, hojas ampliamente ovadas, siempre con mas de 5 nervios basales y bases mas ampliamente cordadas (lóbulos generalmente de mas de 15 mm de profundidad), tubo estaminal mas largo (de 3.5–5 cm), ramas estaminales también mas largas (de 1.4–2.5 cm), cáliz fructífero brevemente cupuliforme, escasamente acrescente y fruto marcadamente apiculado (en seco). De *M. longitubulosa* se diferencia por presentar ésta, hojas elípticas con 7–9 nervios basales, pedicelos florales mas largos (de ca. 25 mm) y al igual que en *M. cordata* tanto el tubo, como las ramas estaminales son de mayor longitud.

Matisia racemifera Fernández-Alonso, sp. nov. TIPO: Colombia. Chocó: Mpio. de Quibdó, km 7 en la vía Quibdó–Yuto, bosque entresacado, 300 m, 13 Ago. 1998 (fl, fr), *J. L. Fernández-Alonso, F. García & estudiantes Univ. Chocó 16719* (holótipo, COL 421861 (1 de 2, fl), 421857 (2 de 2, fr); isótipos, COL 421858, CHOCO, MA, MO, US). Figura 2.

Haec species ad sectionem *Calyculatas* Fernández-Alonso praeclare pertinet, sed a ceteris speciebus sectionis inflorescentiis racemosis in ramos pendulos breves aphyllos bracteatos dispositis, stipulis magnis 2–3 cm longis, calyce exalato atque fructu longe rostrato distinguitur.

Árboles de 12–15 m; tronco con corteza externa oscura; ramificación verticilada y ramas péndulas; las jóvenes densamente recubiertas de indumento tomentoso marrón-ferrugíneo. Hojas dísticas; estípulas cartáceas, caudadas, linear-lanceoladas, de 2–3 × ca. 0.5 cm, densamente estrellado-tomentosas (Fig. 2A); peciolo de 1.3–3.5 cm, con indumento estrellado-ferrugíneo denso, con el pulvínulo proximal muy poco conspicuo y el distal notorio; láminas cartáceas, de estrechamente obovadas a oblanceoladas, de 21–35(46) × 9–14(17) cm, base redondeado-cordada, agudas, ligeramente acuminadas en el ápice, acumen de 1–3 cm; nervios basales 5 a 7, de los cuales 4, muy poco conspícuos; nervios secundarios 4–5 a cada lado del nervio medio principal, broquidódromos; en la haz excavados y en el envés resaltados; nerviación de 3° y 4° orden paralelo-reticulada, resaltada en el envés; haz verde claro (en vivo), con denso indumento estrellado, de radios largos, rojizo; envés con el mismo indumento, densamente dispuesto en los nervios y menos denso en la lámina. Racimos dispuestos en ramas floríferas péndulas (Fig. 2B), de 25–40 cm, con las partes jóvenes tomentoso-ferrugíneas, con brácteas y flores; por cada flor se presentan 2 brácteas florales de estrechamente triangulares a lanceoladas, de 1.6 a 1.8 cm de longitud; pedicelos de 4–5 mm en botón floral, con 3 bractéolas ferrugíneas, estrechamente lanceoladas, de 1.2–1.5 cm × 2–3 mm, dispuestas a modo de calículo; cáliz fusiforme antes de la apertura del botón, levemente estriado, sin costas, de 1.2–1.4 cm, con indumento amarillento, estrellado, disperso; corola blanca. Pedicelo fructífero de 1–1.2 cm, con brácteas y bractéolas persistentes. Fruto de 2.8–2.9 cm (incluido el cáliz), cáliz fructífero cupular, de 1 × 1.8 cm, irregularmente lobado en el margen distal (Fig. 2C); fruto verde, ovado-apiculado, levemente 5-sulcado, de 2.6 × 1.6 cm, pico (rostro) cilíndrico de

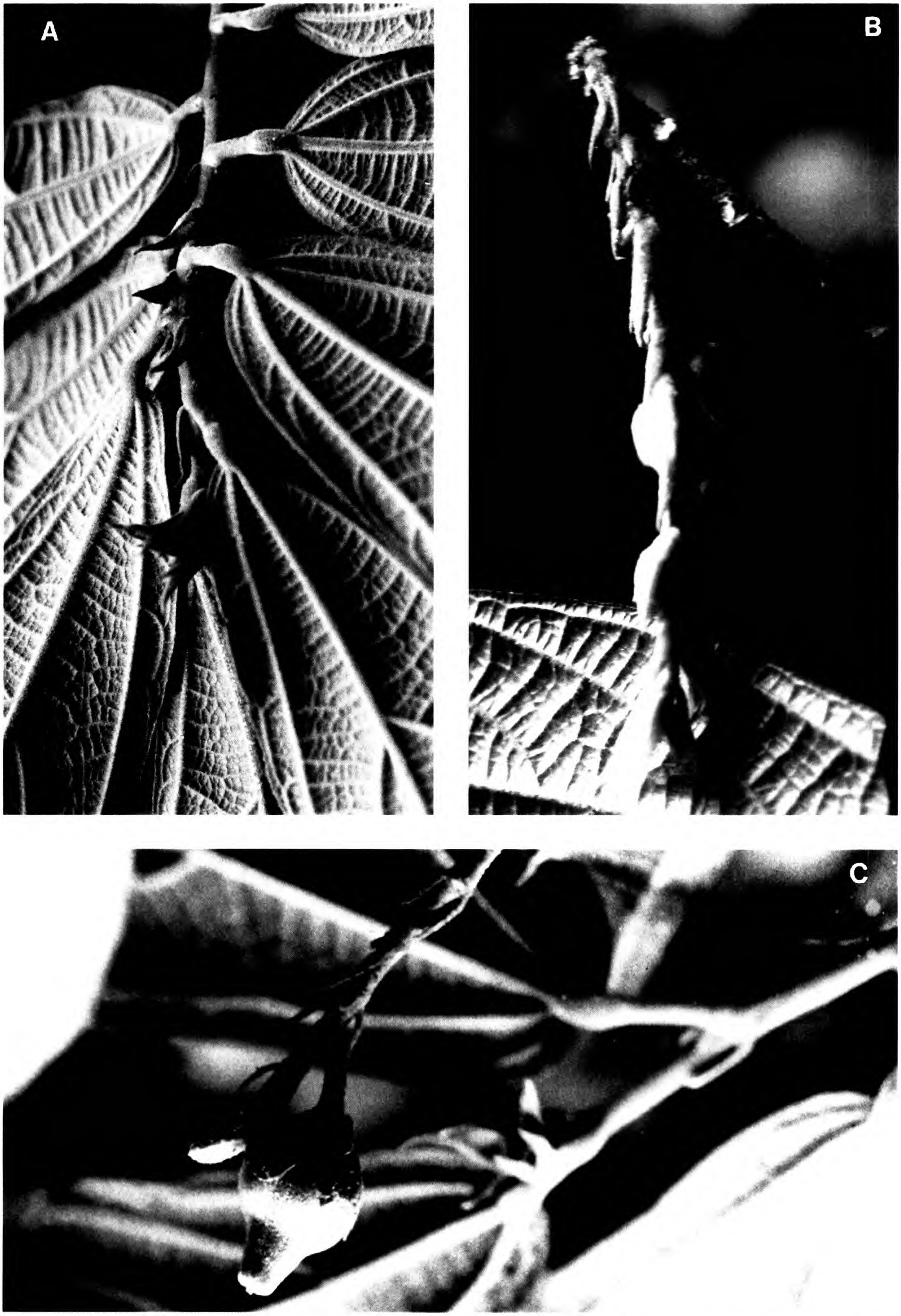

Figura 2. *Matisia racemifera* Fernández-Alonso. —A. Detalle de las estípulas e indumento en una rama joven. —B. Rama florífera áfila, con botones florales. —C. Detalle de un fruto desarrollado. (Fotografías tomadas del espécimen tipo, *Fernández-Alonso et al. 16719.*)

1 cm de longitud × 0.3 cm de ancho, exocarpo lepidoto-ferrugíneo.

Distribución y hábitat. *Matisia racemifera* fue recolectada por primera vez con flores en 1998, en cercanías de Quibdó (Chocó). Crece al igual que la especie anterior, en bosques pluviales del Chocó central, en la cuenca del río Atrato. Estas formaciones vegetales, asentadas sobre lomas bien drenadas, son muy ricas en Bombacaceae y en especial en elementos de la tribu Quararibeae. Las Bombacaceae colectadas en la localidad típica junto con *M. racemifera,* en un área no mayor de 5 hectáreas, fueron: *Matisia bullata* Fernández-Alonso, *M. castano* H. Karsten & Triana, *M. cordata, M. leptandra* (Cuatrecasas) Cuatrecasas, *M. idroboi* Cuatrecasas sensu lato y *M. valdes-bermejoi* Fernández-Alonso & Castroviejo, *Pachira aquatica* Aublet, *Pachira* cf. *sessilis* Bentham, *Eriotheca squamigera* (Cuatrecasas) Fernández-Alonso, *Huberodendron patinoi* Cuatrecasas, *Patinoa almirajo* Cuatrecasas y *Phragmotheca siderosa* Cuatrecasas subsp. *siderosa.*

Etimología. El nombre de la especie hace referencia a sus flores dispuestas en racimos bracteados, infrecuentes en el género.

Discusión. *Matisia racemifera* se ubica claramente en la recientemente establecida sección *Calyculatae* (Fernández-Alonso, 2001a), por sus bractéolas caliculiformes, y se separa del resto de las especies de la sección por presentar inflorescencias racemosas dispuestas en ramas largas, áfilas. Además se caracteriza por presentar estípulas inusualmente grandes (2–3 cm de longitud) y densamente tomentosas, cálices no alados y frutos largamente apiculado-rostrados. En estado vegetativo recuerda notablemente a *Matisia hirta* Cuatrecasas, por la forma de las hojas y el largo indumento (Cuatrecasas, 1946); no obstante ésta puede separarse con facilidad de *M. racemifera* por presentar flores aisladas, opuestas a las hojas y pedicelos florales mas largos, con bractéolas florales no verticiladas, dispuestas en la zona media del pedicelo. En *Matisia dolichosiphon* (A. Robyns & S. Nilsson) W. S. Alverson de Panamá, planta vegetativamente muy diferente a *M. racemifera* (asignable a la sect. *Castano* Fernández-Alonso), se han descrito también inflorescencias ramifloras paniculiformes, en nada parecidas a las que aquí se describen (Robyns & Nilsson, 1970).

Parátipos. COLOMBIA. **Chocó:** Mpio. de Quibdó, km 7 en la vía Quibdó–Yuto, bosque entresacado, 300 m, 13 Ago. 1998, *J. L. Fernández-Alonso et al. 16701* (CHOCO, COL, MA, MO); Mpio. de Tadó, Corregimiento de Salero, 1998–1999, *F. García 299a* (CHOCO); vía Quibdo–Tutunendó, ca. 3 km al oeste de Tutunendó, bosque pluvial tropical, 80 m, 5°46′N, 76°35′W, 5 Ene. 1981, *A. Gentry et al. 30139* (JAUM), ibídem, transecto 9, 7 Ene. 1981, *A. Gentry 30308* (JAUM).

Quararibea cryptantha Fernández-Alonso, sp. nov. TIPO: Colombia. Magdalena: Sierra Nevada de Santa Marta, Corregimiento de El Campano, 1300 m, 5 Jul. 1986 (fl), *E. Carbonó 2029* (holótipo, UTMC; isótipos, COL 500088, MO, UTMC). Figura 3.

Haec species *Quararibeae floribundae* (A. Saint-Hilaire & Naudin) K. Schumann et *Q. yunckeri* Standley affinis, sed ab eis habitu arborescente, foliis membranaceo-chartaceis, ovali-lanceolatis vel oblongo-lanceolatis; subtus domatiis sacciformibus, papyraceis, ebarbatis ad axillas nervorum secundariorum munitis; pedicello 0.8–1 mm longo, calyce viridi, urceolato-campanulato 6–7 mm longo, ad apicem irregulariter 2 vel 3 fisso atque tubo staminali usque ad 11 × 1 mm, distinguitur.

Árboles de ca. 8 m con ramificación verticilada; yemas glabrescentes; hojas dísticas con olor a fenogreco o regaliz (en seco); estípulas diminutas prontamente caducas, con indumento lepidoto adpreso; pecíolos verde amarillentos de 0.6–0.9 cm de largo, con pulvínulo distal de ca. 3 × 1.5 mm (Fig. 3); láminas verde pálido, membranoso-cartáceas, generalmente inequiláteras, de oval-lanceoladas a oblongo-lanceoladas, de (9–)11–14 × (4–)5–6.5 cm, base ligeramente desigual, de cuneada a ligeramente cordada; de subagudas a obtusas en el ápice; haz verde pálido, subglabra con tricomas lepidotos muy dispersos (en los nervios), el envés subglabro; con 5 a 7 nervios laterales a cada lado del nervio medio, excavados en la haz y resaltados en el envés; con domacios sacciformes papiráceos, ubicados en la confluencia de los nervios secundarios con el nervio medio; nerviación de tercer y cuarto orden ligeramente resaltada en el envés. Inflorescencias en ramitas muy cortas, axilares o ramifloras, con hasta 6(8) flores sésiles; pedicelo de hasta 0.8–1 mm de longitud; con 3 bractéolas de ca. 0.8 mm de longitud, obtusas, dispuestas a modo de calículo, densamente lepidotas. Flores actinomorfas; cáliz campanulado-urceolado de 6–7 mm de longitud (Fig. 3), externamente lepidoto, internamente seríceo; con 3 a 5 lobulos marginales, desiguales, papiráceos, de 1.5–2 mm de longitud; pétalos blancos, estrechamente espatulados de 12–13 × 2–3 mm, patentes, con indumento seríceo; columna estaminal de ca. 11 mm de longitud × 1 mm de grosor, subglabra en la mitad inferior y estrellado-tomentosa en la mitad superior; las tecas agrupadas en la zona ensanchada distal (de ca. 3 × 2 mm); lóbulos de la columna estaminal de ca. 1 mm; las tecas 35 a 40, de reniformes a elipsoides, de ca. 0.5 mm de longitud, por lo general agrupa-

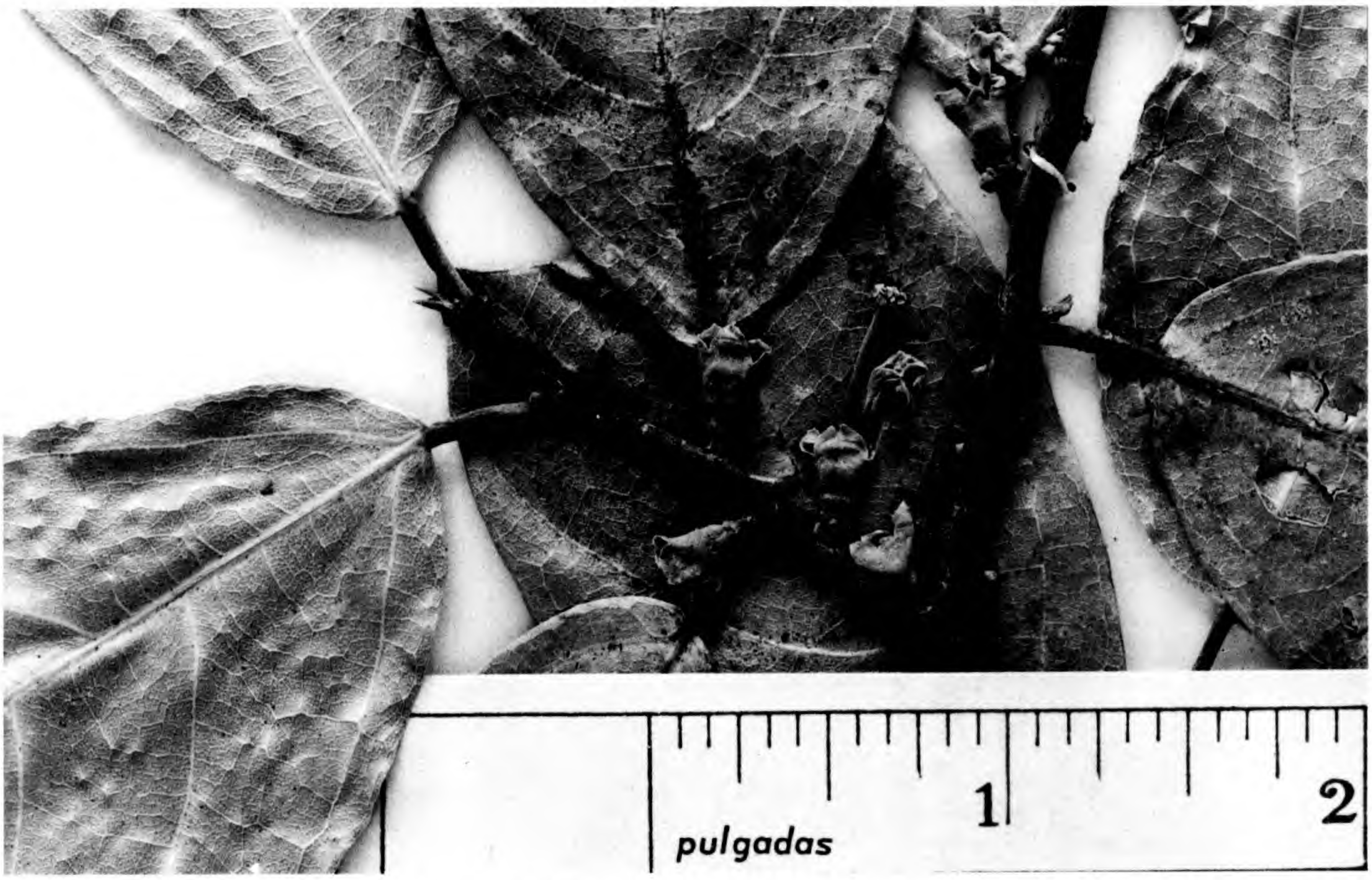

Figura 3. *Quararibea cryptantha* Fernández-Alonso. Detalle de una rama con flores; en el centro una flor con la columna estaminal y pétalos desprendidos del tálamo floral. (Fotografiado de la serie típica, *E. Carbonó 2029*.)

das de a dos; ovario bilocular, con 1 o 2 óvulos por lóculo. Fruto (muy jóven) fusiforme, comprimido, de ca. 3 × 2.2 mm, con exocarpo lepidoto. Semillas desconocidas.

Distribución y hábitat. *Quararibea cryptantha* se conoce sólo de las estribaciones del sector noroccidental de la Sierra Nevada de Santa Marta, en la franja subandina y por una colección de la Serranía del Perijá, recolectada en ambientes similares. De acuerdo con los estudios adelantados en la región (Rangel, 1994), *Q. cryptantha*, se encuentra en bosques dominados por: *Viburnum tinoides* L. f. (Caprifoliaceae), *Parathesis adenanthera* (Miquel) Hooker f. ex Mez (Myrsinaceae), *Prunus integrifolia* (C. Presl) Walpers (Rosaceae) y *Citharexylum subflavescens* S. F. Blake (Verbenaceae).

Etimología. El epíteto específico hace referencia a las flores muy pequeñas y poco conspícuas de ésta especie de *Quararibea*, que son las de menor tamaño entre las especies colombianas y de las mas pequeñas en todo el género.

Discusión. *Quararibea cryptantha* pertenece a un grupo de especies que presentan flores muy pequeñas—grupo de *Q. yunckeri* Standley de Centroamérica/*Q. floribunda* (Saint-Hilaire) K. Schumann de Brasil. *Quararibea cryptantha*, se diferencia de ellas por la siguiente combinación de carácteres: hábito arborescente; hojas membranoso-cartáceas, de oval-lanceoladas a oblongo-lanceoladas, en el envés con domacios sacciformes en las axilas de los nervios secundarios; papiráceos, no barbados; pedicelo de 0.8–1 mm de longitud, cáliz verde, urceolado-campanulado, de 6–7 mm de longitud, irregularmente 3 a 5 lobulado hacia el ápice; tubo estaminal de 11 × 1 mm.

Por el reducido tamaño de sus flores, *Q. cryptantha* representa la antítesis de *Q. ruiziana* Fernández-Alonso (1999b), especie recientemente descrita de Colombia, que presenta flores grandes, con ramas estaminales muy largas y fruto con 3–4 pirenos.

Aunque el género *Quararibea* ya se conoce de la Serranía del Perijá por una colección reciente de *Q. foenigracea* Cuatrecasas sensu lato (*Fernández 13210*, COL) y de la planicie atlántica por la especie *Q. asterolepis* Pittier (*Warner 507*, FMB), *Q. cryptantha* es la única *Quararibea* registrada hasta la fecha en el macizo de la Sierra Nevada de Santa Marta. Con respecto al patrón de distribución restringido a Sierra Nevada-Perijá se ha observado también en otros grupos, así en las Labiatae *Hyptis diffusa* Epling y *Salvia codazzina* Fernández-Alonso y en la Scrophulariaceae *Calceolaria leucanthera* Pennell (Fernández-Alonso, 1995a, 1995b; Molau, 1988). Estas tres especies eran conocidas originalmente solo de uno de los dos macizos, habiéndose colectado mas recientemente en ambos.

Parátipos. COLOMBIA. **Cesar:** Serranía del Perijá, Mpio. de Agustín Codazzi, Vereda Cara de Hombre, 1750 m, 25 May 1994, *O. Rangel et al. 12415* (COL, HUA, MA, MO, UTMC).

Quararibea rangelii Fernández-Alonso, sp. nov. TIPO: Colombia. Boyacá: Mpio. de Puerto Boyacá, Quebrada La Cristalina, 400 m, bosque entresacado, 21 Sep. 1996 (fl, fr), *O. Rangel-Ch. 13475* (holótipo, COL 500093; isótipos, COL 500094, HUA, MA, MO, US). Figura 4.

Haec species quoad calycem manifeste sulcato-aristatum *Quararibeae pterocalycis* Hemsley leniter affinis, sed ab ea stipulis longioribus (2–3 cm longis), foliis membranaceis, florum minorum calyce 2.1–2.3 cm longo, costulis valde sinuatis, petalis ad 4–4.3 cm longis et 6–7 mm latis, sub anthesi retroflexis; columna staminali 2.2–2.4 cm longa; fructu 2.5–2.7 longo et 3–3.5 cm lato, saepe inaequilatero maturitate, plerumque monopyreno distinguitur.

Árboles de hasta 15–20 m, troncos con corteza marrón-grisácea y madera amarillo pálido; ramas con corteza marrón, estriada, muy levemente aromática (en seco); ápice de las ramas jóvenes rematado por un fascículo de brácteas estipuliformes (Fig. 4A) estrechamente linear-lanceoladas de 2.5–4 cm de longitud y hasta 4 mm de ancho en la base. Hojas dísticas; estípulas 2, prontamente caducas, estrechamente lanceoladas, de 2–3 cm × 3–4 mm, membranoso-papiráceas, con indumento lepidoto en la lámina y estrellado-fasciculado en los márgenes. Hojas con pecíolos de 1.5–2(2.8) cm de largo, con indumento estrellado-lepidoto muy fino, pulvínulo proximal notorio, elíptico, de 4–8 × 2.5–3.5 mm, con aspecto de callo, pulvínulo distal inconspícuo; láminas verde pálido por la haz y verde amarillento por el envés, membranosas, estrechamente lanceoladas, por lo general escasamente asimétricas, de 30–45 × 9–15(–17) cm, cuneadas en la base y de agudas a acuminadas en el ápice; glabras y levemente lustrosas por la haz y glabras por el envés; con nerviación pinnada, el nervio medio y 2 nervios basales laterales poco desarrollados y hasta 9 nervios secundarios a cada lado del nervio medio; impresos en la haz y resaltados en el envés; nerviación de 3° y 4° orden reticulada, ligeramente resaltada. Inflorescencias de 1 a 4 flores subsésiles agrupadas en ramas muy cortas; en botón rodeados por varias brácteas estériles de la yema (Fig. 4B) y con 3 bractéolas triangulares de 3–5 mm, sobre el pedicelo, cerca de la base del cáliz; pedicelo floral de 2–4 mm de largo, con indumento estrellado-fasciculado corto; flores actinomorfas (Fig. 4C); cáliz cilíndrico, de 2.1–2.3 × 1–1.2 cm, con 10 costillas sinuosas, muy conspícuas a lo largo del caliz, con indumento densamente estrellado-lepidoto; pétalos de 4–4.3 cm × 6–7 mm, reflejos, externamente blanquecinos con indumento estrellado, internamente subglabros; columna estaminal de 2.2–2.4 cm de longitud, estrellado-serícea, las anteras dispuestas en la zona ensanchada distal (de 3.5 mm de longitud y 3.5 mm de ancho) levemente lobada, los lóbulos de ca. 1–2 mm (Fig. 4D); anteras ca. 40, estrechamente reniformes. Fruto verde-anaranjado o verde-amarillento (en vivo), notoriamente oblicuo-asimétrico (Fig. 4E, F), de subesférico a reniforme, comprimido, de 2.5–2.7 × 3–3.5 cm, por lo regular con un solo pireno desarrollado; exocarpo con estrias longitudinales, marrón claro (en seco), estrellado-lepidoto; pireno corneo, de ca. 3.3 × 1.8–2 cm, fibroso en el exterior y liso-brillante en la cara interna. Semilla con testa marrón oscuro y cotiledones blanquecinos; semilla criptocotilar.

Nombres vernáculos y uso. En Puerto Boyacá, la localidad típica (según las etiquetas de herbario), se la conoce por los siguientes fitónimos: "Guamo rosado" y "Coco cristal". La madera es blanda y se utilizada en la región para la construcción de corrales (*Galeano et al. 5894*).

Distribución y hábitat. Las colecciones conocidas de *Quararibea rangelii* provienen del inventario recientemente efectuado en la Serranía de las Quinchas, en el sector boyacense del valle del Magdalena. Los bosques húmedos donde crece *Q. rangelii*, ubicados sobre substratos calizos y con 2500–3200 mm de precipitación anual, han sido caracterizados botánicamente en fechas recientes (Balcazar-Vargas et al., 2000). Según las parcelas levantadas en el estudio citado, *Quararibea rangelii*, es una especie muy frecuente en los bosques de *Hura crepitans* L. (Euphorbiaceae) y *Romeroa verticillata* Dugand (Bignoniaceae), dominados por las familias Acanthaceae, Bignoniaceae, Bombacaceae y Euphorbiaceae. Otras Bombacaceae con interés corológico para la región y presentes en estas formaciones sobre sustrato calizo son: *Matisia cordata*, "zapote comestible", que es especie nativa, *M. obliquifolia* Standley, "zapote de monte", ampliamente distribuida en Panamá y en el norte de Sudamérica; *M. longiflora* Gleason (sensu stricto), descrita del sector de Muzo en los años 30, y posteriormente localizada solo del otro lado del Magdalena en las formaciones kársticas del Cañon de Rio Claro (Fernández-Alonso & Cogollo, 1992); *Huberodendron patinoi* y una especie afin a *Quararibea asterolepis*, perteneciente a un complejo cuya taxonomía no ha sido aún plenamente resuelta para el territorio colombiano.

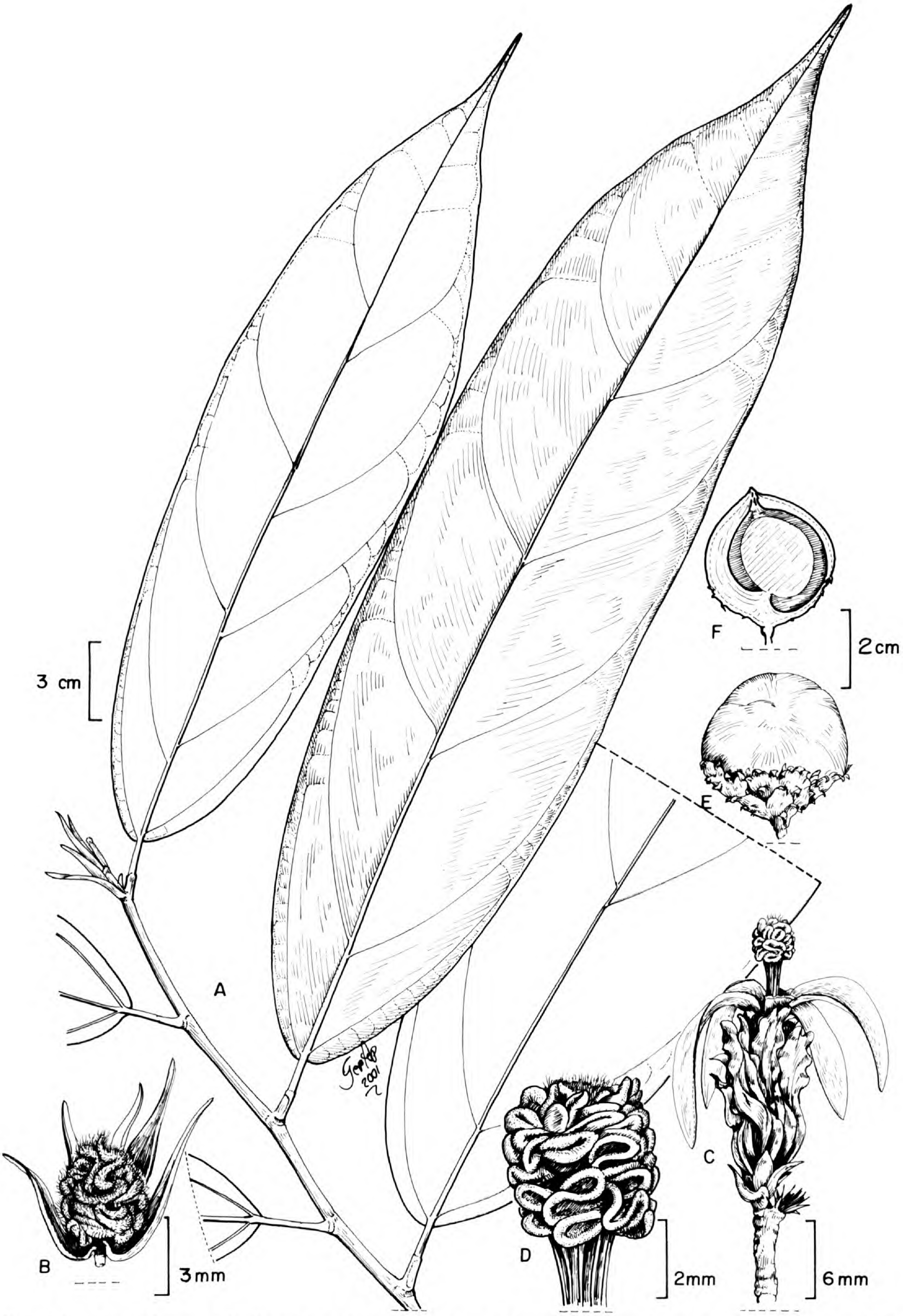

Figura 4. *Quararibea rangelii* Fernández-Alonso. —A. Aspecto de una rama con hojas, estípulas y brácteas de la yema. —B. Botón floral mostrando las bractéolas en el pedicelo. —C. Detalle de una flor en el extremo de una rama corta. —D. Detalle de la porción superior de la columna estaminal con las anteras. —E. Fruto en vista lateral. —F. Sección sagital del fruto con un pireno. (Dibujado a partir de: A de *P. Franco et al. 5760*; B y E de *J. Betancur 6681*; C, D y F de *O. Rangel-Ch. 13475*.)

Hasta donde se conoce, *Q. rangelii*, se encuentra restringida a la vertiente occidental de la Cordillera Oriental de Colombia. Todos los registros provienen de la Serranía de las Quinchas, Magdalena Medio (Boyacá), en la franja de bosques de terraza, ubicada a 300–700 m. *Quararibea rangelii* se suma a la importante lista de taxones endémicos del Magdalena Medio colombiano, que incluye numerosas especies y algunos géneros (Fernández-Alonso et al., 2000).

Etimología. Especie dedicada al botánico colombiano y colega Orlando Rangel Churio (COL), quien centró sus esfuerzos en la descripción y en el conocimiento integral de las comunidades vegetales de Colombia, con resultados admirables. Fruto de una de sus numerosas exploraciones por el territorio colombiano son las muestras de la serie tipo de la especie aquí descrita.

Discusión. Quararibea rangelii es ligeramente afín a *Q. pterocalyx* Hemsley por presentar cálices marcadamente sulcado-aristados, pero se diferencia de ella entre otros caracteres por sus estípulas mas largas (2–3 cm long.), hojas membranáceas, mas alargadas; flores menores, cáliz de 2.1–2.3 cm de longitud, con costillas marcadamente sinuadas, pétalos menores, de 4–4.3 cm de longitud y 6–7 mm de ancho, reflejos en la antesis, columna estaminal mas corta de 2.2–2.4 cm de longitud, fruto menor y muy comprimido, de 2.5–2.7 × 3–3.5 cm, a menudo inequilátero y en la madurez por lo general con un solo pireno desarrollado.

Parátipos. COLOMBIA. **Boyacá:** Mpio. de Puerto Boyacá, Inspección de Puerto Romero, alrededores de la Quebrada La Fiebrecita, 400–680 m, 11 Oct. 1996 (fr), *J. Betancur 6681* (COL, HUA); Quebrada La Fiebrecita, 300 m, 23 Nov. 1997 (fl), *G. Galeano et al. 5894* (COL, FMB, UPTC); Vereda La Cristalina, bosque secundario en terraza, 21 Sep. 1996, *E. Linares et al. 4413* (COL, JAUM); Puerto Romero, Vereda Las Palomas, 380 m, 15 Jun. 1997, *P. Franco et al. 5760* (COL, F, JAUM); Quebrada La Cristalina, 400 m, bosque en base de ladera, 21 Sep. 1996, *O. Rangel et al. 13.489* (COL, MO).

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Notes and New Species of *Moraea* (Iridaceae: Iridoideae) from the Southern African Winter-Rainfall Zone

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ABSTRACT. *Moraea cantharophila* and *M. lilacina* are new species of the African genus *Moraea* (ca. 195 species), of subfamily Iridoideae of the Iridaceae. Both species belong to *Moraea* subg. *Vieusseuxia*, which comprises 35 species restricted to southern Africa and is centered in the southern African winter-rainfall zone. *Moraea cantharophila*, from southwestern Western Cape Province, has unusual flowers for the subgenus with entire relatively large inner tepals with a broad dark median streak on the claw. It is distinguished from its closest relative, the fly-pollinated *M. lurida*, by the shallower floral cup and unscented nectarless flowers. *Moraea lilacina*, from the northern Langeberg foothills in the Little Karoo of southeastern Western Cape Province, can be distinguished from the related *M. unguiculata* by its relatively large flower, pink pigmentation, trilobed inner tepals with a long, erect central cusp, and often densely hairy filament column. Nomenclatural adjustments include the reduction of *M. neopavonia* in *M. tulbaghensis* and the provision of a new name for the homonym *M. flexuosa* Goldblatt. Newly discovered populations of *M. saxicola* and *M. rivulicola* increase their known geographical ranges and require some adjustment to their delimitation.

Key words: beetle pollination, Iridaceae, Iridoideae, *Moraea*, *Moraea* subg. *Vieusseuxia*.

Moraea Miller, now comprising some 195 species (Goldblatt, 1998; Goldblatt & Manning, 2000a), is the largest African genus of tribe Irideae of the Iridoideae, one of four subfamilies of the Iridaceae currently recognized (Goldblatt, 1990, 2001). *Moraea*, including *Barnardiella*, *Galaxia*, *Gynandriris*, *Hexaglottis*, *Homeria*, and *Roggeveldia*, occurs widely across sub-Saharan Africa and has two species in the Mediterranean–Middle East; it is now defined by bifacial, channeled to flat leaves and a unique type of cormous rootstock consisting of a single enlarged internode that is derived entirely from an axillary bud (Goldblatt, 1976b, 1990). The genus is currently divided into five subgenera (Goldblatt, 1986). *Moraea* subg. *Vieusseuxia*, to which the new species belong, is restricted to southern Africa, south of the Limpopo–Cunene axis, and is centered in the winter-rainfall zone in the southwest of the subcontinent. Including the new species described here and the synonymous reduction of *M. neopavonia* R. C. Foster in *M. tulbaghensis* L. Bolus, *Moraea* subg. *Vieusseuxia* now includes 35 species.

The winter-rainfall zone of southern Africa is the center of *Moraea* both in species diversity and evolutionary depth. All five subgenera and over two-thirds of the species of the genus occur in this small portion of the African continent, extending from southwestern Namibia along the western and southern coast of South Africa to Port Elizabeth. This area of highly dissected landscape and a mosaic of different soils has very steep ecological gradients that expand the number of ecological niches available for plant species. This situation has promoted extraordinary radiation in a range of genera in many plant families there, including geophytic genera of Iridaceae like *Babiana* (ca. 75 species), *Geissorhiza* (over 80 species), *Gladiolus* (some 145 species), and of course *Moraea* (Goldblatt & Manning, 2000b). Many species of the southern African winter-rainfall zone have narrow ranges, and as might be expected of a flora of semi-arid to arid habitats, flowering is often dependent on the highly variable seasonal rainfall. The flowering of geophytes such as *Moraea* is also related to the fire cycle, an important factor in the vegetation of the region. One of the species described here, *M. cantharophila*, flowers well only after wild fires, and at some sites evidently only in the first spring season after fire. The other new *Moraea* described here is a narrow

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geographic endemic of dry valleys in the central southern Cape. Variable rainfall, narrow distributions, and erratic flowering make the documentation of the southern African geophyte flora difficult. It is not so surprising then, that new species of narrow distribution or of specialized habitat continue to be discovered in a part of the world that has enjoyed the attention of botanists for over 230 years since Linnaeus's student Carl Peter Thunberg collected there in the 1770s. We suspect that additional species, especially geophytes, will continue to be recognized as local exploration of the flora continues.

Exsiccatae are cited below following the quarter-degree square system in use in southern Africa as outlined by Edwards and Leistner (1971).

1. Moraea cantharophila Goldblatt & J. C. Manning, sp. nov. TYPE: South Africa. Western Cape: Sandy's Glen, loamy clay slope on farm Vredehoek, 16 Sep. 2000, *P. Goldblatt & J. C. Manning 11542* (holotype, NBG; isotypes, K, MO, PRE). Figure 1.

Plantae 20–45 cm altae, cormo globoso 15–20 mm diam. tunicis reticulatis fibrosis pallidis obtecto, folio unico producto lineari canaliculato 2.5–3.5 mm lato, caule erecto usitate ramoso, inflorescentiae spatha externa 35–45 mm longa, interna 45–65 mm longa, floribus albis vel cremeis tepalis externis prope basem limbi flavo- vel aurantiaco-notatis, tepalorum unguibus plerumque flavis ca. 10 mm longis, limbis patentibus, externis (15–)18–20 × 14–19 mm, internis 8–15 × 5–11 mm, filamentis 4–5 mm longis in columnam omnino connatis vel superne per 1 mm liberis, antheris purpureis ca. 6 mm longis, styli ramis 6–7 mm longis cristis 2.5–4 mm longis ornatis, ovario exserto 7–12 mm longo, capsula oblongoidea, 16–18 mm longa.

Plants 20–45 cm high. *Corm* globose, 15–20 mm diam., the tunics of coarse, pale straw-colored, netted fibers. *Cataphylls* papery, uppermost reaching shortly above the ground, becoming dry and dark brown by flowering time. *Foliage leaf* solitary, linear, channeled, arching outward, overtopping the stem and often dry toward the tip, mostly 2.5–3.5 mm wide, inserted on the stem at or close to ground level. *Stem* erect, straight or flexed at nodes, always arching outward below the inflorescence, usually with two aerial internodes, bearing an entirely sheathing bract-like leaf at the aerial node, this 4.5–5.5 cm long, green with a ± dry, attenuate apex, simple or with one, rarely two branches in the leaf axil and aerial node, the branches arching outward above the sheathing leaf. *Inflorescence* a rhipidium, terminal on the branches, mostly 2- or 3-flowered; *spathes* unequal, green, with dry attenuate apices, the outer 35–45 mm long, the inner 45–65 mm long. *Flowers* white or cream, the tepals

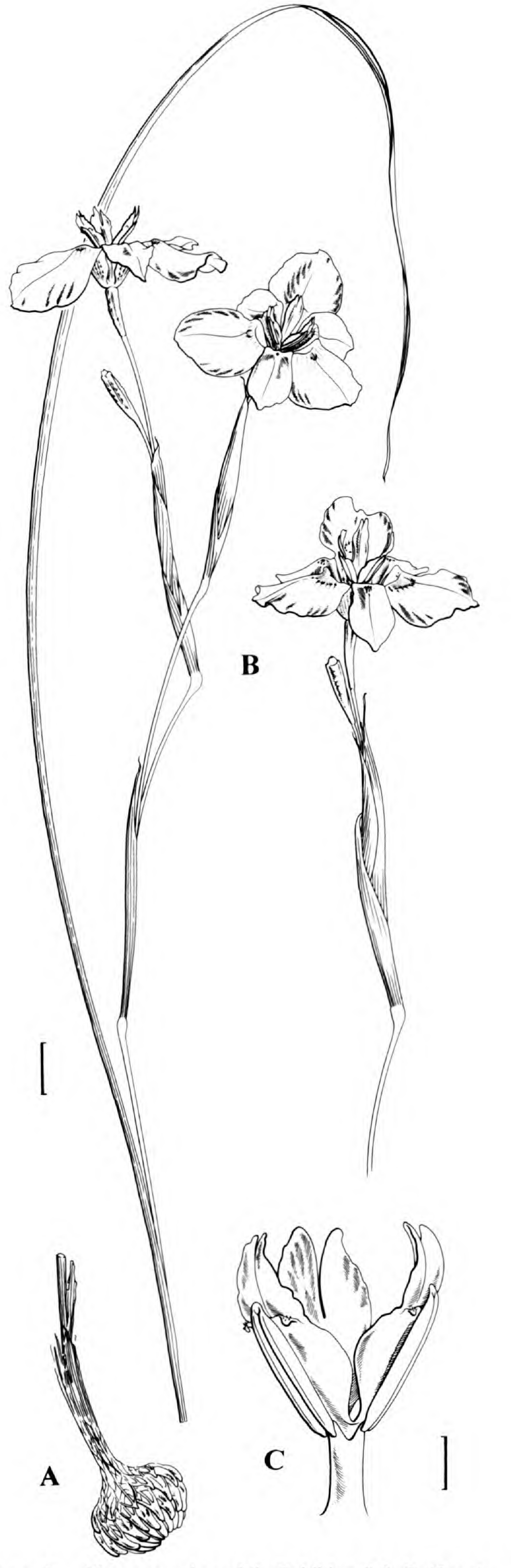

Figure 1. *Moraea cantharophila* Goldblatt & J. C. Manning (*Goldblatt & Manning 11580*). —A. Corm. —B. Flowering stem and leaf. —C. Detail of stamens and style branches. Scale bar 1 cm (A, B), 3 mm (C). Drawn by J. C. Manning.

darkly veined on the outside, the outer tepals each with a yellow or orange nectar guide outlined in dark purple at the limb base, the claw mostly yellow, the inner tepals each with a broad, dark purple-brown central band and pinkish edge, the tepal limbs spreading ± horizontally or the tips curving slightly upward, the claws ascending, forming a cup ca. 12 mm wide at the mouth, enclosing the filament column and anther bases; *tepals* clawed, the outer larger than the inner, the claws ca. 10 mm long, limb of the outer tepals obovate, (15–)18–20 × 14–19 mm, without a basal nectary, the claw smooth or papillate, limb of the inner tepals 8–15 × 5–11 mm. *Filaments* 4–5 mm long, united in a cylindric column or free in the upper 0.5–1 mm, smooth, greenish to dark purple; *anthers* ca. 6 mm long, oblong, diverging, appressed to the style branches, purple, the pollen orange. *Ovary* exserted, oblong-triquetrous, 7–12 mm long; *style* dividing at the apex of the filament column, yellow to salmon pink with a dark central band, the branches 6–7 × ca. 3 mm, ascending, the stigmatic flap bilobed, the crests triangular, uniformly salmon pink, ± erect, 2.5–4 mm long. *Capsules* ± oblong, 16–18 mm long; *seeds* unknown.

Flowering late August and September, rarely in early October; flowers lasting 3 days, the tepals arching upward and partially closing at night.

Etymology. From the Latin *cantharophila*, "beetle-loving," referring to the pollinators, hopliine scarab beetles, which visit the flowers and transfer pollen from one plant to another.

Distribution and habitat. Restricted to the southwestern Cape, *Moraea cantharophila* occurs on mountain slopes between the foot of Sir Lowry's Pass near Somerset West and Sandy's Glen in the Bredasdorp Mountains near Napier. It grows in loamy clay and not in the coarse sandy substrate that is more common in the Cape mountains.

Relationships. A member of subgenus *Vieusseuxia* (Goldblatt, 1976b, 1986), *M. cantharophila* has a single, long, channeled foliage leaf typical of the subgenus, a branched stem, but unlike the majority of the species the inner tepals are not tricuspidate, but are broadly lanceolate with an entire, acute apex. It is distinctive in the shape of the inner tepals, and it is one of the few species in the subgenus with entire inner tepals with a broad, well-developed limb. The filaments are united to the apex, also rare in the subgenus, in which most species have the upper 1–2 mm of the filaments free and diverging. The dark central streak on the inner tepals is distinctive and is directly related to the pollination biology. *Moraea cantharophila* is evidently most closely related to two other southwestern Cape species, *M. lurida* Ker Gawler and *M. insolens* Goldblatt, which also have entire inner tepals with a well-developed limb. Fly-pollinated *M. lurida* has flowers with a fetid, rotting scent and typically a darker-colored perianth, both the inner and outer tepals of which produce nectar over the entire inner surface of the claw, and the outer tepals do not usually have contrastingly colored markings. An important distinction between *M. lurida* and *M. cantharophila* is that the tepal claws of the former are relatively long, 13–17 mm, and slightly exceed the claw, compared to ca. 10 mm in *M. cantharophila*, this shorter than the limb. The tepal cup is thus deeper in *M. lurida* and includes both stamens and style branches. The anthers are partly exserted in *M. cantharophila*. *Moraea insolens* has rather different flowers with the short tepal claws spread almost horizontally, thus not forming a cup, and the anthers are ca. 8 mm long and exceed the short style crests less than 1 mm long (Goldblatt, 1976b). It is pollinated by hopliine beetles, as is *M. cantharophila*, and lacks nectaries, thus producing no nectar (Goldblatt et al., 1998; Goldblatt, unpublished data).

All three species occur in the same area, that is, from Sir Lowry's Pass eastward to Cape Agulhas, but *M. insolens* has the narrowest range, occurring along a band of loamy soil at the foot of the Caledon Swartberg. *Moraea lurida* occurs only on stony, sandstone-derived soils. These three species flower well after a wild fire the previous summer or autumn, and *M. cantharophila* and *M. lurida* flower poorly, if at all, until another fire. The known populations of *M. cantharophila* vary to some extent. The flowers of the Sir Lowry's Pass population lack floral odor entirely, and the inner tepals are white with a broad, dark median streak, like those of the Sandy's Glen plants, which have a broad, dark brown streak in the midline. The tepals of the Sir Lowry's Pass plants are smaller and 8–9 × 5–6 mm vs. 12–15 × 9–11 mm in the Sandy's Glen population.

Plants collected in the Elgin area east of Sir Lowry's Pass (*Goldblatt 11633, 11638*) appear to be an unusual form of *Moraea cantharophila* and may represent a form intermediate between this species and related *M. lurida*. Although they have white flowers with yellow inner tepals with a dark median streak or yellow inner and outer tepals, the inner tepals have short limbs mostly 3–4 × 5 mm, either entire or three-lobed with a short, acute central cusp. The flowers have an unpleasant, fetid odor, and the outer tepal claws are lightly papillate and produce a sweet exudate. Typical *M. canthar-*

ophila has entire inner tepal limbs 8–15 × 5–11 mm. The fetid odor and sweet exudate on the tepal claws are features of *M. lurida* (Goldblatt, 1986, and unpublished obs.), which has short inner tepal limbs that are occasionally trilobed. The possibility of hybridization between more typical *M. cantharophila* and *M. lurida* also occurred to us as an explanation for the strange floral morphology in the Elgin plants. No *M. lurida* was, however, found on sandstone slopes adjacent to the shale soils on which *M. cantharophila* grew.

Moraea cantharophila flowers have the features that are now associated with pollination by hopliine or monkey beetles (Scarabaeidae: Rutelinae: Hopliini): bright coloration, bold, contrasting markings, a salver- or bowl-shape, absence of floral odor (usually), and little or no nectar (Steiner, 1998; Goldblatt et al., 1998, 2000). Two species of hopliine beetles have been captured in the flowers, *Anisonyx* sp. and *Peritrichia pseudoplebia*, the insects typically found at rest with their body nested in the space between the tepal claws and style branches. All beetles captured carried heavy loads of *M. cantharophila* pollen on their bodies. Hopliines normally do little damage to flowers, although they consume some pollen, instead using the flowers as sites for assembly, competitive behavior, and copulation. At the type site, in Sandy's Glen in the Bredasdorp Mountains, *M. cantharophila* formed a guild with two other species with similarly colored and shaped flowers, *Drosera cistiflora* L. and *Aristea teretifolia* Goldblatt & J. C. Manning. Both species at this site have cream flowers with dark brown central markings and prominent anthers bearing bright yellow pollen. At the Sir Lowry's Pass site, *M. cantharophila* formed a guild with *Aristea cantharophila* Goldblatt & J. C. Manning, *Drosera cistiflora*, and *D. pauciflora* L. All four species were pollinated there by two other hopliine beetles, *Peritrichia pseudoplebia* and *Anisonyx ursus* (Goldblatt et al., 1998). Despite the fetid odor in the plants from Elgin, suggesting muscid fly pollination, we noted that these plants are, like other populations of *M. cantharophila*, also pollinated by hopliine beetles, in this case *Anisonyx hessei*. At one site, Die Hawe, we noted small bees visiting the flowers.

Paratypes. SOUTH AFRICA. **Western Cape:** 3418 (Simonstown) near the foot of Sir Lowry's Pass (BB), 28 Aug. 1995, *Goldblatt & Manning 10281* (K, MO, NBG); 3419 (Caledon) foot of Viljoen's Pass, clay ground (AA), 5 Sep. 1974, *Goldblatt 2491* (MO); slopes of the Groenland Mountains N of Elgin, 10 Oct. 2000, *Goldblatt 11633* (K, MO, NBG, PRE); Die Hawe, Elgin, 10 Oct. 2000, *Goldblatt 11638* (MO, NBG).

2. **Moraea lilacina** Goldblatt & J. C. Manning, sp. nov. TYPE: South Africa. Western Cape: northern foothills of the Langeberg, near Perdebont, Farm Graskloof, 23 Sep. 1979, *P. Goldblatt & I. Nänni 11587* (holotype, NBG; isotypes, K, MO). Figure 2.

Plantae 20–35 cm altae, cormo usitate globoso 12–16 mm diam. tunicis reticulatis fibrosis pallidis obtecto, folio unico producto lineari anguste canaliculato ca. 1.5 mm lato, caule erecto usitate eramoso, inflorescentiae spatha externa 25–30 mm longa, interna 40–45 mm longa, floribus perpallide roseis, tepalorum externorum 27–30 mm longorum abaxialiter lilacino suffusorum unguibus flavis ca. 10 mm longis ac limbis patentibus, internorum usque ad 18 mm longorum tricuspidatorum unguibus brunneis ca. 9 mm longis canaliculatis, filamentis 7–8 mm longis infra in columnam connatis superne liberis divergentibus, antheris albescentibus ca. 3.5 mm longis, styli ramis ca. 5 × 2 mm cristis 5–8 mm longis gracilibus ornatis, ovario exserto 7–8 mm longo, capsula ignota.

Plants 20–35 cm high. *Corm* globose or flattened by pressure, 12–16 mm diam., tunics of light brown, netted fibers. *Leaf* solitary, linear, narrowly channeled or the margins conduplicate, ca. 1.5 mm wide, trailing and often dry above. *Stem* erect, normally unbranched, with three aerial internodes, the nodes each bearing a sheathing, bract-like leaf 40–45 mm long, the apex attenuate and dry. *Inflorescence* mostly 2-flowered; *spathes* unequal, green, with dry attenuate apices, the outer 25–30 mm long, the inner 40–45 mm long. *Flowers* palest pink, flushed lilac-pink on the reverse of the outer tepals, fading darker pink, the outer tepals each with a bright yellow nectar guide at the base of the limb; *tepals* unequal, the outer larger, 27–30 mm long, the claw ascending, ca. 10 mm long, yellow, densely hairy, bearing a nectary at the base partly covered by a short flap of tissue ca. 1 mm long, the limb spreading at ca. 45° below horizontal, inner tepals to 18 mm long, tricuspidate, the claw ca. 9 mm long, brown, channeled, with a long, suberect central cusp ca. 9 mm long, and short, obtuse lateral lobes. *Filaments* 7–8 mm long, united in the lower two-thirds into a cylindrical column, smooth or papillate, free and diverging above; *anthers* appressed to the narrow style branches, ca. 3.5 mm long, reaching to within 1 mm of the stigma lobes. *Ovary* oblong, 7–8 mm long, exserted from the spathes; *style* dividing at the apex of the filament column, the branches diverging, ca. 5 × 2 mm, crests slender, erect, 5–8 mm long. *Capsules* and *seeds* unknown.

Flowering September.

Etymology. From the Latin *lilacina*, "lilac-colored," referring to the color of the tepals, flushed lilac below and darkening to lilac-pink with age.

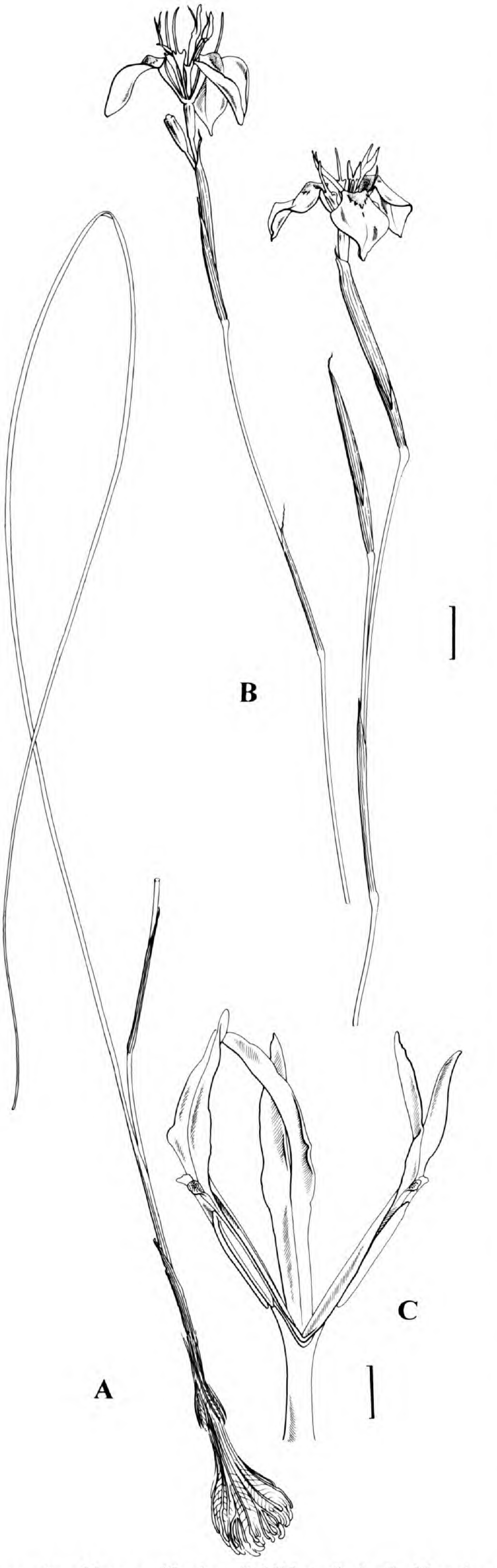

Figure 2. *Moraea lilacina* Goldblatt & J. C. Manning (*Goldblatt & Nänni 11587*). —A. Corm. —B. Flowering stem and leaf. —C. Detail of stamens and style branches. Scale bar 1 cm (A, B), 3 mm (C). Drawn by J. C. Manning.

Distribution and habitat. Restricted to the southern mountains of Western Cape Province, *Moraea lilacina* is known from the type site in the northern foothills of the Langeberg, northwest of Robinson's Pass. Plants grow in loamy soil mostly wedged in broken sandstone rock.

Relationships. *Moraea lilacina* is closely allied to the widespread southern African winter-rainfall *M. unguiculata* Ker Gawler, which is a remarkably variable species, both as regards perianth color and size. Important features of *M. unguiculata* are the inner tepals, which are 10–12 mm long and trilobed with the central cusp linear and coiled inward. The filaments are usually 3–5 mm long, with the column lightly to densely papillate, and the outer tepals are typically 12–20 mm long, exceptionally to 24 mm long in northern Namaqualand populations, with the limb (5–)8–12(–14) mm. The outer tepals may be white to cream, brown, violet, or even dull yellow and usually have a contrasting mark at the base of the limb. The style branches are narrow, spreading as in *M. lilacina*, but with erect crests 2–4(–5.5) mm long. Extending from Steinkopf in northern Namaqualand in the north to Humansdorp in the southeast, with isolated populations in the Karoo and Eastern Cape Mountains (Goldblatt, 1986; Goldblatt & Manning, 1995), *M. unguiculata* typically favors shale slopes and grows in renosterveld or transitional fynbos–renosterveld, but populations are known from sandstone slopes. *Moraea lilacina* favors a similar habitat. It can be recognized mainly by the large size of the flowers, which have inner tepals 16–18 mm long with an erect central cusp, filaments 7–8 mm long with a papillate or smooth column, and outer tepals 27–30 mm long. Most of the 16 plants we examined had unbranched stems, whereas individuals of *M. unguiculata* almost always have branched stems unless they are depauperate due to environmental stress.

Paratypes. SOUTH AFRICA. **Western Cape:** 3321 (Oudtshoorn) valley E of Perdebont, ridge SW of Beacon 90, S-facing slopes (DD), 16 Sep. 1998, *E. G. H. Oliver & I. Oliver 10874* (NBG).

TAXONOMIC NOTES

REDUCTION OF *MORAEA NEOPAVONIA* IN *M. TULBAGHENSIS*

Moraea tulbaghensis L. Bolus, S. African Gard. 22: 276. 1932. TYPE: South Africa. Western Cape: Saron, *H. M. L. Bolus s.n.* (holotype, BOL).

Moraea neopavonia R. Foster, Contr. Gray Herb. 165: 108. 1947. Syn. nov. *Iris pavonia* L. f., Suppl. Pl. 98.

1781. *Moraea pavonia* (L. f.) Ker Gawler, Konig & Sims, Ann. Bot. 1: 240. 1804, nom. illeg., non *M. pavonia* (L. f.) Thunberg, Diss. *Moraea*, 14. 1787 [= *Tigridia pavonia* (L. f.) DC.]. TYPE: South Africa. Western Cape: Swartland hills, *Thunberg s.n.* (lectotype, designated by Goldblatt (1976b), UPS, Herb Thunberg 1148A).

In the most recent account of *Moraea* in southern Africa (Goldblatt, 1986) *M. tulbaghensis* and *M. neopavonia* were regarded as closely allied species of subgenus *Vieusseuxia*. They shared with a small group of species within the subgenus, including the widespread *M. villosa* (Ker Gawler) Ker Gawler, a solitary foliage leaf hairy on the abaxial surface and a shortly hairy stem. Of these species, only the blue-flowered *M. gigandra* L. Bolus, *M. neopavonia*, and *M. tulbaghensis* have narrow style branches, as wide as or hardly wider than the anthers, and short style crests 1–2 mm long, which are overtopped by the anthers. Both *M. neopavonia* and *M. tulbaghensis* have orange (rarely to red) tepals and are distinguished in the key by the anthers exceeding the style crests by more than 1 mm (*M. neopavonia*) or by up to 1 mm (*M. tulbaghensis*). This distinction seemed useful in 1986 (Goldblatt, 1986) and was supported by the presence of brilliant green nectar guides on the outer tepals and anthers 7–10 mm long in *M. tulbaghensis* versus navy blue or speckled nectar guides and anthers 9–12 mm long in *M. neopavonia*. The type population of the latter species in the west of its range near Piketberg has boat-shaped, attenuate inner tepals, but other populations have tricuspidate inner tepals with a long, narrow central cusp, as does *M. tulbaghensis*.

New collections of both species have rendered this distinction untenable. Plants from Elandberg between Gouda and Hermon have flowers that seem to be most like those of *Moraea tulbaghensis*, but the deep orange to reddish outer tepals have navy blue nectar guides and anthers about 9 mm long exceeding the style crests by more than 1 mm. We no longer find it possible to distinguish the two species and therefore unite them under the earliest valid name, *M. tulbaghensis*. Available chromosome counts, for one population of each species, are $2n = 12$ (as *M. neopavonia*) and $2n = 24$ (as *M. tulbaghensis*) (Goldblatt, 1971a, 1976a). The basic chromosome number in *Moraea* subg. *Vieusseuxia* is $x = 6$. Thus in its revised circumscription *M. tulbaghensis* is heteroploid with both diploid and tetraploid populations. Related *M. villosa* also has diploid and tetraploid races, as do a handful of other species in the genus (Goldblatt, 1981).

NOTES ON *MORAEA SAXICOLA* GOLDBLATT

A species of Namaqualand, that is the coast and near interior of northwestern South Africa, *Moraea saxicola* (subg. *Moraea* sect. *Deserticola*) has a recorded range from Steinkopf in the north to near the town of Nuwerus in the south. Over this wide range its morphology is relatively uniform except that in the type population, from the Spektakel Mountains west of Springbok, plants have flowers with pale blue-mauve tepals and deep green leaves. Elsewhere flowers are almost white with the outside of the tepals faintly flushed with mauve or brown, and the leaf is gray-glaucous. Plants most closely resembling *M. saxicola*, collected in 2000 and 2001, some 50 to 70 km south of the known range, below the foot of Vanrhyns Pass near Vanrhynsdorp (*Goldblatt 11616*) and at the foot of the Kobee Mountains (*Goldblatt & Porter 11788*), are much smaller than all known populations of that species in all parts. They are mostly only 7–10 cm high and have a trailing to almost prostrate leaf with strongly undulate and crisped margins and a somewhat twisted blade. The small flowers are pale mauve with deep yellow nectar guides. Plants grow on the slopes of low hills in clay loam among quartzite pebbles, a common habitat in the area. The Vanrhyns Pass plants, collected in flower, have inflorescence spathes 25–30 mm long, and flowers with outer tepals 22–24 mm long, inner tepals ca. 18 mm long, filaments ca. 7 mm long, anthers ca. 3 mm long, and style crests 7–8 mm long.

The recorded variation for *Moraea saxicola* for these features is consistently larger: inflorescence spathes 30–60 mm long; outer tepals 30–40 mm long; inner tepals 25–30 mm long. Other floral parts similarly exceed those in this southern population, with filaments 7–13 mm, anthers 6–9 mm, style branches 8–15 mm, and crests mostly 10–15 mm long. Despite the size differences, the aspect of the plants is so consistent with *M. saxicola* that for the present we think this southern population is best regarded as an arid habitat ecotype of *M. saxicola* and should thus be included here, despite the argument that can be made for infraspecific recognition.

The vegetation where the southern populations of *Moraea saxicola* grow consists of a sparse cover of succulent shrubs, mostly Aizoaceae–Mesembryanthemoideae, and geophytes including *Moraea serpentina* Baker, *Babiana salteri* G. J. Lewis, and *B. sinuata* G. J. Lewis (Iridaceae), and *Ornithogalum polyphyllum* Jacquin (Hyacinthaceae). It is probably no coincidence that flowers of *M. serpentina* that are similar in size, coloring, and general morphology fade and deliquesce at about the time that those of *M. saxicola* open, at ca. 16:00H. Flowers of *M. serpentina* utilize the late morning and early afternoon for display and those of this population of *M. saxicola* the late afternoon. Presumably they share the same set of pollinators. In other populations of *M. saxicola* flowers have been recorded as opening after 13:00H and as late as 15:00H (Goldblatt, 1976b).

Additional specimens. SOUTH AFRICA. **Western Cape:** 31.118 (Vanrhynsdorp) foot of Kobee Pass, E of Vanrhynsdorp, in quartzite pebble areas (BD), Sep. 2000, *Goldblatt & Porter 11788* (MO, NBG); foot of Vanrhyns Pass (DB), Oct. 2000, *Goldblatt 11616* (K, MO, NBG, PRE).

MORAEA FLEXICAULIS, A NEW NAME FOR THE HOMONYM *M. FLEXUOSA* GOLDBLATT

Moraea flexicaulis Goldblatt, nom. nov. pro *M. flexuosa* Goldblatt, Ann. Missouri Bot. Gard. 69: 356. 1982, nom. illeg., non *M. flexuosa* L. f., Suppl. Pl. 100. 1781 (= *M. lewisiae* (Goldblatt) Goldblatt). TYPE: South Africa. Northern Cape: Richtersveld, Eksteenfontein road, *Goldblatt 6000A* (holotype, MO; isotypes, K, NBG, PRE, S, WAG).

The name *Moraea flexuosa* Goldblatt is a homonym for *M. flexuosa* L. f., an epithet in turn illegitimate (Goldblatt, 1971b) because it is superfluous for *M. longifolia* Jacquin, which dates from 1776. *Moraea flexuosa* L. f. is currently called *M. lewisiae* (Goldblatt) Goldblatt, and the epithet *lewisiae* was proposed for that species, then included in the genus *Hexaglottis*, because the combination *H. flexuosa* (L. f.) Sweet was, like the basionym, superfluous. Nevertheless, the name *M. flexuosa* L. f. is valid, and prevents the subsequent use of the epithet in *Moraea*. The new name *M. flexicaulis* is proposed here for the later homonym.

We also report a range extension for this rare species of the southern Richtersveld in Namaqualand. The species was described from the Anenous flats on the farm Grasvlakte in 1982. During fieldwork in the Richtersveld in September 2000, we found plants at the type locality and some 20 km to the north in stony ground at the foot of low hills adjacent to the road to Eksteenfontein (*Goldblatt, Manning & Savolainen 11494,* 11 Sep. 2000, NBG). Plants were in fruit, but the distinctive vegetative morphology makes it all but certain that they represent *M. flexicaulis.*

RANGE EXTENSIONS FOR *MORAEA RIVULICOLA* AND AN EMENDED CIRCUMSCRIPTION

Described in 1995, *Moraea rivulicola* Goldblatt & J. C. Manning (*Moraea* subg. *Vieusseuxia*) was then known from northern Namaqualand in seasonal watercourses at Spektakel Pass, near Springbok, and in the Kamiesberg (Goldblatt & Manning, 1995). Plants were distinguished from the nearly sympatric *M. unguiculata* by the larger flowers with outer tepals 20–24 mm long with claws 7–10 mm long and limbs 14 × 10 mm, and the inner tepals 13–15 mm long. The filaments are ca. 8 mm long with the column ca. 5.5 mm long, and the anthers are 4–5 mm long.

Plants from the Richtersveld near Kosies accord with the description and represent a range extension to the north. A population from the rocky hills west of Bitterfontein and south of Kotzesrus collected in 2001, however, differs in their substantially larger flowers with bright yellow-green tepals and strong foetid odor, a feature not reported in other populations. These plants have outer tepals ca. 28 mm long with the claw up to 14 mm and the limb 14 × ca. 10 mm, while the inner tepals are ca. 19 mm long and not trilobed but have an ovate-attenuate limb. Other organs are also larger, with the filament column ca. 10 mm long and free for an additional 2.5 mm, while the anthers are 5.5–6 mm long and the style crests about 5 mm long. The inner rhipidial spathes are 6–9 cm long, contrasting with 5.5–6.7 cm long in other populations. Plants of the Kotzesrus population share with more typical *M. rivulicola* the smooth tepal claws and elongate ovary, 11–14 mm long. The habitat was not, as in other populations, in a watercourse, but along a dry gully, where water presumably accumulates in periods of precipitation. While the taxonomic status of this population remains to be determined, there is no doubt that it represents a significant variant and thus a distinctive race, perhaps deserving of subspecific recognition.

Additional specimens. SOUTH AFRICA. **Northern Cape:** 29.17 (Springbok) Richtersveld, base of Kosies (BA), 26 Sep. 1987, *Williamson 3751* (NBG); 30.17 (Hondeklipbaai) W of Bitterfontein, 19 km S of Kotzesrus on the road to Landplaas, edge of granite escarpment (DD), 16 Sep. 2001, *Goldblatt & Porter 11892* (K, MO, NBG, PRE).

Acknowledgments. We thank Guy Brooke-Sumner for drawing our attention to the presence of wild flowers on the burn on the farm Vredehoek and allowing us to work there, Roy Gereau for checking the Latin descriptions, and Ingrid Nänni and Lendon Porter for assistance and companionship in the field. Hopliine beetles were identified by Holger Dombrow, Worms, Germany, and beetle vouchers are housed at the University of Kansas Museum, Lawrence, Kansas. Collecting permits were provided by the Nature Conservation authorities of Western Cape Province, South Africa. Support for our study by grants 6704-00 and 7103-01 from the National Geographic Society is gratefully recognized.

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Megacorax gracielanus (Onagraceae), a New Genus and Species from Durango, Mexico

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ABSTRACT. *Megacorax gracielanus*, a distinctive new genus and species from the Sierra de Coneto in central Durango, Mexico, is described and illustrated. Its distinctive characters include: leaves linear, petals presented to one side of the flower, and capsule wall thin and distended by the seeds. It appears to be most closely related to *Lopezia* Cavanilles based on possession of 4-merous flowers, deciduous sepals, a capitate stigma, stipules, and a tendency toward the structural zygomorphy in the flowers found in *Lopezia*. In addition, the capsules of *Megacorax gracielanus* are very similar in shape and structure to the capsules of certain species of *Lopezia*. Because *Megacorax* has distinctive morphological characters and does not have the unique synapomorphies of *Lopezia* (2 fertile stamens or 1 fertile stamen and 1 staminode, and petals unequal), it is here described as a related genus.

RESUMEN. *Megacorax gracielanus*, un nuevo género y especie notoriamente diferente, se describe e ilustra a partir de material colectado en la Sierra de Coneto, en el centro de Durango, México. Sus caracteres distintivos incluyen hojas lineares, pétalos orientados hacia un lado de la flor, y pared de la cápsula delgada y distendida por las semillas. El nuevo taxón parece estar más cercanamente relacionado a *Lopezia*, género con el que comparte los caracteres de flores tetrámeras, sépalos deciduos, estigma capitado, y estípulas. Manifiesta una tendencia hacia la zigomorfia estructural de las flores que se presenta en *Lopezia*, y sus cápsulas son muy similares en forma y estructura a las cápsulas de algunas especies de ese género. Debido a que *Megacorax* tiene caracteres morfológicos distintivos y no presenta las sinapomorfias únicas de *Lopezia* (2 estambres fértiles o 1 estambre fértil y un estaminodio, y pétalos desiguales o iguales) se describe aquí como un género relacionado.

Key words: *Megacorax*, Mexico, Onagraceae.

The family Onagraceae in the order Myrtales comprises some 650 species in 16 genera. The family is distributed worldwide, but it is most species-rich in the New World (Raven, 1988). Raven (1964, 1979, 1988) divided the Onagraceae into seven tribes; only tribe Onagreae, with nine genera, contains more than two genera. A recent molecular phylogenetic study (Levin et al., in press) suggests that *Gongylocarpus* should be moved to a unigeneric tribe, Gongylocarpeae, bringing the total to eight tribes for the family. Systematic revisions are available for virtually the entire family (see references cited in Munz, 1965; Raven, 1979, 1988). Surveys are essentially complete for many aspects of the biology of the family, including chromosome numbers and morphology (e.g., Raven & Tai, 1979; Raven & Gregory, 1972; Hoch et al., 1993), floral, leaf, and wood anatomy (e.g., Eyde, 1981; Carlquist, 1982), as well as morphology, embryology, palynology (e.g., Skvarla et al., 1978; Praglowski et al., 1987), reproductive biology including pollination systems and extent/mechanism of self-incompatibility (summarized in Raven, 1979), chemosystematics (e.g., Averett et al., 1988), and, most recently, molecular systematics (e.g., Levin et al., in press), providing a wealth of characters of evolutionary interest (summarized in Raven, 1988; Hoch et al., 1993; Conti et al., 1993).

Because of intense scrutiny of the family for many decades, it was unexpected to discover an unknown Onagraceae subshrub during recent floristic research in the Sierra de Coneto in Durango, Mexico. The morphological characters of this plant show that it does not fit in any of the 16 currently recognized genera or, with current understanding, readily in any of the eight tribes. We here describe

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it as a new genus and species, but do not assign it to a tribe pending further studies.

Megacorax S. González & W. L. Wagner, gen. nov. TYPE: *Megacorax gracielanus* S. González & W. L. Wagner, sp. nov. Figures 1, 2.

Genus novum, *Lopeziae* affine a qua habito suffruticoso, foliis alternatis subfasciculatis, floribus tri-tetrameris uterque chasmogamis vel cleistogamis, tubo floris brevi nectario apicali, petalis unilateralibus, parietibus tenuibus capsulae differt.

Weakly woody shrubs; stems profusely branched; bark thin, gray brown, exfoliating on older stems; younger stems red. Stipules present, in pairs, subulate, persistent. Leaves cauline, alternate, those on short lateral branches with arrested internodes crowded and appearing fasciculate, linear to linear-lanceolate. Flowers numerous, in the axils of the upper leaves, on long pedicels, diurnal, perfect, but with both chasmogamous and cleistogamous ones present on same branch. Floral tube minute with enlarged nectary disk at mouth. Sepals (3)4, regular and equal, valvate in aestivation, reflexed in anthesis. Petals (3)4, contorted in aestivation, white, entire, appearing radially arranged in dry specimens, but displaced to one side of the flower in anthesis. Stamens (6)8 in two unequal series, all fertile, the antisepalous ones longer; anthers versatile, pale yellow. Style filiform, exceeding or slightly shorter than the stamens; stigma entire, capitate. Ovary pluriovulate, turbinate or cylindric. Fruit a loculicidal, thin-walled capsule, locules 3 or 4, ellipsoid-cylindrical to oblong-cylindrical, dehiscing 1/8 to nearly 1/2 the length, the dehisced valves spreading, locule partitions thin, persisting to maturity. Seeds small, in 1 irregular row in each locule, distending the capsule walls.

Morphologically, *Megacorax* does not fit into any of the other genera of the Onagraceae. It is unique in its combination of the following characters: presence of stipules, flowers 3- or 4-merous, presence of chasmogamous and cleistogamous flowers, petals presented to one side of the flower, (6)8 stamens in two whorls, and thin-walled capsules that dehisce 1/8 to 1/2 their length. It shares some characters with several other genera but it does not fit into any of them. Presence of stipules excludes it from the tribes Epilobieae and Onagreae. The capsule structure excludes it from the tribes Hauyeae, Fuchsieae, and Circaeeae. The deciduous sepals and presence of a floral tube exclude it from tribe Jussiaeeae. This leaves only the tribe Lopezieae (only genus *Lopezia* Cavanilles), with which it shares the presence of stipules, 4-merous flowers, a capitate "dry" stigma, and slight floral zygomorphy that approaches the structural zygomorphy found in *Lopezia* flowers. However, *Lopezia* is clearly marked in Onagraceae by having in 4-merous flowers only two stamens (one species) or one stamen and a staminode (Plitmann et al., 1973), unlike *Megacorax* and all other Onagraceae, which have twice as many stamens as sepals. The capsules of *Megacorax* are similar in shape and structure to those of some *Lopezia*, such as *L. riesenbachia* Plitmann, P. H. Raven & Breedlove. The stipules of most species of *Lopezia* are generally caducous, but are persistent in the shrubby species, similar to the persistent stipules in *Megacorax*. *Megacorax* has a nectary disk (Fig. 2D) unlike those in *Lopezia*, but possibly similar to nectaries in *Gongylocarpus* (Gongylocarpeae). Overall, the morphology of *Megacorax* places it closest to *Lopezia*, but it clearly lacks the synapomorphies of that genus, and deserves separate generic status. In fact, a recent *rbc*L and *ndh*F cpDNA analysis (Levin et al., in press) confirms the placement of *Megacorax* in a strongly supported clade sister to *Lopezia*.

Etymology. The generic name is based on the combination of the Greek words *mega*, large or great, and *korax*, raven, to honor Peter H. Raven, who has studied the Onagraceae for nearly half a century and has published numerous papers and monographs on many aspects of the family. He also has inspired many others to contribute to the scientific knowledge of Onagraceae, and has been one of our foremost advocates for conservation and sustainable use of the environment.

Megacorax gracielanus S. González & W. L. Wagner, sp. nov. TYPE: Mexico. Durango: Nuevo Ideal, Sierra de Coneto, al N de Dr. Castillo del Valle, por el camino a Ignacio Zaragoza, 25°5′11″N, 104°57′10″W, 2210 m, 5 Nov. 2001, *S. Acevedo, L. López & S. González 1352* (holotype, US 3376228; isotypes, ANSM, CAS, CHAPA, CIIDIR, ENCB, IEB, IIZD, MEXU, MO, TEX, UAMIZ). Figures 1, 2.

Ex speciebus generum affinium, foliis linearibus ad lineari-oblanceolata 8–12 × 0.8–1.3 mm, tubo florali 0.2–0.6 mm longo et disco annulari, parietibus capsulae seminibus distentis differt.

Xeromorphic, rhizomatous, weakly woody shrub from a branched, ascending caudex up to 1.4 cm thick. Stems profusely branched, ascending, (15–)25–60 cm high, covered with thin gray bark and exfoliating in longitudinal strips on the lowermost stems, becoming pale brown to yellow and shredding or flaky on stems further up, the bark of main stem and pri-

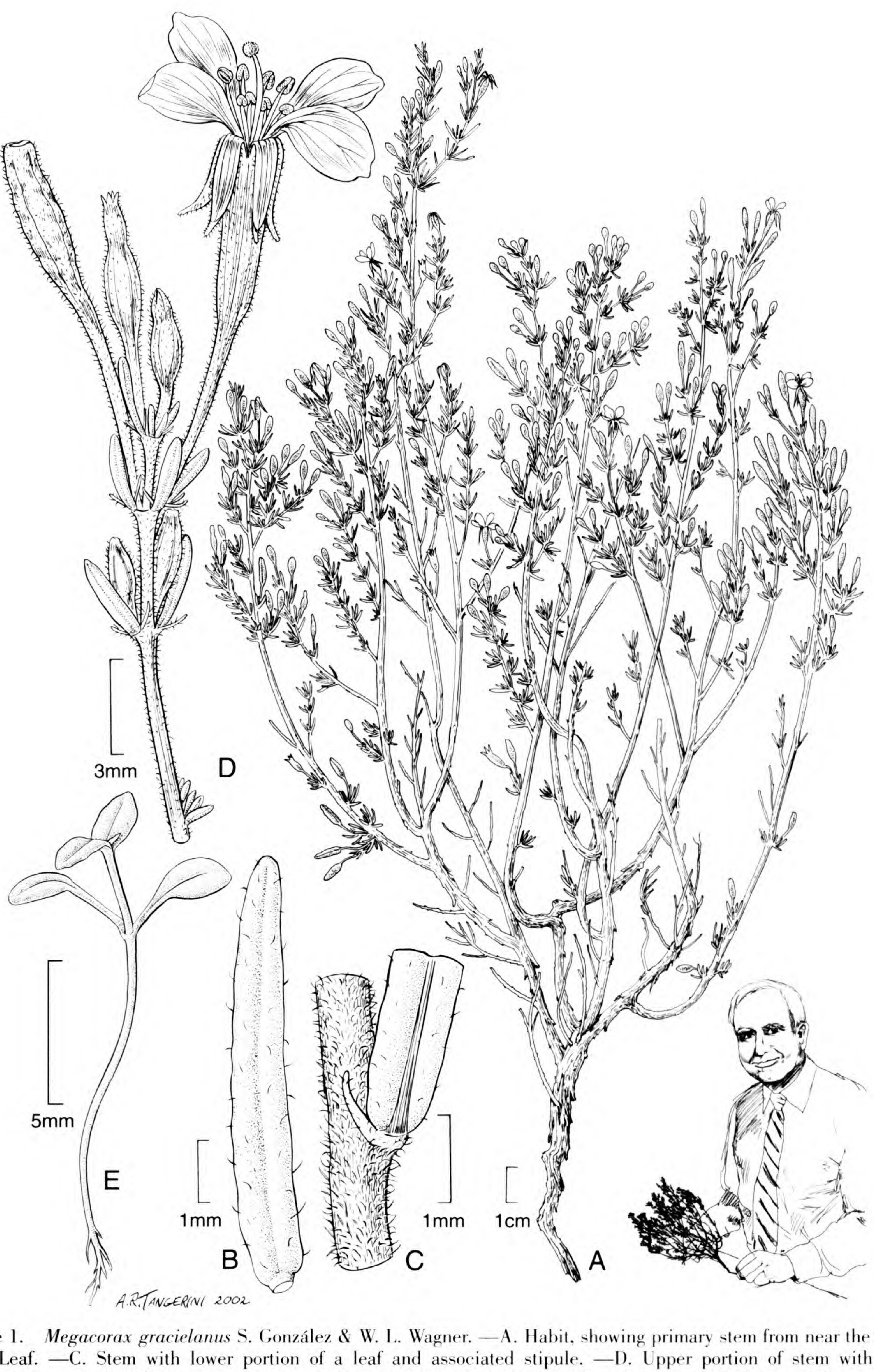

Figure 1. *Megacorax gracielanus* S. González & W. L. Wagner. —A. Habit, showing primary stem from near the base. —B. Leaf. —C. Stem with lower portion of a leaf and associated stipule. —D. Upper portion of stem with both chasmogamous and cleistogamous flowers on the same branch. —E. Seedling showing cotyledons and first pair of leaves.

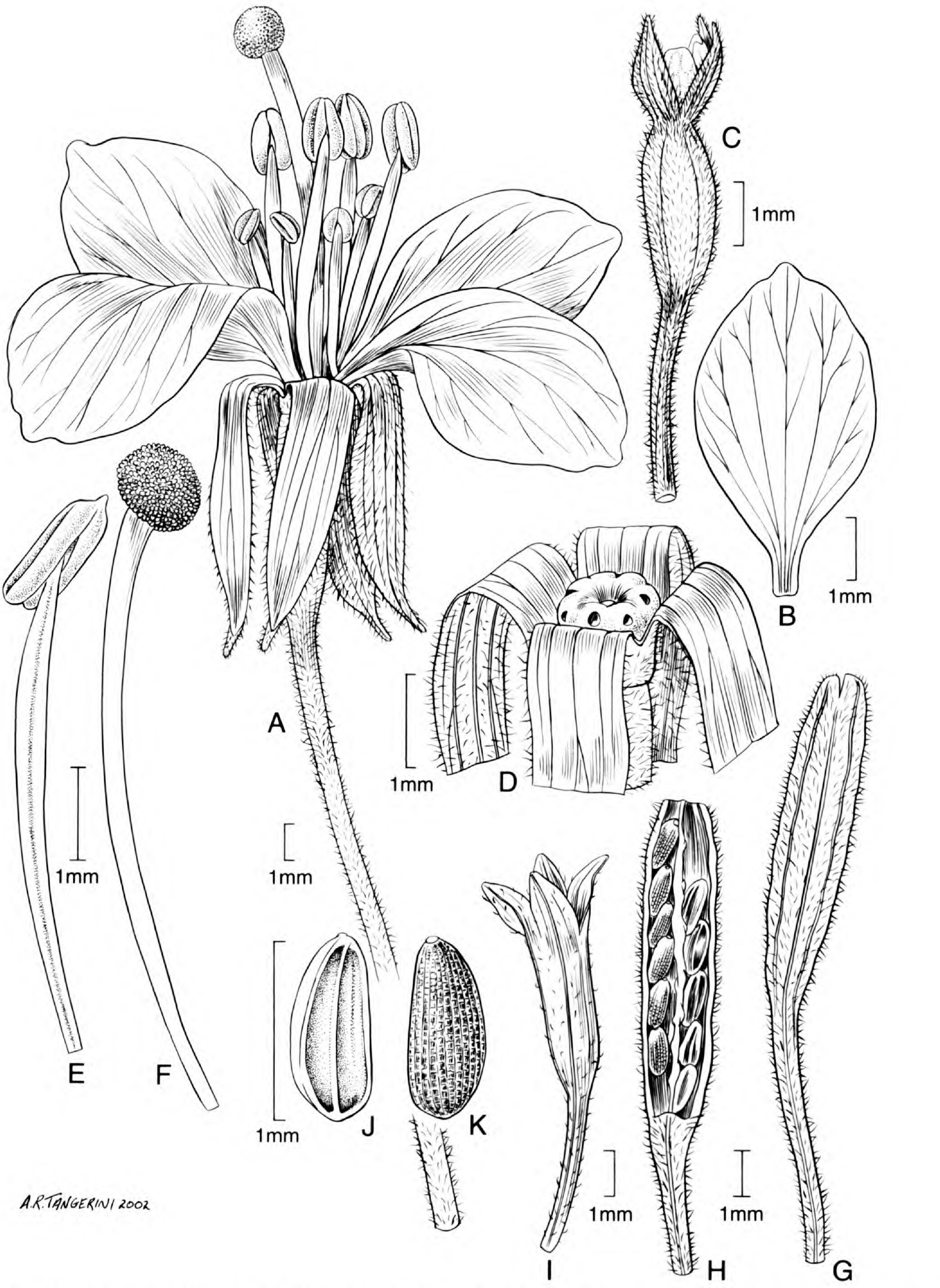

Figure 2. *Megacorax gracielanus.* —A. Chasmogamous flower, showing slight zygomorphy of petal presentation. —B. Petal of chasmogamous flower. —C. Cleistogamous flower, slightly open showing small petals. —D. Flower with petals, stamens, and style removed, showing fleshy disk. —E. Stamen. —F. Style and capitate stigma. —G. Immature capsule with pedicel, showing slightly distended capsule walls from seeds. —H. Longitudinal view of capsule, showing arrangement of seeds. —I. Mature dehised capsule. —J. Adaxial (raphial) surface of seed. —K. Abaxial surface of seed.

mary branches smooth and pale brown, upper branches terete or angled, yellow to purple or red tinged, puberulent with patent or ascending, translucent hairs 0.07–0.2(–0.3) mm long. Stipules 0.2–1 mm long, linear to subulate, puberulent to glabrate, pale yellow, persistent at least briefly after the leaf falls. Leaves alternate, usually reduced and crowded on short lateral branches and thus appearing fasciculate, young ones thick and somewhat fleshy, 8–12 × 0.8–1.3 mm, linear to linear-lanceolate, green to reddish or purple, minutely papillate, often with minute white dots on the upper surface, the midrib broad and evident on the lower surface except toward the apex, narrow and impressed on the upper surface, otherwise the veins indistinct, puberulent with translucent hairs ca. 0.1–0.2 mm long, becoming glabrate, margin entire to shallowly sinuate-denticulate, whole leaf revolute or sometimes just the margins revolute, apex obtuse to subacute, base gradually attenuate, sessile on a thickened base that persists as a protuberant scar. Flowers in the axils of the upper leaves, the branches resembling leafy, many-flowered racemes, both chasmogamous and cleistogamous flowers present on the same branch, the floral parts variable in size, especially of cleistogamous ones; pedicels up to 14 mm long, filiform, ascending to erect, purple, puberulent with white hairs 0.1–0.25 mm long, or sometimes glabrate. Floral tube inconspicuous, 0.2–0.6 mm long, enlarged by annular disk in upper 2/3, puberulent. Buds up to 6.2 mm long, narrowly elliptic, the free tips 0.4–0.5 mm long, linear. Sepals regular and equal, valvate in aestivation, reflexed in anthesis, rarely two of the sepals coherent, (1.2–)3.4–6.2 × 0.3–0.8 mm, oblong-lanceolate, deep red or reddish purple, sparsely appressed to spreading puberulent on adaxial surface, especially toward the apex, puberulent on abaxial surface, abruptly narrowed at the apex. Petals white, (1.3–)3.8–6.2 × 1.2–2.6 mm, narrowly obovate, rarely with inconspicuous purple veins, shorter than or equaling the sepals, rounded to acute at apex, tapering to the base, in chasmogamous flowers appearing radially arranged in dry specimens, but displaced to one side of the flower in anthesis. Stamens all fertile, (6)8, in two unequal series, the antisepalous ones longer; filaments pink to purple at least toward the proximal half, the longer set 1.2–4 mm long, the shorter set 0.9–2.4 mm long, with smaller anthers; anthers of longer stamens 0.6–0.7 mm long, those of shorter ones 0.4–0.5 mm long, broadly oblong, cream-colored, aging to yellow. Ovary 1.9–4.1 × 0.9–1.1 mm, turbinate or cylindric, gradually tapering to the base, puberulent. Style filiform, 1.8–8 mm long, pink to purple; stigma entire, capitate, ca. 0.4–0.6 mm diam., whitish, held above the stamens or surrounded by stamens. Capsule (3–)4.4–5.8(–6.7) × 1.3–1.8 mm, thin-walled, ellipsoid-cylindrical, oblong-cylindrical, nearly terete or walls slightly distended by seeds, tapering at base, truncate at summit, pink to purple, puberulent to glabrescent, 3- or 4-celled and 3- or 4-valved, the valves dehiscing 1/8 to nearly 1/2, spreading in maturity, the thin partitions between the locules persisting to maturity, with several seeds in 1 irregular row in each cell. Seeds 1–1.2 × 0.4–0.55 mm, narrowly obovoid or narrowly oblong, pale brown, glossy, the abaxial side convex, the raphal surface (adaxial) side slightly depressed with margins slightly incurved, with raphe visible as a longitudinal ridge, the testa appearing nearly smooth, but in fact minutely pitted-reticulate (> 50×). Apparently self-compatible judging from the presence of cleistogamous flowers.

Etymology. The specific epithet honors Graciela Calderón Díaz-Barriga, who has written revisions of about half of the families for the *Flora del Valle de México* (the only complete flora published until now in Mexico, in which she is the editor along with her husband, J. Rzedowski). She is also writing many of the revisions for the *Flora del Bajío*, and she has greatly contributed to the mentoring of several generations of students. We are very pleased to dedicate this species to such an inspiring botanist and friend.

Distribution and habitat. Megacorax gracielanus is known only from two localities in the Sierra de Coneto, a volcanic mountain located in central Durango, Mexico, on the western boundaries of the Chihuahuan Desert. Sierra de Coneto constitutes the southeastern extreme of the Sierra de Promontorio and the eastern limit of an endorrheic (closed) basin (Laguna de Santiaguillo). The climate in the area is temperate semi-dry. The predominant substratum is formed by ignimbrites (igneous extrusive rocks of acidic pH). *Megacorax gracielanus* has been collected between 24°55′49″ to 25°5′11″N and 104°47′5″ to 104°57′10″W, at 2210 and 2360 m. It occurs in colonies and is scarce to abundant in patches on rocky areas with acidic soils. The dominant vegetation is open xerophytic woodland of *Pinus cembroides* Zuccarini (pinyon pine) with *Quercus emoryi* Torrey and sclerophyllous shrubs, mainly *Arctostaphylos pungens* Kunth and *Quercus depressipes* Trelease. The two known populations are about 18 km apart (air distance). Based on a survey in June 2002 (SG and LL), it is likely that *Megacorax gracielanus* grows in much of the intervening area as well as in other parts of the Sierra de Coneto. It has not been possible to survey these areas because there are no roads. The new survey showed that at the type locality *Megacorax gracielanus* is much more abundant than originally thought, and in some areas it is one of the dominant elements in the lower stratum. It grows along an open canyon about 1 km long (at least) and 150 m wide. In some places there are 4 to 5 plants/m^2. In the other collection site (southernmost) *Megacorax gracielanus* is scarce and infrequent with only a few plants found (< 20). It is interesting that in both areas it grows not only under shrubs and trees, but also in open areas along recently open roads, on fragmented rocks. It is much more abundant and well developed under the shrubs, but it seems to adapt well to colonizing disturbed areas, which raises the question of why this unique plant is not much more widely distributed. The Sierra de Coneto is also the only known locality for *Mammillaria theresae* Cutak, and perhaps the perceived localized nature of their distribution is due to the lack of thorough collecting in this region of Mexico.

Phenology. Some plants were found flowering and fruiting after the rainy season, in early November, but by then most of the plants were finished fruiting, suggesting that *Megacorax gracielanus* flowers primarily earlier in the year. The paratype collection made at the higher elevation was even more mature and senescing for the winter. Plants in the population had indications of foraging by domestic or wild animals.

Paratypes. MEXICO. **Durango:** Nuevo Ideal, Sierra de Coneto, al NE de Once de Marzo por el camino a Coneto, ladera con exposición al N, 24°55′49″N, 104°47′5″W, 2360 m, matorral esclerófilo (*Arctostaphylos pungens* y *Quercus depressipes*) con *Pinus cembroides, Quercus emoryi* y *Arbutus arizonica*, suelo somero, 6 Nov. 2001, *S. González et al. 6532* (CIIDIR, IEB, MEXU, US).

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Compsoneura diazii (Myristicaceae), a New Species from the Rio Cenepa Area of Northwestern Peru

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ABSTRACT. *Compsoneura diazii* (Myristicaceae), a new species from the Rio Cenepa area of Bagua Province, Amazonas, Peru, is described, illustrated, and discussed. The new species is segregated from the *Compsoneura capitellata* complex and is easily distinguished by the chartaceous leaf laminas that turn brown upon drying; brochidodromous secondary veins; an elongate-tubular perianth; erect, elongate perianth lobes; erect anthers with acute apices; a reduced filament column; presence of minute glandular hairs on the inner perianth surface; and a ligneous, strongly rugose to sulcate pericarp covered with ferrugineous bifid trichomes.

Key words: *Compsoneura*, Magnoliales, Magnoliidae, Magnoliophyta, Myristicaceae, Neotropics, Peru.

The Myristicaceae are a family of arborescent flowering plants that have significant ecological and ethnobotanical importance worldwide in wet lowland tropical forests. Comprised of 19 genera and up to 500 species, the Myristicaceae rank among the 10 most diverse and important tree families in this ecosystem (Gentry, 1982, 1988; Pascal & Pelissier, 1996; Poulsen et al., 1996; Spichiger et al., 1996).

I have initiated studies of Neotropical Myristicaceae with a monograph of *Compsoneura* (DC.) Warburg, a genus that ranges in moist tropical forest from southeastern Mexico, through Central America, and into northwestern South America. De Candolle (1856) provided the first taxonomic treatment of the Myristicaceae, in which he grouped about 90 species known at the time into 13 sections of the single genus *Myristica*, one of them being section *Compsoneura* A. DC. By far, the most comprehensive treatment of the Myristicaceae was produced by Warburg (1897). In his *Monographie der Myristicaceen*, he assembled 240 species into 15 genera, and among those was *Compsoneura*, erected from *Myristica* sect. *Compsoneura* of De Candolle. Warburg recognized a total of 5 species in *Compsoneura* represented by 8 available specimens, and divided the genus into 2 sections (*Compsoneura* and *Coniostele*) based solely on trends of staminate floral morphology.

With increased exploration and specimen availability, five more species of *Compsoneura* were recognized and described by Smith and Wodehouse (1937), and a taxonomic synopsis was presented. Since 1937, little attention has been paid to *Compsoneura* aside from descriptions of new species by Rodrigues (1989), who also produced a taxonomic treatment of Brazilian members of *Virola* Aublet (Myristicaceae) (Rodrigues, 1980).

In preparation of a monograph of *Compsoneura*, several new species have been discovered. The purpose of this paper is to describe, illustrate, and discuss one of these new species.

Compsoneura diazii Janovec, sp. nov. TYPE: Peru. Amazonas: Bagua Province, Imaza District, Aguaruna Community Putuim, annex Yamayakat, zone of rolling hills 24 degrees SW of Putuim, 5°37'S, 78°22W, 700–820 m, 23 Sep. 1994, *C. Diaz 7224* (holotype, MO). Figure 1.

Consortio specifico *Compsoneurae capillatae* affinis sed lamina tenui vel chartacea, venatione foliari secondaria conspicue brochidodroma, perianthio tubulari elongato arrecto, lobis perianthii lanceolatis arrectis, antheris arrectis atque apicibus acutis praeditis, columna filamentosa reducta, pilis in superficie perianthii interiore minutis glandulosis, pericarpio fructus valde rugoso atque trichomatibus bifidis ferrugineis obtecto distinguenda.

Trees to 18 m tall, the inner bark exuding profuse red sap; branchlets terete to subterete, 0.3–0.4 cm diam., rigid, longitudinally striate, drying dark brown, densely ferrugineous-tomentose when young, glabrescent or ferrugineous-tomentose in leaf axils and scattered throughout with age, the hairs short-stalked to sessile, 2-branched. *Leaves* alternate, spiral on primary shoot, distichous on branches, simple; *petioles* stout, subterete, strongly canaliculate, 0.7–1.5 × 0.1–0.2 cm, slightly rugose, drying dark brown, glabrescent to thinly ferrugineous-tomentose, the hairs short-stalked to sessile, 2-branched; *blades* elliptic to slightly elliptic-ovate or slightly to strongly obovate-elliptic, 9.6–16.1 cm long, 3.3–5.8 cm wide at 1/4 length,

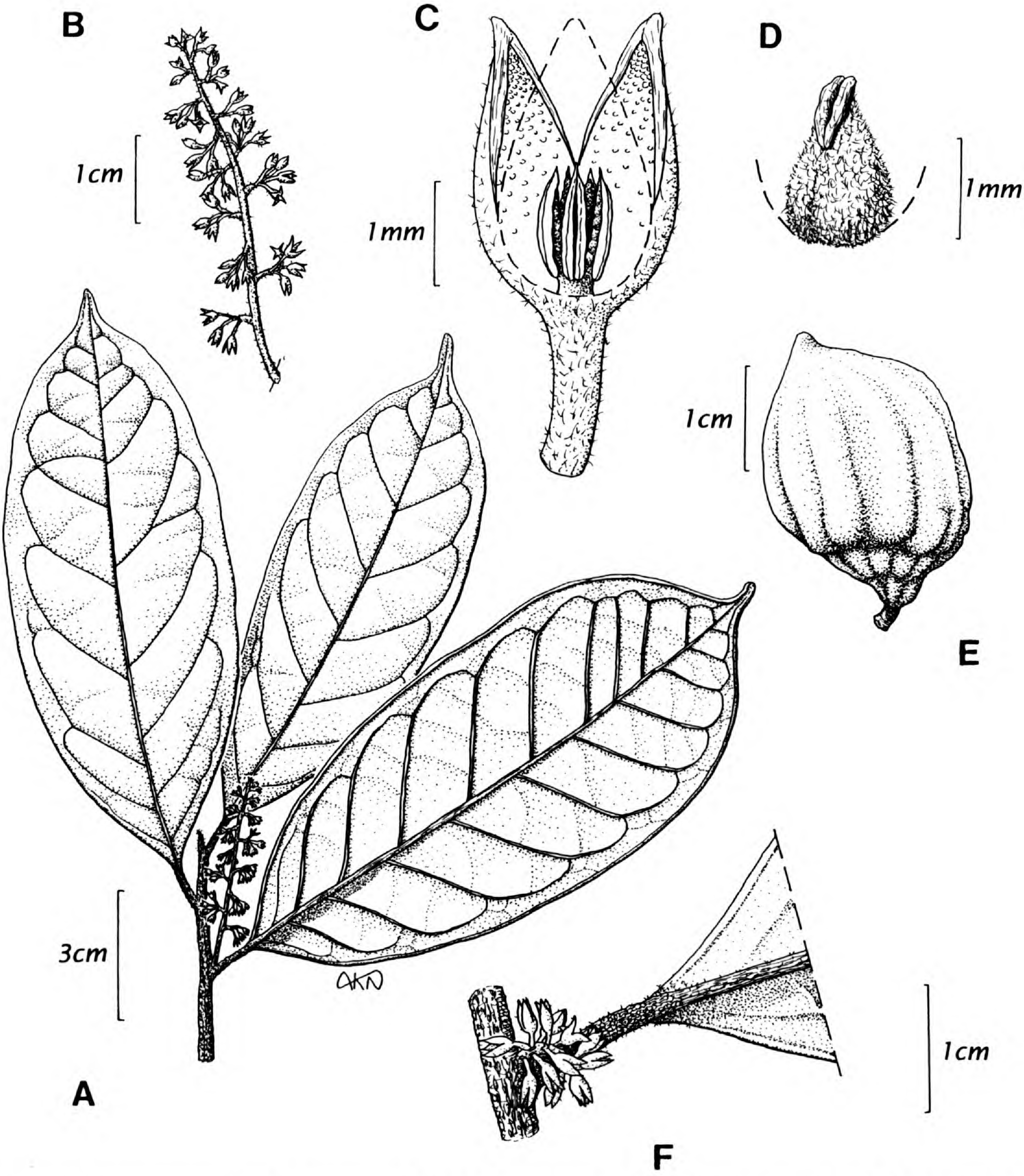

Figure 1. *Compsoneura diazii* J. Janovec. —A. Habit showing axillary staminate inflorescence. —B. Staminate inflorescence. —C. Staminate flower. —D. Gynoecium. —E. Immature fruit. —F. Leaf base showing abaxial view and pistillate inflorescence showing reduced axillary habit. (Based on *C. Diaz 7749A*, *7692A*, and *7644A*.)

4.2–6.2 cm wide at 1/2 length, 3.7–5.7 cm wide at 3/4 length, thin to chartaceous, adaxially drying dark brown, dull to semi-glossy, glabrous, abaxially drying light or dull brown, weakly resinous-puncticulate, glabrous or glabrescent throughout, the hairs minute, sessile or short-stalked, 2-branched, the base acute, the margins conspicuously revolute, the apex acute to narrowly obtuse to weakly attenuate, caudate to strongly caudate, the acumen 0.7–1.1 cm long; *venation* with costa raised and glabrous adaxially, prominently keeled, glabrous to glabrescent, especially toward base abaxially, the secondary veins 5–11 per side, arcuate-ascending, conspicuously brochidodromous, anastomosing near margins, shallowly impressed adaxially, prominent abaxially, 0.7–2.9 cm apart. *Staminate inflorescences* axillary, 2-fasciculate, once-paniculate, 4.0–4.5 × 1.0–1.4 cm, glabrescent to sparsely or densely ferrugineous-tomentose, the hairs 2-branched; rachis alternately branched, the branchlets 15–20, 0.1–0.2 cm long, with a minute bract at the apex, the flowers arranged in clusters of about 2–6 per branchlet; pedicels slender, 0.15–0.30 cm long. *Pistillate inflorescences* axillary, once-pinnate, 0.7–0.8 × 0.8–0.9 cm, densely to sparsely ferrugineous-tomentose, the hairs 2-branched; rachis 4 or 5 alternately branched, the branchlets 0.02–0.03 cm long, the flowers arranged in clusters of about 1–2 per inflorescence branchlet; pedicels slender, 0.09 × 0.06 cm. *Staminate flower buds* long-ovate to long elliptic-ovate or ovate-lanceolate. *Pistillate flower buds* elliptic to ovate-elliptic. *Staminate flowers:* perianth elongate-tubular, 0.21–0.32 × 0.12–0.2 cm, thin-coriaceous to coriaceous, orange-yellow when fresh, drying brown to dark brown, thinly pubescent adaxially, the hairs short glandular, glabrescent to ferrugineous-tomentellous to tomentose abaxially, the hairs short-stalked to sessile, 2-branched, the tube 0.9–0.13 cm long, the lobes 3 or 4, narrowly ovate to lanceolate-ovate to narrowly deltoid, 0.12–0.21 × 0.1–0.15 cm; androecium 0.10–0.14 cm long, the filament column 0.01–0.02 cm long, 0.02 cm wide at apex, 0.02–0.03 cm wide at base, the anthers 4 or 5, free, erect, 0.09–0.12 cm long, the apices strongly acute. *Pistillate flowers:* perianth elongate-tubular, 0.35 × 0.13 cm, thick coriaceous, orange-yellow when fresh, drying brown to dark brown, thinly pubescent adaxially, the hairs short-glandular, densely to sparsely ferrugineous-tomentellous to ferrugineous-tomentose abaxially, the hairs 2-branched, the tube 0.13 cm long, the lobes 3, long-ovate to lanceolate-deltoid, 0.22 × 0.09 cm; ovary subglobose to ovate, 0.17 cm long, 0.07 cm wide at 1/4 length, 0.08 cm wide at 1/2 length, 0.03 cm wide at 3/4 length, drying brown, densely ferrugineous-tomentose; stigma bilobate, shallowly cleft, 0.02 × 0.03 cm, brown to dark brown when dry. *Immature fruits* 2 or 3 per infructescence, elliptic to elliptic-ovate, 2.0–3.3 × 1.6–2.1 cm, strongly rugose to cerebriform-rugose or irregularly sulcate, green to green-brown when fresh, drying light brown to brown, ferrugineous-tomentose, the hairs simple or 2-branched, the apex minutely acuminate, the acumen 0.1–0.2 cm long, the base rounded. *Seeds* unknown.

This species has been collected on only four separate occasions from wet forest in the vicinity of the Aguaruna community of Yamayakat, Bagua province, Amazonas, Peru. As all four collections were made by Camilo Diaz, a Peruvian botanist who has conducted floristic studies in every corner of Peru, the name *Compsoneura diazii* is given in his honor.

Compsoneura diazii is hypothetically a member of the *Compsoneura capitellata* species complex based on the following suite of characteristics: (1) brown-drying leaves; (2) the presence of ferrugineous bifid trichomes on young stems, petioles, leaves, inflorescences, and external perianth surfaces; and (3) a ligneous fruit pericarp. However, it can be unmistakably distinguished from all known species of this complex by its combination of (1) chartaceous leaf lamina; (2) conspicuously brochidodromous secondary leaf venation; (3) elongate-tubular perianth; (4) erect, elongate perianth lobes; (5) erect anthers with acute apices; (6) a reduced filament column; (7) presence of minute glandular hairs on the inner perianth surface; and (8) a ligneous, strongly rugose to irregularly sulcate fruit pericarp covered with ferrugineous bifid trichomes.

Paratypes. PERU. **Amazonas:** Bagua Province, Distrito Imaza, Comunidad Aguaruna Putuim, anexo Yamayakat, zona de colinas alatas 24 degrees SW de Putuim, 5°37′S, 78°22W, 700–820 m, 18 Jan. 1996, *C. Diaz et al. 7644A* (MO), *C. Diaz et al. 7692A* (MO), 22 Jan. 1996, *C. Diaz 7749A* (MO).

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Three New Species of *Symplocos* (Symplocaceae) from Panama and Costa Rica

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Abstract. Three species of *Symplocos* are newly described from Panama and Costa Rica. *Symplocos morii* Almeda & L. Kelly, known from high-elevation western Panama, is distinguished by coriaceous leaves with entire and revolute margins, short, glabrous styles, and white fruits. *Symplocos naniflora* L. Kelly & Almeda is a low-elevation Costa Rican species with serrate leaf margins, small flowers, densely villous styles, and small fruits. *Symplocos elliptica* L. Kelly & Almeda, known from Cerro Hornito and Cerro Sapo, Panama, is distinguished by broadly elliptic leaves with crenate-denticulate margins and solitary flowers. All three species are likely members of *Symplocos* sect. *Symplocastrum* Brand based on their basally connate stamens that are adnate to the petals.

Key words: Costa Rica, Panama, Symplocaceae, *Symplocos*.

Symplocos Jacquin consists of 250–300 species distributed through tropical and subtropical regions of America, southern and eastern Asia, Australia, and the East Indies. Selected species are also found in temperate latitudes in the Northern Hemisphere. Not surprisingly, many species of *Symplocos* have been described in the century since Brand's (1901) useful but now outdated monograph of the genus. In the course of studies of *Symplocos* for the *Flora Mesoamericana*, three new species were discovered from Costa Rica and Panama. Two of these species were collected from windswept, dwarf cloud-forest vegetation near Cerro Hornito (Cerro Pata de Macho), Panama.

1. **Symplocos elliptica** L. Kelly & Almeda, sp. nov. TYPE: Panama. Chiriquí: Cerro Pata de Macho [Cerro Hornito], windswept ridge, 2100 m, 17 Jan. 1986, *G. de Nevers & G. McPherson 6842* (holotype, CAS; isotypes, BM, MEXU, MO, PMA). Figure 1.

Arbor 2–3(–20) m alta, ramis junioribus sparsissime sericeis. Laminae foliorum 5.5–8.5 cm longae, 3–4.3 cm latae, coriaceae, ellipticae, margine denticulato-crenatae, basi obtusae, apice acuminatae, adultae supra glabrae, subtus glabratae vel sparsissime strigillosae; petiolus 10–12 mm longus. Flores pedicellati in foliorum axillis solitarii, bracteolis ovatis vel deltoideis, 1–2 mm longis, 1–1.5 mm latis, pedicello 7–10 mm longo; calycis tubus glaber, lobis semicircularibus, ciliatis, 1–1.5 mm longis, 1–2 mm latis; corolla rosea, campanulata, 7–9 mm longa, glabra, lobis oblongis vel obovatis, 3–4 mm latis; stamina multiseriata; stylus pilosus ad basim, 4–5 mm longus. Fructus glaber, ellipsoideus, 1 cm longus, 5 mm latus, 4-locularis.

Small trees 2–3(–20) m tall; vegetative buds and juvenile branches sparsely sericeous, the hairs 0.25–0.5 mm long, translucent brown. Petioles sparsely strigose abaxially, 10–12 mm long and ca. 1 mm wide. Leaves coriaceous, broadly elliptic, 5.5–8.5 × 3–4.3 cm, margins crenate-denticulate with minute, black, deciduous teeth, apex acuminate, base obtuse, abaxially sparsely strigose to glabrescent on the elevated network of veins, adaxially glabrous with the midvein impressed. Flowers axillary, solitary; pedicels terete, 7–10 mm long, sparsely sericeous to glabrate; bracteoles 3 or 4, closely subtending the base of the flower, sessile, caducous, ovate to triangular-ovate, 1–2 × 1–1.5 mm, apex acute to obtuse, abaxially minutely sericeous to glabrous, adaxially glabrous, margins ciliate. Calyx 5-lobed, the lobes subrotund, 1–1.5 mm long, 1–2 mm wide at the base, glabrous, margins ciliate and also commonly bearing brown, vesicular glands. Corolla sympetalous, glabrous, campanulate, 7–9 mm long, 5-lobed, pink; lobes connate basally for 2–3 mm and adnate to the filaments for 3–4 mm at the base, oblong to obovate, apically rounded, 3–4 mm wide, entire to minutely ciliate distally. Stamens 4-seriate; filaments connate basally for 5–6 mm, the free portions of outermost filaments linear-oblong, 2.5–3.5 × 0.75–0.9 mm. Ovary inferior, villous at the summit, glabrous on

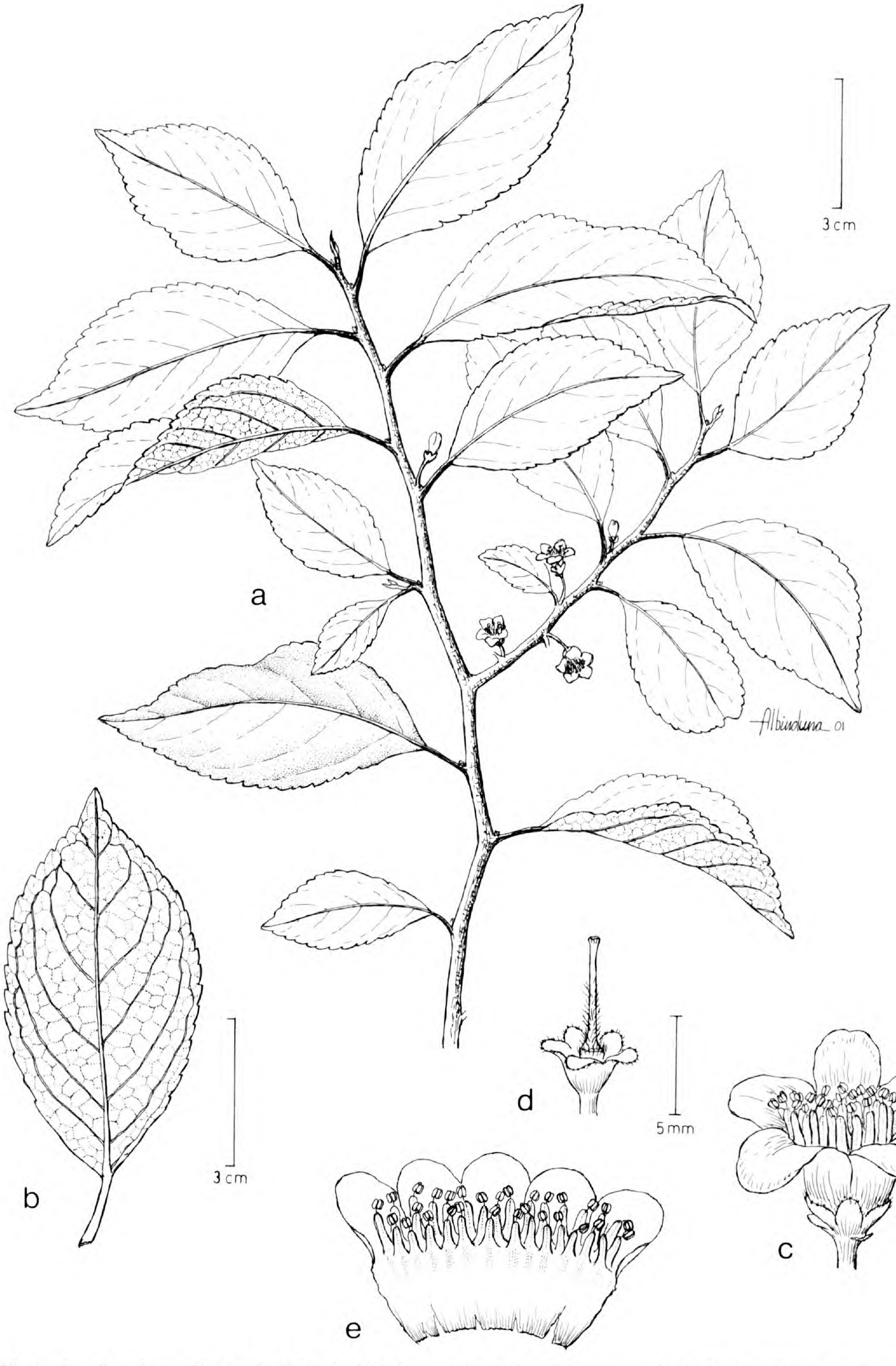

Figure 1. *Symplocos elliptica* L. Kelly & Almeda. —a. Branch with flowers. —b. Leaf, abaxial surface. —c. Flower. —d. Style. —e. Stamens and petals. Based on isotype *de Nevers & McPherson 6842* (MEXU).

the sides; style straight, pilose basally, 4–5 mm long; stigma conspicuously but irregularly lobed. Fruits drupaceous, glabrous, ellipsoid, ca. 1 × 0.5 cm, 4-celled in cross section with a rounded bony endocarp.

Known from Cerro Hornito and Cerro Sapo, Panama. The growth form of this species appears to be highly variable in different habitats. The collections from Cerro Hornito indicate that it reaches 2–3 m as a component of windswept dwarf vegetation. The collection from the summit of Cerro Sapo was reportedly a large tree of 20 m.

The combination of broadly elliptic leaves with crenate-denticulate margins and an acuminate apex, solitary flowers, and basally pilose styles distinguishes *Symplocos elliptica* from all other Central American species. The species is likely a member of *Symplocos* sect. *Symplocastrum* Brand based on its basally connate stamens that are adnate to the corolla tube. Based on its solitary, 3- or 4-bracteolate flowers this species is somewhat similar to *Symplocos tribracteolata* Almeda, a recently described Costa Rican species; however, *S. elliptica* differs by the size and shape of its leaves and the basally pubescent style. Leaves of *S. tribracteolata* are elliptic to elliptic-lanceolate and 1.1–2.1 cm wide, whereas those of *S. elliptica* are broadly elliptic and 3–4.3 cm wide. Texture and venation of the leaves of *S. elliptica* suggest that this species may be related to *S. limoncillo* Humboldt & Bonpland, which occurs from Mexico (Veracruz and Chiapas) to Panama. Both *S. limoncillo* and *S. elliptica* have coriaceous leaves with an elaborate network of protruding higher-order veins on the undersurface. Nevertheless the solitary flowers and small fruits of *S. elliptica* serve to clearly separate this species from *S. limoncillo* (which has racemose inflorescences and fruits 1.5–1.8 cm long).

Paratypes. PANAMA. **Bocas del Toro:** NW ridge of Cerro Pata de Macho [Cerro Hornito] from summit to Finca Serrano, 1200–2100 m, 27 May 1981, *K. Sytsma et al. 4958* (CAS, MO). **Darién:** NE slope of Summit Cerro Sapo, approach from Garachiné, 3300 ft., 8 May 1979, *B. Hammel 7269* (CAS, MO).

2. Symplocos morii Almeda & L. Kelly, sp. nov. TYPE: Panama. Chiriquí: Cerro Hornito (Cerro Pata de Macho), S rim of the Edwin Fabrega Dam and Reserve watershed, ridge trail leading to the summit, 1800–1950 m, 17 Jan. 1989, *F. Almeda et al. 6267* (holotype, CAS; isotype, PMA). Figure 2.

Frutex vel arbor parva 2–5 m alta, ramis vegetativis glabris. Laminae foliorum 5.5–8(–9) cm longae, 3–5 cm latae, coriaceae, late ellipticae, margine integrae, basi obtusae vel rotundatae, apice rotundatae vel breviter obtusato-acuminatae, adultae supra subtusque glabrae, subtus glabris; petiolus 2–7 mm longus. Inflorescentia axillaris, racemosa, 5–7 mm longa, glabra, bracteis bracteolisque ovatis vel oblongis, 1–3 mm longis, 1.5–3 mm latis; calycis tubus glaber, lobis rotundis, ciliatis, 1.3–1.7 mm longis, 1.8–2.2 mm latis; corolla alba, campanulata, 5–6 mm longa, glabra, lobis oblongis, 2.8–3.2 mm latis; stamina fere libera ad basim; stylus glaber, 2 mm longus. Fructus glaber, ovoideus vel ellipsoideus, 6–8 mm longus, 4–5 mm latus, 3-locularis.

Shrubs or small trees 2–5 m tall. Vegetative buds, juvenile branches, and inflorescences glabrous. Petioles glabrous, 2–7 mm long and 2–2.5 mm wide. Leaves coriaceous, entire and revolute along the margins, broadly elliptic, 5.5–8(–9) × 3–5 cm, apex rounded to very shortly blunt-acuminate, base obtuse to rounded (rarely acute), glabrous. Inflorescences short, axillary, bracteate racemes 5–7 mm long with 3 to 5 subsessile to short-pedicellate (pedicels 0–2 mm long) flowers exceeded by subtending leaves; bracts and bracteoles sessile, persistent, ovate to oblong, 1–3 × 1.5–3 mm, glabrous, margins ciliate. Calyx 5-lobed, the lobes very broadly ovate, 1.3–1.7 mm long, 1.8–2.2 mm wide at the base, glabrous, margins ciliate. Corolla sympetalous, glabrous, ± campanulate at anthesis, 5–6 mm long, 5-lobed, white; lobes connate basally for 1.5–1.8 mm and adnate to the filaments for 2–2.2 mm, oblong, apically rounded and involute distally, 2.8–3.2 mm wide, margins entire to minutely erose. Stamens ± triseriate; filaments connate basally for 2–3 mm, the free portions of outermost filaments linear-oblong, 2–2.5 × 0.5–0.75 mm; anthers minutely papillose, bilocular, ± globose, 0.4–0.6 mm long and wide. Ovary inferior, glabrous on the sides, the apex villous but glabrescent in fruit; style straight, ca. 2 mm long, glabrous; stigma conspicuously but irregularly lobed. Fruits drupaceous, white, glabrous, ovoid to ellipsoid, 6–8 × 4–5 mm, 3-celled in cross section with an irregularly undulate bony endocarp.

This species is known from Bocas del Toro, Chiriquí, and Veraguas Provinces, Panama, where it occurs in exposed, windswept sites at high elevation with dwarf cloud-forest vegetation that forms a 3–5 m canopy. Common associates, noted in the Mori and Bolten collection, include *Quercus* spp., *Podocarpus*, and *Drimys*.

Symplocos morii is readily distinguished from all other Central American species of *Symplocos* by its broadly elliptic, entire- and revolute-margined leaves that are 3–5 cm wide, glabrous styles ca. 2 mm long, and fruits that are white when mature. The species appears to be a member of *Symplocos* sect. *Symplocastrum* and is somewhat similar to

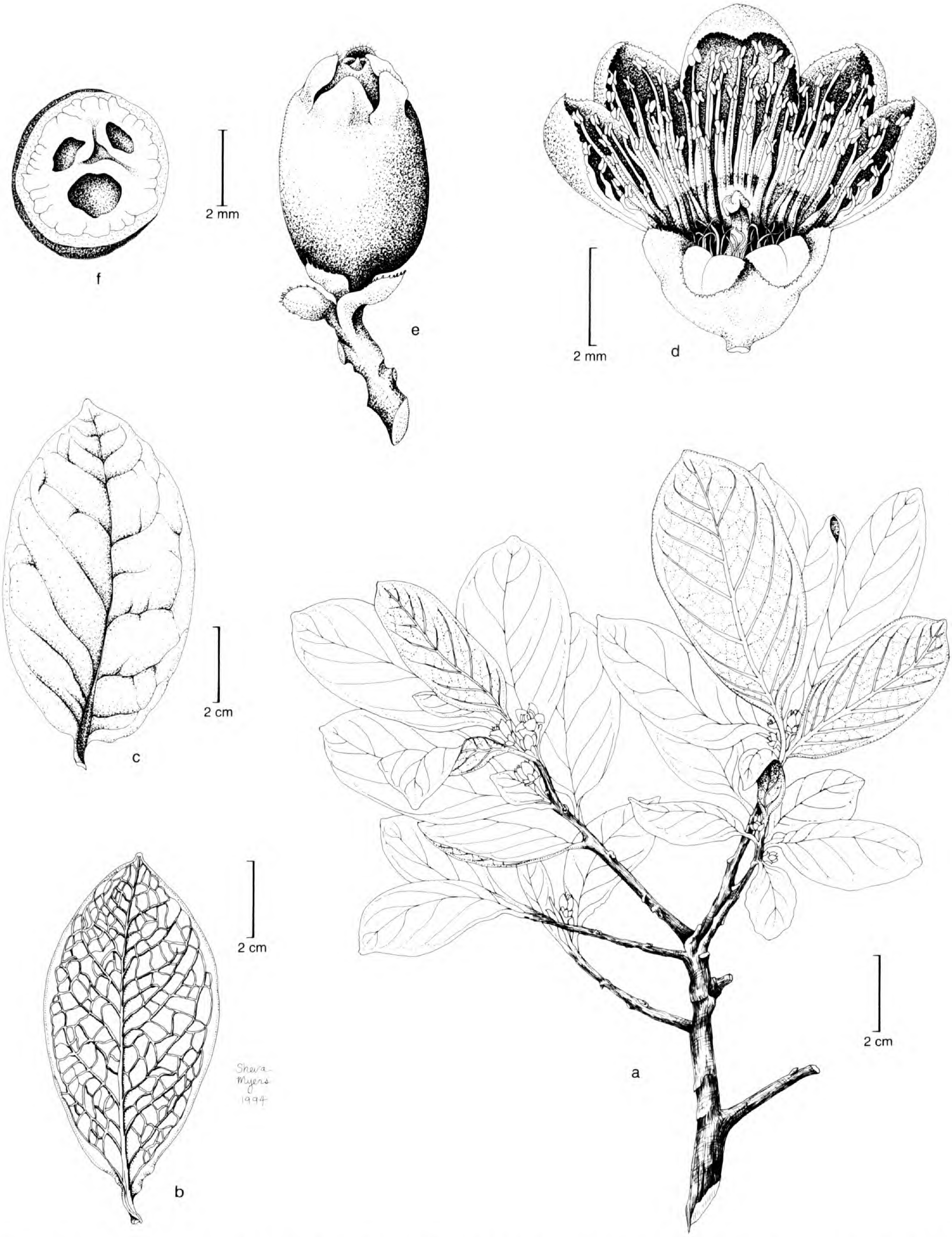

Figure 2. *Symplocos morii* Almeda & L. Kelly. —a. Branch with flowers. —b. Leaf, abaxial surface. —c. Leaf, adaxial surface. —d. Flower. —e. Fruit. —f. Fruit, cross section. Based on the holotype, *Almeda et al. 6267* (CAS).

Symplocos costaricana Hemsley, another predominantly glabrous, entire-margined species that occurs at low elevations throughout Central America. *Symplocos costaricana* can nevertheless be distinguished from *S. morii* based on its flat (non-revolute), narrower leaves (2–3.5 cm wide), longer styles (7–8 mm long), and blue-green fruits.

It is our pleasure to name this species in honor of Scott Mori (b. 1941), an expert in the Neotropical flora at The New York Botanical Garden, in rec-

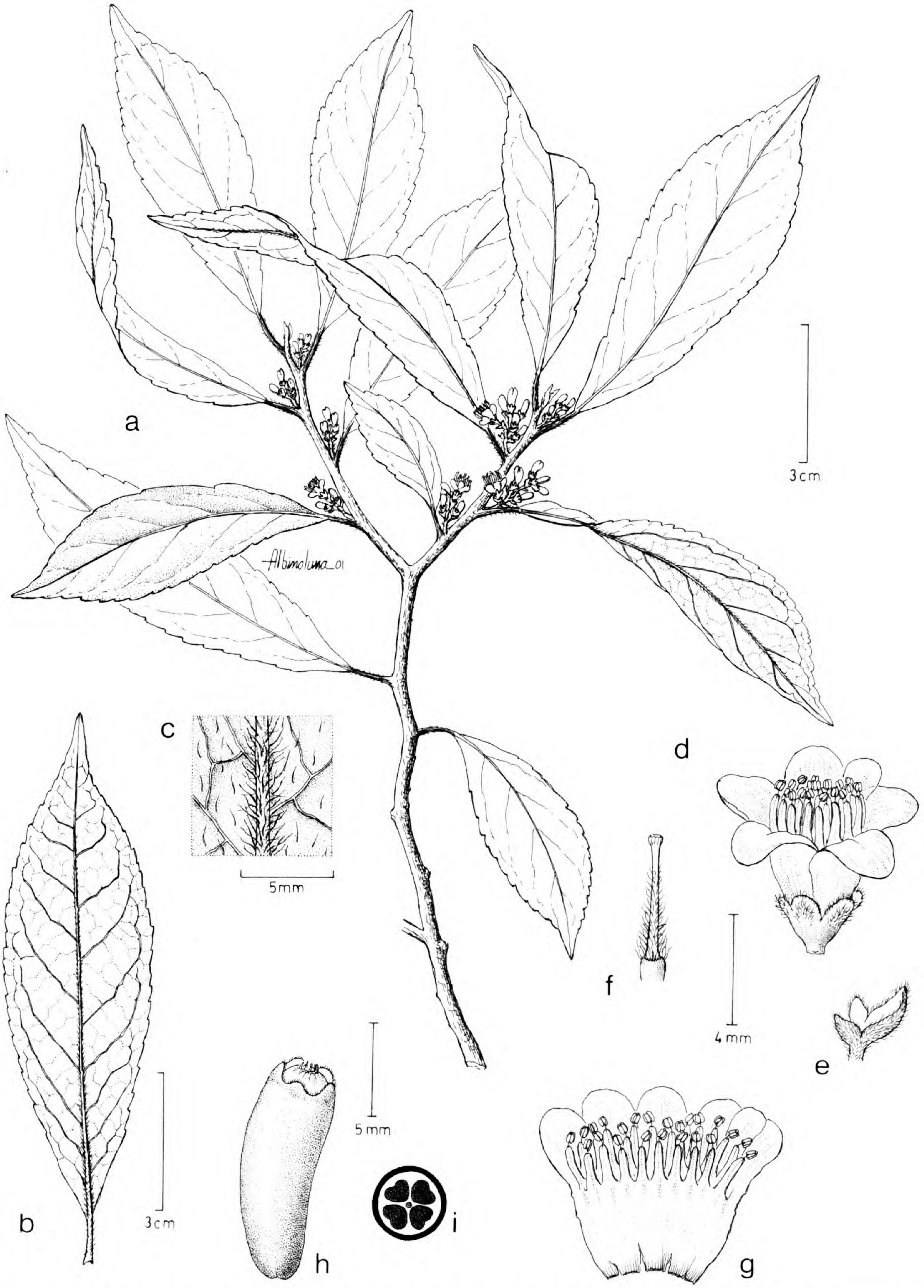

Figure 3. *Symplocos naniflora* L. Kelly & Almeda. —a. Branch with flowers. —b. Leaf, abaxial surface. —c. Leaf pubescence, abaxial surface. —d. Flower. —e. Bracteoles. —f. Style. —g. Stamens and petals. —h. Fruit. —i. Fruit, cross section. Based on isotype *Herrera 4677* (MEXU).

ognition of his outstanding contributions to botanical research.

Paratypes. PANAMA. **Bocas del Toro:** on Chiriquí trail, Elfin Forest at Divide, 20 Apr. 1968, *J. H. Kirkbride & J. A. Duke 992* (MO, NY). **Chiriquí:** path from Linares Farm ca. 1400 m to top of Cerro Hornito at 1750 m, 27 Dec. 1977, *J. P. Folsom et al. 7240* (CAS 2 sheets, MO); Cerro Hornito, 40 km NW of Gualaca, 2238 m, 27 July 1975, *S. Mori & A. Bolten 7502* (CAS, MEXU, MO). **Veraguas:** summit of Cerro Tute above Escuela Agricola Alto de Piedra, just W of Santa Fé, 1350–1410 m, 8°32′N, 81°07′W, 5 June 1982, *S. Knapp & R. Dressler 5396* (CAS, MEXU, MO).

3. Symplocos naniflora L. Kelly & Almeda, sp. nov. TYPE: Costa Rica. Puntarenas: Cantón del Golfito Jiménez, between Quebrada Patemazo and the headwaters of Río Madrigal, 650 m, 30 Nov. 1990, *G. Herrera 4677* (holotype, CAS; isotypes, CR, F, MEXU, MO, NY). Figure 3.

Arbor 13–20 m alta, ramis junioribus pilosis. Laminae foliorum 6.5–11(–12.5) cm longae, 2.5–3.5(–4.4) cm latae, membranaceae, oblanceolatae, margine serrulatae, basi acutae, apice acuminatae, adultae supra glabrae, subtus pilosae; petiolus 4–8 mm longus. Inflorescentia axillaris, racemosa, 5–10 mm longa, sericea, bracteis bracteolisque ovatis vel subrotundis, 1–1.5 mm longis, 1–1.5 mm latis; calycis tubus sericeus vel glabratus, lobis triangularibus vel semicircularibus, ciliatis, 1–1.5 mm longis, 1–1.5 mm latis; corolla alba, campanulata, 4–6 mm longa, glabra, lobis oblongis, 2–2.5 mm latis; stamina multiseriata; stylus pilosus, 4–6 mm longus. Fructus glaber, ellipsoideus, 1–1.2 cm longus, 4–5 mm latus, 4-locularis.

Trees 13–20 m tall; vegetative buds and juvenile branches moderately to sparsely pilose, the hairs 1–1.5 mm long, soft, brown, spreading to erect. Petioles pilose to glabrate, 4–8 mm long and ca. 1 mm wide. Leaves membranaceous, serrulate, oblanceolate rarely varying to elliptic, 6.5–11(–12.5) × 2.5–3.5(–4.4) cm, apex acuminate, base acute (often narrowly so), abaxially pilose, densely so on the protruding midvein, adaxially glabrous. Inflorescences short, axillary, bracteate racemes 5–10 mm long with 3 to 6 sessile to short-pedicellate (pedicels 0–3 mm long) flowers; rachis sparsely to densely sericeous; bracts and bracteoles sessile, persistent, ovate to subrotund, 1–1.5 × 1–1.5 mm, abaxially glabrate to densely sericeous, adaxially glabrous, margins ciliate. Calyx 5-lobed, the lobes triangular-ovate to subrotund, 1–1.5 mm long, 1–1.5 mm wide at the base, abaxially sparsely sericeous to glabrate, adaxially glabrous, margins ciliate. Corolla sympetalous, glabrous, cylindric-campanulate at anthesis, 4–6 mm long, 5- or 6-lobed, white; lobes connate basally for 1.5–2.5 mm and adnate to the filaments for 2–3 mm at the base, oblong, apically rounded, 2–2.5 mm wide, entire to minutely ciliate distally. Stamens 3- or 4-seriate; filaments connate basally for 3–5 mm, the free portions of outermost filaments linear-oblong, 2–3 × 0.25–0.5 mm. Ovary densely villous at the summit, glabrous on the sides; style straight, 4–6 mm long, middle and lower part densely villous; stigma inconspicuously and irregularly lobed. Fruits drupaceous, glabrous, ellipsoid, 1–1.2 × 0.4–0.5 cm, 4-celled in cross section with a rounded to very slightly undulate bony endocarp.

This species is distinguished based on the following combination of characters: membranaceous leaves, small flowers with densely villous styles, and small fruits. It is likely a member of *Symplocos* sect. *Symplocastrum* and may be closely related to *S. bicolor* L. O. Williams, another low-elevation, small-fruited species of the section. *Symplocos bicolor* is distributed from Chiapas to Nicaragua and is distinguished from *S. naniflora* based on its glabrous leaves and styles, larger flowers (corolla 6–7 mm long), and 5-lobed corolla.

Paratypes. COSTA RICA. **Alajuela:** Cantón de Los Chiles, Caño Negro, Las Cubas, Cuenca del Río Frío, 35 m, 11 Oct. 1996, *A. Rodríguez 1653* (F); Cantón de San Carlos, llanura de San Carlos, finca aserradero San Jorge, 100 m, 21 Jan. 1996, *N. Zamora & A. Zeledón 2368* (MEXU, MO). **Puntarenas:** Reserva Forestal Golfo Dulce, entre Rancho Quemado y Drake, 300 m, 29 Mar. 1991, *R. Aguilar et al. 105* (MEXU, MO); Cantón de Osa, R.F. Golfo Dulce, Península de Osa, Los Mogos, 200 m, 5 July 1994, *R. Aguilar 3462* (MO); Cantón del Golfito, Valle de Coto Colorado, camino a las torres del ICE, cabecera del Río Sorpresa, 5 km al este, 300–400 m, 1 Feb. 1992, *N. Zamora et al. 1748* (F, MO); Cantón del Golfito, Valle de Coto Colorado, camino a las torres del ICE, cabecera del Río Sorpresa, 5 km al este, 300–400 m, 22 Jan. 1993, *N. Zamora et al. 1924* (F, MO, NY). **San Jose:** basin of El General, 675–900 m, 12 Dec. 1977, *A. F. Skutch 5523* (F 2 sheets).

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A New Variety of *Miconia ceramicarpa* (Melastomataceae) from French Guiana

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ABSTRACT. *Miconia ceramicarpa* (Melastomataceae) is commonly found in the tropical forest of French Guiana. A study of the taxonomy, vegetative architecture, and inflorescence structures showed the existence of an undescribed variety, *Miconia ceramicarpa* var. *crozieriae*.

RESUMÉ. *Miconia ceramicarpa* est abondamment rencontrée en forêt tropicale de Guyane française. Une étude de la taxonomie, de l'architecture végétative et des structures inflorescentielles a montré la présence d'une nouvelle variété, *Miconia ceramicarpa* var. *crozieriae*.

Key words: French Guiana, Melastomataceae, *Miconia*.

In the series *Flora of the Guianas*, the treatment of Melastomataceae subfamily Melastomoideae was prepared by Wurdack (in Wurdack et al., 1993). The author recognized 39 genera and 283 species, including 96 species of *Miconia* for the Guianas (Guyana, Suriname, and French Guiana) and 72 for French Guiana alone.

According to Wurdack (in Wurdack et al., 1993), *Miconia ceramicarpa* (DC.) Cogniaux is a subshrub 0.4 to 1 m tall, occurring in Venezuela, the Guianas, and the lower Amazon basin in Brazil. Wurdack recognized two varieties: *Miconia ceramicarpa* var. *ceramicarpa* (= var. *violacea* (DC.) Cogniaux), present throughout the range of the species, and variety *candolleana* Cogniaux (= var. *navioensis* Wurdack), known from French Guiana and Brazil (Amapá, Pará).

While conducting studies in various forest habitats in French Guiana, we were especially interested in the morphological variation of this species, which occupies an important place in the understory, particularly in sunny locations such as logging roads and forest gaps.

The vegetative architecture of *M. ceramicarpa*, following the concept of Hallé and Oldeman (1970) and Hallé et al. (1978), was examined by Dauchez (1977) and Cremers (1986). These studies showed considerable morphological diversity in this species with each variety showing a specific model.

Dauchez (1977) and Cremers (1986) described the architecture of *M. ceramicarpa* var. *ceramicarpa*. The structure is modular and three-dimensional, conforming to Leeuwenberg's model (Hallé & Oldeman, 1970): the modules are orthotropic, with a terminal inflorescence and apical relays (Fig. 1a–c).

The same authors (Dauchez, 1977; Cremers, 1986) described the architecture of *M. ceramicarpa* var. *candolleana* as mixed, monopodial, and modular, conforming to Fagerlind's model (Hallé & Oldeman, 1970): the primary axis (trunk) is orthotropic, monopodial with rhythmic growth, and produces lateral branches that are plagiotropic and modular by apposition. The modules have terminal inflorescences (Fig. 1d–h). It was already noted by Dauchez (1977) and Cremers (1986) that some other plants of *Miconia ceramicarpa* have a miniaturized architecture with a very contracted, short-lived trunk developing only one pair of plagiotropic branches (Fig. 1i, j). These plants do not conform to either of the currently recognized varieties and are therefore described here as new.

The new variety conforms with Fagerlind's model, as does variety *candolleana*, but with the primary axis completely reduced producing a single plateau at ground level (Fig. 1i, j). The pubescence is similar to that of *Miconia ceramicarpa* var. *ceramicarpa*, as is the general aspect of the leaves, although they are smaller.

The three varieties grow in similar ecological conditions and were often found to co-occur at the same sites in open areas in the forest (clearings, trails, etc.). They have the characteristics of pioneer plants.

Miconia ceramicarpa var. **crozieriae** Cremers & C. V. Martin, var. nov. TYPE: French Guiana. Montsinéry, Piste de Saut Léodate, PK 25, 50 m, 19 Mar. 2000, *C. V. Martin 283* (holotype, P; isotypes, B, BBS, BM, BR, BRG, CAY, G, HAMAB, INPA, K, MG, MO, NY, U, US). Figures 2, 3.

A *Miconia ceramicarpa* var. *ceramicarpa* et *Miconia ce-*

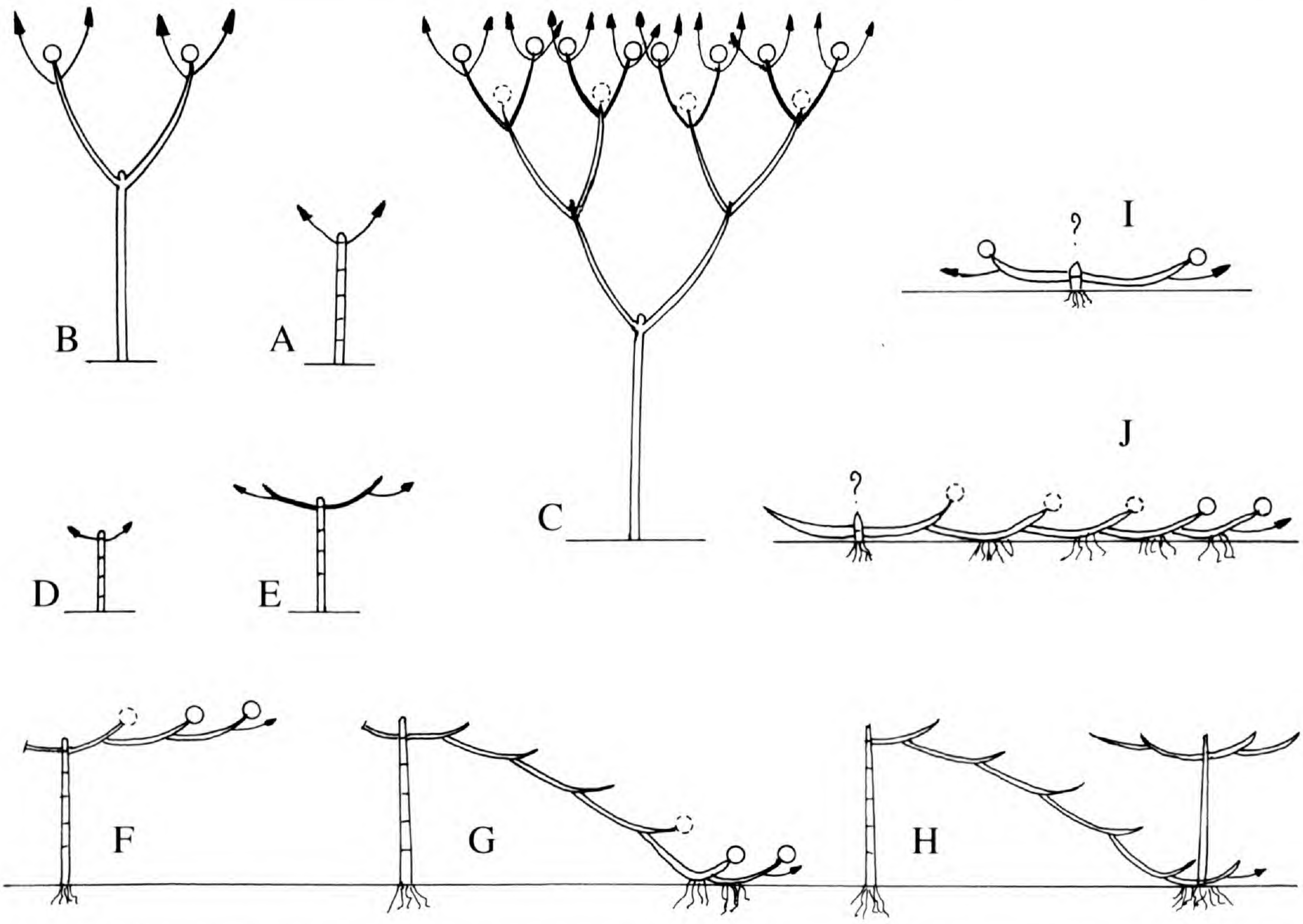

Figure 1. Vegetative architecture. *Miconia ceramicarpa* (DC.) Cogniaux. —A–C. Variety *ceramicarpa*, Leeuwenberg's model. —D–H. Variety *candolleana* Cogniaux, Fagerlind's model. —I, J. Variety *crozierae* Cremers & C. V. Martin, Fagerlind's model with primary axis very contracted or not developed.

ramicarpa var. *candolleana* primario axe, reducto habitu differt. A typo apposita sympodialibus ramulis differt. A var. *candolleana* orthotropa reiteratione carente in secondare stratis axibus, glabro abaxiali limbo praeter nervos, sparso tenui indumento, praecipue differt.

Creeping herb, (10–)15–20(–30) cm tall; primary axis not seen, but probably short and ephemeral; plagiotropic axis prostrate on the ground, rooting at nodes, sympodial by apposition; stems, veins, inflorescences, and hypanthium covered with sparse, fine, appressed pubescence. Leaves opposite, decussate, with dorsiventral leaf dimorphism; larger leaves with petiole 1–2.5 cm long, lamina 7.5–10.5 × 2.5–4.5 cm, oval to elliptic, apex acuminate, base acute to obtuse, margin finely dentate and ciliate, pubescence between and on the veins adaxially, only on the veins abaxially, main veins 3 with branching point 0.2–1.8 cm from base or less often 5 with branching 0.1–0.5 cm from base; smaller leaf similar but with petiole 0.2–1 cm long, lamina 3.5–7 × 1.5–2.5 cm; glandular hairs 30–50 μm visible only with the SEM on the abaxial and adaxial leaf surface. Inflorescence a raceme (0.8–)2–4.5(–5.5) cm long; bracts persistent. Flowers 5-merous, sessile; hypanthium 2–3 mm long; calyx oblate, lobes not projecting, 0.2–0.3 mm; corolla white to pink, petals elliptic to obovate, 1–2.5 mm long, glabrous; stamens isomorphic, glabrous; anthers 2 mm long, dehiscing by a pore; style slightly pilose at base; stigma slightly enlarged at apex. Fruits red, becoming blackish blue and fleshy at maturity, 10 × 6 mm; seeds 0.4 mm long.

In order to facilitate identification of material of *Miconia ceramicarpa*, the following key has been prepared.

KEY TO THE VARIETIES OF *MICONIA CERAMICARPA*

1. Prostrate herbs, 0.15–0.2 m tall; stems plagiotropic; pubescence sparse, short, appressed . . . . var. *crozieriae*
1′. Shrubs or subshrubs, 0.5–2 m tall; stems orthotropic or plagiotropic; pubescence dense or sparse, appressed or erect 2
    2. Shrubs 1–2 m tall; all stems orthotropic, erect; pubescence sparse, short, appressed . . . . var. *ceramicarpa*
    2′. Subshrubs 0.5–1 m tall; main stem orthotropic, lateral shoots plagiotropic, sympodial by apposition, decumbent, rooting at nodes and reiterating; pubescence dense, appressed or erect . . . . var. *candolleana*

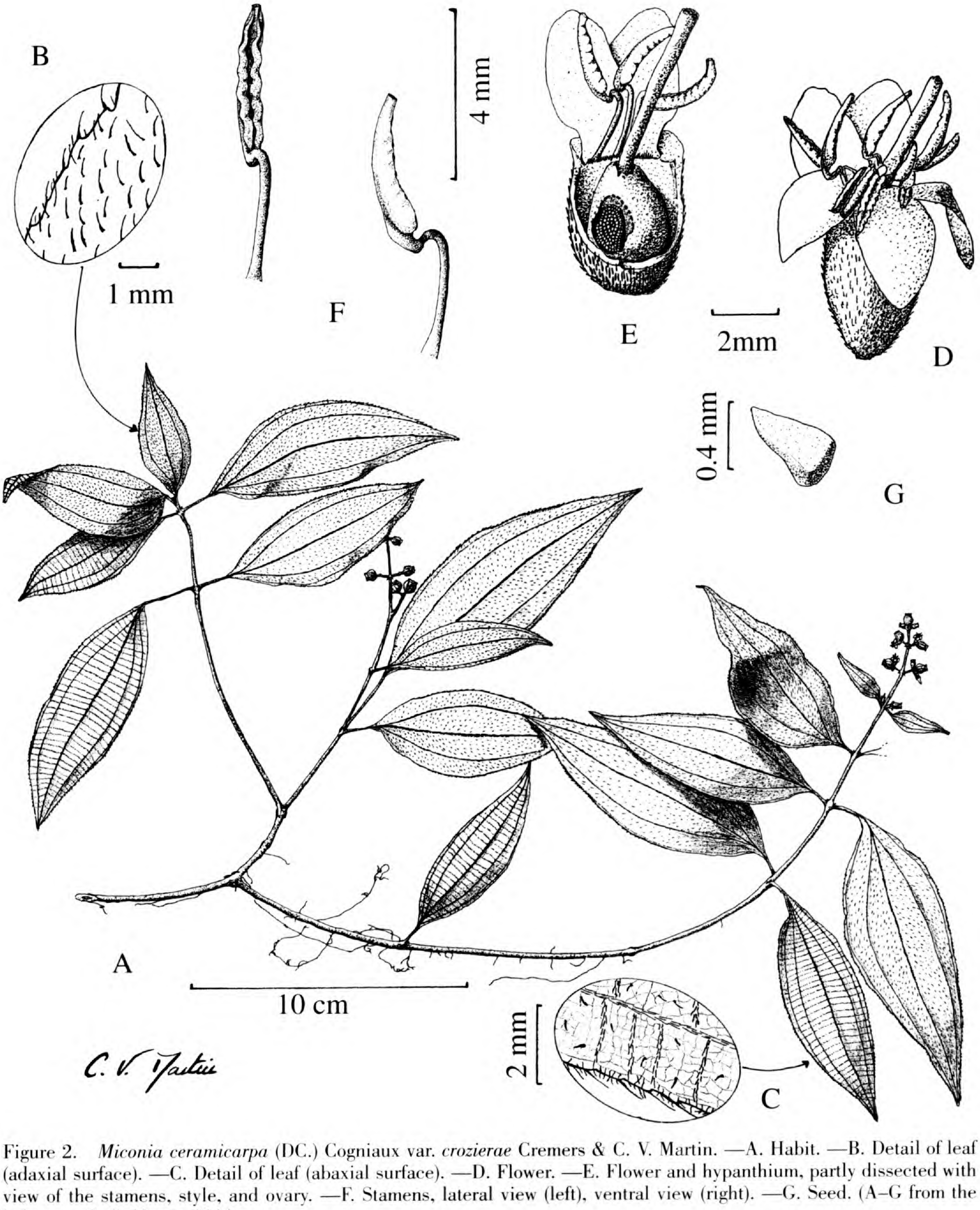

Figure 2. *Miconia ceramicarpa* (DC.) Cogniaux var. *crozierae* Cremers & C. V. Martin. —A. Habit. —B. Detail of leaf (adaxial surface). —C. Detail of leaf (abaxial surface). —D. Flower. —E. Flower and hypanthium, partly dissected with view of the stamens, style, and ovary. —F. Stamens, lateral view (left), ventral view (right). —G. Seed. (A–G from the holotype, *C. V. Martin 283*.)

This variety is named in honor of Françoise Crozier for her work with the collections at the new "Herbier de Guyane" (Cayenne), since its opening in 1995.

Paratypes. FRENCH GUIANA. Kourou, *Acevedo-Rodriguez 4910* (CAY, US); Saül, *Allorge 385* (P); Belizon, *Aubreville 295* (P); Saül, *Aumeeruddy 60* (CAY); Cacao, *Cremers 5534* (CAY, P, US); Montagne de Kaw, *Cremers 5681* (CAY, P, US); Fl. Mana, *Cremers 7497* (BR, CAY, P, US); Crique Kapiri, *Cremers 11566* (CAY, US); Savane-Roche Quatorze Juillet, *Cremers 12255* (CAY, P, US); Saül, *Descoings 20526* (CAY, P); Montagne de Kaw, *Granville 212, 213* (CAY, P); Rivière Ouaqui, *Granville 1752* (CAY, P); Layon des Emerillons, *Granville 2269* (CAY, P); Nord du Massif des Emerillons, *Granville 3942* (CAY); Saül, *Granville 4452* (CAY, P); Rivière Ouaqui, *Granville 4930* (CAY); Montagne Bellevue de l'Inini, *Granville 8142* (CAY, P, U); Trois Sauts, *Grenand 975* (CAY, P); Layon

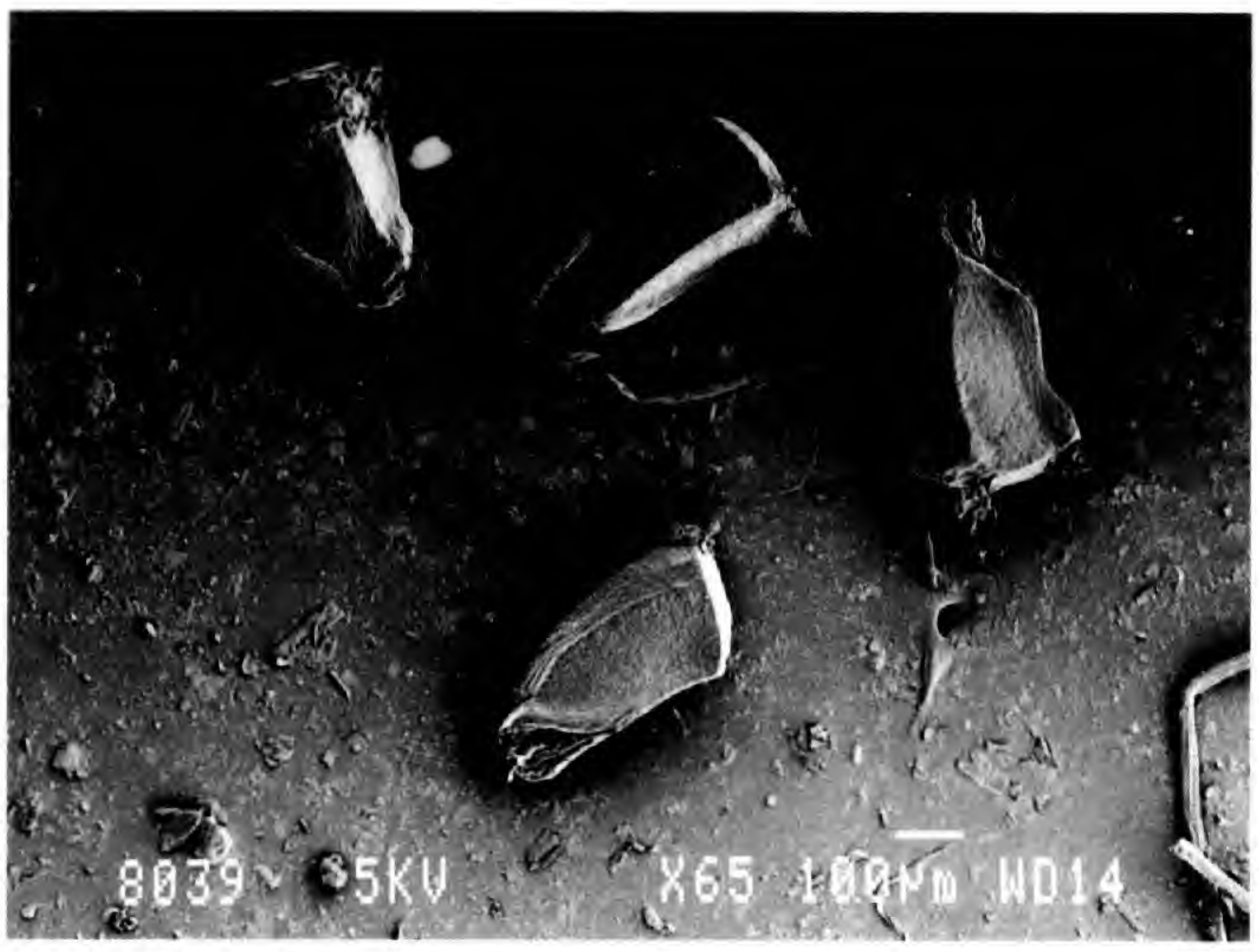

Figure 3. SEM. *Miconia ceramicarpa* (DC.) Cogniaux var. *crozierae* Cremers & C. V. Martin. Seeds. (From the holotype, *C. V. Martin 283*.)

Régina-Kaw, *Hequet 620* (CAY); Montagne de Kaw, *Hoff 5550* (CAY, P, US); Montagne de Kaw, *Jansen-Jacobs 5214* (CAY, P, U); Trois-Sauts, *Lescure 530* (CAY, P); route de Belizon, *Martin 41* (CAY); Piste Saut Léodate, *Martin 383* (B, BBS, BM, BRG, CAY, G, HAMAB, INPA, K, MG, MO, NY, P, U, US); Saül, *Mori 15628, 18340* (CAY, NY); Fleuve Oyapock, *Oldeman-T 847* (CAY, P); Fleuve Maroni, *Petibon 114* (P); Saül, *Philippe 26919* (CAY, NY); Kourou, *Hb. L. C. Richard* (P); Rivière Arataye, *Riera 699* (CAY, P); Rivière Inini, *Sastre 3963* (CAY, P); Trois-Sauts, *Sastre 4653* (CAY, P); Rivière Arataye, *Sastre 5716* (CAY, P); Maripasoula, *Schnell 11518, 11567, 11657, 11685, 11699* (P), Rivière Ouaqui, *Schnell 11903* (P). BRAZIL. **Amapá:** *Lourteig 1792* (P). **Pará:** *Jobert 102* (P); Benevides, *Poisson s.n.* (P). **Rio de Janeiro:** *Glaziou 9825* (P).

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Paysonia, a New Genus Segregated from *Lesquerella* (Brassicaceae)

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ABSTRACT. The annual, auriculate-leaved species of *Lesquerella* (Brassicaceae) of the southeastern United States are transferred to the new genus *Paysonia*. The new combinations *Paysonia auriculata, P. densipila, P. grandiflora, P. lasiocarpa, P. lasiocarpa* subsp. *berlandieri, P. lasiocarpa* subsp. *heterochroma, P. lescurii, P. lyrata, P. perforata,* and *P. stonensis* are proposed. The distinguishing characters between the combined taxon *Lesquerella–Physaria* are discussed. A detailed description of the genus and a key to the species are provided.

Key words: Brassicaceae, *Lesquerella, Physaria, Paysonia,* Southeastern United States.

In his account of the auriculate-leaved species of the genus *Lesquerella* S. Watson, Rollins (1955: 241) stated that these species "are all more closely related to each other than to other species of the genus and should be formed into a separate section or subgenus." Based on leaf and trichome morphology, chromosome number, duration, and molecular data (see below), we concur with Rollins's assessment of the close relationship among these species and that they warrant taxonomic recognition. No formal taxonomic recognition of this well-marked group of species, however, has been proposed. Rollins and Shaw (1973) included them in their informal "Group 10" (of 10 groups of *Lesquerella* species), but in his monograph of the North American Brassicaceae, Rollins (1993) made no such distinction.

Rollins (1955: 241) wondered where had the auriculate-leaved "Lesquerellas come from and by what migratory route did they get here." By "here" he was referring to their geographic range in the southeastern United States west to Texas and Oklahoma. Rollins's question presupposed that the auriculate-leaved species *were* Lesquerellas, and that they dispersed to the southeastern United States from their main distribution in the American West. The group containing the auriculate-leaved species (hereafter *Paysonia*) also contain species of the genera *Dimorphocarpa* Rollins, *Dithyrea* Harvey, *Lyrocarpa* Hooker & Harvey, *Nerisyrenia* Greene, and *Synthlipsis* A. Gray. These five genera, together with *Paysonia, Lesquerella,* and *Physaria,* form a monophyletic group easily distinguished from the rest of Brassicaceae by having pollen grains with 4–10 colpi. By contrast, the remaining ca. 96% of the family have tricolpate pollen.

In a companion paper (Al-Shehbaz & O'Kane, 2002 this issue) we combine *Lesquerella* and *Physaria* (Nuttall ex Torrey & A. Gray) A. Gray into a much-expanded *Physaria*. In that paper we provide a justification for these nomenclatural innovations and supporting literature. The larger, monophyletic *Physaria* is characterized by (1) stem leaves that are cuneate or attenuate into a petiole-like base, (2) chromosome numbers based on $n = 4, 5, 6$, or 7 (with a few polyploids derived from these numbers; see Rollins & Shaw, 1973), (3) perennial duration (or biennial or rarely annual, through derivation from perennial ancestors), (4) no documented interspecific hybridization (Rollins & Shaw, 1973), and (5) trichomes that are strictly stellate to stellate-peltate (often webbed between the rays), and nearly always tuberculate. We here place those species excluded from the expanded *Physaria* in a new genus, *Paysonia,* named in honor of Edwin B. Payson (1893–1927), the first monographer of *Lesquerella* (Payson, 1922). *Paysonia* is characterized by (1) stem leaves that are sessile and auriculate, (2) chromosome numbers based on $n = 8$, (3) an annual duration, (4) frequent natural (and artificial) interspecific hybridization (Rollins, 1957; Rollins & Shaw, 1973; Rollins & Solbrig, 1973), and (5) trichomes that lack tubercles and are not stellate but rather are simple, one-branched, bifurcate, or dendritic (Rollins & Banerjee, 1975, 1979).

Molecular data (O'Kane, unpublished) based on DNA sequences of the nuclear ribosomal internal transcribed spacer (ITS) support the recognition of *Paysonia* and show that this genus and the combined taxon *Physaria–Lesquerella* shares a common ancestor.

Paysonia O'Kane & Al-Shehbaz, gen. nov. TYPE: *Paysonia lescurii* (A. Gray) O'Kane & Al-Shehbaz.

Herba annua; pili ramosi minute stipitati et pilis simpilicibus praesentibus. Folia caulina sessilia, sagittata vel auriculata. Racemi ebracteati, valde elongati. Sepala oblonga, nonsaccata. Petala alba vel flava, obovata. Ovula 2–8(–10) per locula. Siliculis globosis, subpyriformis, suborbiculatis, vel subovatis, teretis vel compressis et angusti- vel latiseptatis; septum completum vel perforatum; stylus 1–3 mm longus; stigma integra. Semina compressa; cotyledones accumbentes.

Herbs annual. Trichomes coarse, simple, mixed with much smaller, short-stalked, forked or subdendritic ones. Stems erect to ascending, sometimes decumbent. Basal leaves petiolate, rosulate, lyrate or pinnately lobed. Cauline leaves sessile, minutely to coarsely auriculate or sagittate, often amplexicaul, dentate. Racemes many flowered, ebracteate, often elongated considerably in fruit; rachis straight. Fruiting pedicels slender, ascending to divaricate or recurved, straight or slightly curved. Sepals oblong, deciduous, suberect, ascending, or spreading, equal, base of inner pair not saccate, margin membranous. Petals yellow or white, broadly obovate, apex rounded; claw slightly differentiated from blade. Stamens 6, erect, tetradynamous; filaments dilated or not at base; anthers oblong, not apiculate at apex. Nectar glands confluent, subtending bases of median stamens, surrounding those of lateral stamens. Ovules 2 to 8(to 10) per locule. Fruit dehiscent silicles, globose, subpyriform, suborbicular, or subovate, terete, latiseptate or angustiseptate, not inflated, subsessile; valves papery or leathery, veinless, glabrous or pubescent with branched and/or simple trichomes; septum complete, perforated, or reduced to a rim, membranous; style 1–3 mm long, slender, glabrous or pubescent; stigma capitate, entire. Seeds subbiseriate, margined, orbicular to subovate, flattened; cotyledons accumbent.

Key to the Species of *Paysonia*

- 1a. Fruits orbicular or elliptic, flattened; valves often with coarse simple trichomes and much smaller branched ones.
  - 2a. Fruit latiseptate; fruiting pedicels divaricate-ascending; cauline leaves strongly auriculate to sagittate, amplexicaul; filaments dilated at base . . . . *P. lescurii*
  - 2b. Fruits angustiseptate; fruiting pedicels recurved; cauline leaves minutely auriculate, not amplexicaul; filaments not dilated at base . . . . *P. lasiocarpa*
- 1b. Fruits globose to subpyriform, not flattened; valves uniformly with small, simple and/or branched trichomes.
  - 3a. Flowers white; septum perforated.
    - 4a. Fruits subpyriform, valves glabrous or sparsely pubescent outside, densely pubescent inside; styles glabrous . . . . *P. perforata*
    - 4b. Fruits subglobose, valves densely pubescent outside, glabrous inside; style pubescent . . . . *P. stonensis*
  - 3b. Flowers yellow; septum complete.
    - 5a. Fruit valves and styles pubescent . . . . *P. densipila*
    - 5b. Fruits valves and styles glabrous.
      - 6a. Fruits 2.4–3.5 mm long; ovules 2–4 per locule; septum opaque . . . . *P. lyrata*
      - 6b. Fruits 4–6(–8) mm long; ovules (4–)6–8(–10) per ovary; septum translucent.
        - 7a. Lower stems hirsute with spreading simple trichomes; petals 4–5 mm wide; fruiting raceme congested, slightly elongated . . . . *P. auriculata*
        - 7b. Lower stems pubescent with branched trichomes; petals 6–10 mm wide; fruiting raceme lax, considerably elongated . . . . *P. grandiflora*

For a complete synonymy of the following taxa, see Rollins (1993).

Paysonia auriculata (Engelmann & A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria auriculata* Engelmann & A. Gray, Bost. J. Nat. Hist. 5: 240. 1845. *Lesquerella auriculata* (Engelmann & A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 250. 1888. TYPE: U.S.A. Texas: Austin Co., near San Felipe, *F. Lindheimer 217* (holotype, GH; isotypes, GH, MO).

Paysonia densipila (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella densipila* Rollins, Rhodora 54: 186. 1952. TYPE: U.S.A. Tennessee: Marshall Co., Duck River bottom, N of Verona, 10 Apr. 1949, *A. J. Sharp, C. J. Felix & W. Adams 11187* (holotype, GH; isotypes, GH, MO, NY).

Paysonia grandiflora (Hooker) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria grandiflora* Hooker, Curtis's Bot. Mag., n.s. 10: pl. 3464. 1836. *Lesquerella grandiflora* (Hooker) S. Watson, Proc. Amer. Acad. Arts 23: 250. 1888. TYPE: U.S.A. Texas: Austin Co., San Felipe, *Drummond 20 bis* (lectotype, designated by Rollins & Shaw (1973), K; isolectotypes, GH, NY).

Paysonia lasiocarpa (Hooker ex A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria lasiocarpa* Hooker ex A. Gray, Smithsonian Contr. Knowl. (Pl. Wright.) 5: 13. 1853. *Lesquerella lasiocarpa* (Hooker ex A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 251. 1888. TYPE: "Country and state unknown:" between Bexar and Trinity River, May 1828, *Berlandier s.n.* (holotype, K).

Paysonia lasiocarpa subsp. **berlandieri** (A. Gray) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Synthlipsis berlandieri* A. Gray, in Emory, Report U.S. & Mex. Bound. Survey 34. 1859. *Lesquerella lasiocarpa* var. *berlandieri* (A. Gray) Payson, Ann. Missouri Bot. Gard. 8: 139. 1922. TYPE: Mexico. Tamaulipas: Matamoros, *Berlandier 3017* (lectotype, designated by Rollins & Shaw (1972), GH; isolectotypes, GH, US).

Paysonia lasiocarpa subsp. **heterochroma** (S. Watson) O'Kane & Al-Shehbaz, comb. et stat. nov. Basionym: *Synthlipsis heterochroma* S. Watson, Proc. Amer. Acad. Arts 17: 321. 1882. *Lesquerella lasiocarpa* var. *heterochroma* (S. Watson) Rollins, Rhodora 57: 245. 1955. TYPE: Mexico. Nuevo León: Guajuco, 27 mi. SE from Monterrey, *Edward Palmer 33* (holotype, GH).

Paysonia lescurii (A. Gray) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Vesicaria lescurii* A. Gray, Manual Bot., ed. 2, 38. 1856. *Lesquerella lescurii* (A. Gray) S. Watson, Proc. Amer. Acad. Arts 23: 250. 1888. TYPE: U.S.A. Tennessee: Davidson Co., near Nashville, Apr. 1855, *Leo Lesquereux s.n.* (lectotype, designated by Rollins (1952), GH).

Paysonia lyrata (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella lyrata* Rollins, Rhodora 57: 252. 1955. TYPE: U.S.A. Alabama: Franklin Co., near Richardson's Crossing, 7 mi. E of Russellville, 16 Apr. 1955, *Reed C. Rollins, George R. Cooley & L. J. Brass 5599* (holotype, GH; isotypes, GH, MO, NY, UC).

Paysonia perforata (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella perforata* Rollins, Rhodora 54: 190. 1952. TYPE: U.S.A. Tennessee: Wilson Co., 5 mi. N of Lebanon, 30 Mar. 1952, *Reed C. & Diane Rollins 5207* (holotype, GH; isotypes, F, GH, MO, NY, US).

Paysonia stonensis (Rollins) O'Kane & Al-Shehbaz, comb. nov. Basionym: *Lesquerella stonensis* Rollins, Rhodora 57: 255. 1955. TYPE: U.S.A. Tennessee: Rutherford Co., E Fork of Stones River, Walterhill, 26 Apr. 1955, *Reed C. Rollins 55176* (holotype, GH; isotypes, F, GH, MO, NY, US).

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Novae Gesneriaceae Neotropicarum X: A New Species of *Achimenes* from Mexico

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ABSTRACT. A new species of *Achimenes* Persoon, *A. hintoniana*, is described from western Mexico and distinguished from the closely related *A. mexicana* by the pilose indumentum of the stem, leaves, and pedicels, the linear-lanceolate calyx lobes, and the slightly saccate purple or rarely white corolla.

Key words: *Achimenes*, Gesneriaceae, Mexico.

Achimenes Persoon is a genus of neotropical Gesneriaceae distributed from northern Mexico (Chihuahua and Tamaulipas states) south to Ecuador, Venezuela, and Jamaica and comprising 23 species. About two-thirds of the species are endemic in Mexico, where numerous collections have been made and where the center of diversification appears to be. A recent revision of *Achimenes* (Ramírez Roa, 1987) and recent plant collections have shown that the description of a new species, *A. hintoniana* from Mexico, is warranted.

Achimenes hintoniana Ramírez Roa & L. E. Skog, sp. nov. TYPE: Mexico. Nayarit: Nayar, 7 km al S de La Mesa del Nayar, encinar en barranca, brecha a Jesús María, 22°12′N, 104°36′W, 1400 m, 23 Sep. 1989, *P. Tenorio L. & G. Flores F. 16332* (holotype, MEXU; isotypes, FCME, US). Figure 1.

Herba erecta pilosa non ramosa ad 56 cm alta. Folia petiolata opposita paribus subaequalibus, laminis ovatis vel ovato-ellipticis longiacuminatis margine serratis. Flores axillares solitarii; calycis lobi lineari-lanceolati pilosi; corolla infundibuliformis ad 6.9 cm longa purpurea, fauce albida glabra maculis purpureis, tubo sursum ampliato base leviter saccata, limbo 5-fido; stamina 4 (quinto ad staminodium reducto) didynama inclusa, filamentis glabris tubo insertis; discus annularis integer membranaceus. Ovarium glabrum; stylus puberulus; stigma infundibuliforme; capsula pilosa.

Herbs; stems erect, 5.3–56 cm tall, green or red-tinged, pilose. Rhizome 6.4 cm long, 7.5 mm wide, scales red-tinged. Leaves almost isophyllous; ovate-elliptic or ovate, 3.2–12 × 1.4–8 cm, apex largely acuminate, base oblique, margin serrate, 10–27 teeth per side, and ciliate, 7–12 pairs of secondary veins, the upper surface pilose, green, the lower surface pilose, pale green or red; petioles 1.5–4.5 cm long, pilose. Flowers solitary; pedicels 1.1–2.3 cm long, pilose, green or red; floral tube 2–3 × 1.5–2 mm, pilose or almost glabrous; calyx lobes linear-lanceolate, 4–9 × 1–2 mm, pilose or nearly glabrous, ciliate; corolla infundibuliform, slightly oblique in the calyx, 4.1–6.9 cm long, purple or rarely white, glabrous to pilose, tube slightly saccate, 2–5 cm long, slightly ventricose, 3–6 mm wide at the base, very narrow, 1.2–2.5 cm wide at the throat, white with purple spots at the throat, limb 3.4–4.2 cm wide, 5-lobed, lobes oblate, 0.9–1.9 × 1–2.2 cm, crenate, purple or rarely white; stamens 4 (with a reduced staminode), 2.5–2.8 cm long, filaments briefly adnate to corolla tube base and free above, glabrous, anthers ovate depressed, 0.5–1 × 1–1.5 mm; annular nectariferous disc entire, membranous, 0.7 mm long; ovary glabrous, style 2.3–3.3 cm long, glandular-puberulous, stigma funnel-shaped. Capsule 8 mm long, 4 mm wide, green, lightly pilose to glabrous. Seeds oblong, ca. 0.5 × 0.2 mm, red-brown, longitudinally striate.

Distribution and ecology. Endemic to Mexico, *Achimenes hintoniana* is known mainly from Jalisco and Nayarit states at 800–1650 m, with outliers in Durango and Michoacán, growing in oak forests, mixed oak-pine forests, dry deciduous forests, and montane rain forests. Collections have been made of flowering plants in July through September and fruiting in September.

The specimens included here had in most cases been identified as the closely related *Achimenes mexicana* (Seemann) Bentham & J. D. Hooker ex Fritsch. However, *A. mexicana* has villous indu-

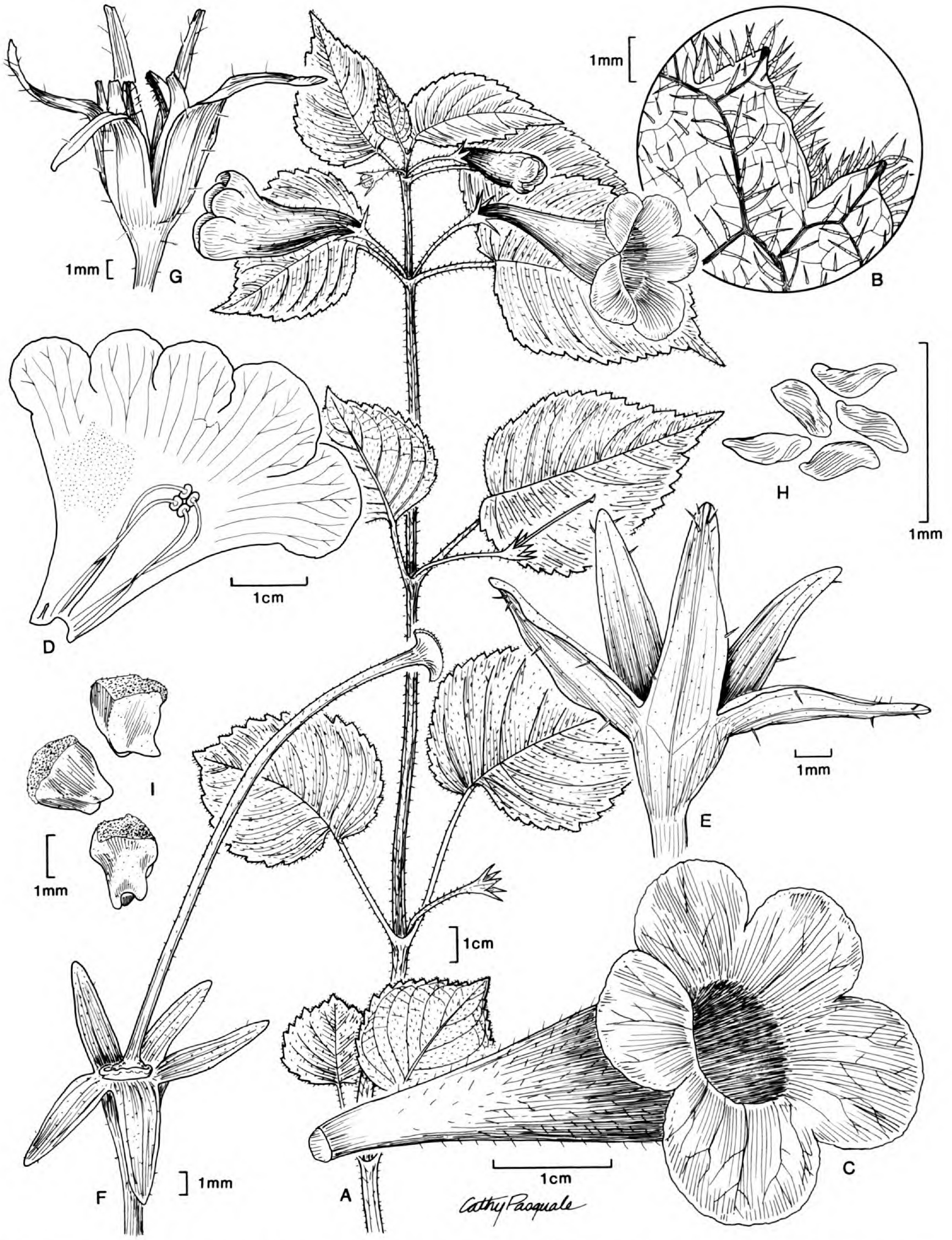

Figure 1. *Achimenes hintoniana* Ramírez Roa & L. E. Skog. —A. Habit. —B. Lower leaf surface. —C. Corolla. —D. Opened corolla with stamens and staminode. —E. Calyx. —F. Pistil with calyx and disc. —G. Dehisced capsule with surrounding persistent calyx and floral tube split to the base, and funicles within the capsule. —H. Seeds. —I. Rhizome scales. (A–F, I from *R. McVaugh 16443*; G, H from *R. McVaugh 16336*.)

ment with hairs of various lengths primarily on the stems, petioles, pedicels, and floral tube. The indumentum of *A. hintoniana* is pilose and much less dense. In addition, the calyx lobes in *A. mexicana* are lanceolate-ovate, and the blue-violet corollas are ventricose with a broadly sacciform base. *Achimenes mexicana* occurs in Chihuahua, Durango, Sinaloa, and Sonora. The two species are not sympatric except for an unlocalized collection of *A. hintoniana* from Durango (*Rose 2331*).

The variation seen in *Achimenes hintoniana* is principally in size, but the specimen collected by McVaugh (*16336A*) has white corollas. McVaugh mentioned on the specimen label that these plants were found among plants with purple corollas. This color variation is not unusual in the genus and is found also in *A. antirrhina* (DC.) C. V. Morton, *A. erecta* (Lamarck) H. P. Fuchs, *A. heterophylla* (Martius) DC., and *A. patens* Bentham. The epithet honors George B. Hinton (1882–1943), a collector of plants in southwestern Mexico where he collected many specimens of *Achimenes* species.

Paratypes. MEXICO. **Durango:** 16 Aug. 1897, *J. Rose 2331* (NY, US). **Jalisco:** 8.2 mi. W of Chapala on road to Jocotepec, at km 62, hills above Lake Chapala's N shore, *W. Anderson & C. Anderson 5169* (GH, MICH, NY); Mpio. Talpa de Allende, Texcalame, sobre la brecha de Talpa a Cuale, *M. Cházaro et al. 7378* (MEXU); Mpio. Tonalá, Barranca de Huentitán, microcuenca de las 7 Cascadas, 2 km al E de Tonalá, *A. Flores-M. & P. Ramos G. 2428* (MEXU); 10.1 mi. SSW Autlán off hwy. 80, *R. Kral 27657* (ENCB); 9.4 mi. from Autlán (kms 218–219) on road to Barra de Navidad, *H. Moore & G. Bunting 8725* (US); km 69–70, near Jocotepec, on hills above the W end of Lake Chapala, *E. Norman 64* (MICH); along Jocotepec–Chapala road on the N side of Lake Chapala, ca. 2 mi. (3 km) E of San Juan Cozalá, *A. Sanders 74140* (MICH); along hwy. 110 about 5 mi., NE of Rio Tuxpan bridge and about 20 mi. NE of Huizache, *W. Stevens & M. Fairhurst 1820* (MICH, MO); trail between El Chante and Manantán about 15 mi. SSE of Autlán, *R. Wilbur & C. Wilbur 2092* (MICH, US); 10 mi. S of Autlán, *R. Wilbur & C. Wilbur 2118* (MICH, US). **Michoacán:** Sierra Naranjillo-Puentes, Dist. Coalcoman, *G. Hinton et al. 15978* (US). **Nayarit:** mountain 10 mi. SE of Ahuacatlán, on road to Barranca del Oro, *C. Feddema & R. King 258* (MICH, US); 3.5 mi. NW of Ahuacatlán, S of the base of volcán Ceboruco and about 1 km N of the highway, *C. Feddema 422* (MICH); 31 km al NE de Jesús María, camino Jesús María–Huejuquilla, *G. Flores-F. et al. 2094* (MEXU, US); Mpio. Nayar 5 km al SE de la Mesa del Nayar, *G. Flores-F. & R. Ramírez R. 2639* (MEXU, US); Mpio. Nayar, 32.5 km al NE de Jesús María, La China, *G. Flores-F. & P. Tenorio L. 1008* (MEXU, US); Mpio. Nayar, 22.7 km al NW de Jesús María, camino Jesús María–La Mesa del Nayar, *G. Flores-F. & P. Tenorio L.* 1333 (MEXU, US); 5–8 km al NW de la Mesa del Nayar, camino a la Mesa del Nayar–Villa de Guadalupe (Cerro Cangrejo), *G. Flores-F. et al. 1130* (MEXU, US); 2 mi. NW of Ahuacatlán, *R. McVaugh 15405* (MICH); Arroyo de la Fundición, 5 mi. SE of Ahuacatlán on road to Barranca del Oro, *R. McVaugh 16336* (MICH, US), *R. McVaugh 16336A* (MICH); 9 mi. N of Compostela, *R. McVaugh 16443* (MICH, US); ca. 12 mi. W of Tepic, 6.5 mi. E of Jalcocotán, *McVaugh et al. 18919* (MICH), *McVaugh et al. 18975* (MICH); km 15 on road from Tepic to Jalcocotán, *H. Moore & G. Bunting 8699* (MEXU, UC, US); along road from Hwy. 15 to Santa Cruz (W of Tepic), about 9.9 mi. W of Hwy. 15, *W. Stevens 1486* (ENCB, MICH, MO); km 4 de la carr. a San Blas, del entronque con carr. Tepic–Mazatlán, *O. Téllez V. et al. 10742* (MO). **Cultivated:** Growing at Marie Selby Botanical Gardens, Sarasota, FL, originally from Nayarit, W of Tepic near La Libertad, *N. Bashor 1878* (F, SEL, US).

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Oxypetalum rusticum (Apocynaceae, Asclepiadoideae), a New Species from the Espinhaço Range, Minas Gerais, Brazil

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ABSTRACT. The Latin diagnosis of *Oxypetalum rusticum* Rapini is provided to validate the species, proposed but not validly published in the survey of the Asclepiadoideae from the Espinhaço Range of Minas Gerais, Brazil. The species, endemic to the Diamantina Plateau, is closely related to *O. insigne* (Decaisne) Malme and *O. glabrum* (Decaisne) Malme, differing mainly by the wooly indumentum of the branches and the longer corpusculum of the pollinaria.

Key words: Apocynaceae, Asclepiadoideae, Brazil, Espinhaço Range, Minas Gerais, *Oxypetalum*.

Oxypetalum R. Brown includes more than 150 species distributed mainly in Brazil (Hoehne, 1916) and Argentina (Meyer, 1943), with its species richness decreasing toward the north of its distribution. The genus is usually recognized by the gynostegium, which is prolonged in a rostrum, and the translator arms of the pollinaria, which have lateral teeth.

Studies on the Asclepiadoideae from the Espinhaço Range of Minas Gerais, Brazil (Rapini, 2000; Rapini et al., 2001), have suggested new species and several taxonomic changes in the subfamily (see Rapini, 2002, for new species of *Ditassa* R. Brown and discussions on taxonomic concepts of Metastelmatinae genera). Here, the Latin diagnosis of *Oxypetalum rusticum* Rapini, a new species proposed but not validly published in the survey, is provided (for full description and paratypes, see Rapini et al., 2001).

Oxypetalum rusticum Rapini, sp. nov. TYPE: Brazil. Minas Gerais: Mun. Datas ["Diamantina"], Diamantina–Gouveia road, km 605, 14 Feb. 1998 (fl), *F. N. Costa, P. T. Sano, W. Vilegas, L. Campaner & F. P. Andrade 35* (holotype, SPF; isotype, K). Figure 1.

Oxypetalo insigni similis, ramis et inflorescentiis racemiformibus lanatis, foliis persaepe latioribus superne villosis sed nervis lanatis, laciniis corollae sursum glabrescentibus et retinaculis maioribus, ultra 2.4 mm longis, recedens.

Twining vine; branches wooly. Leaves elliptic or ovate, cordate to reniform at the base, pilose adaxially, villous on the veins, villous abaxially, wooly on the veins. Cymes racemiform, with up to 6 flowers. Corolla hirsute to pubescent abaxially, puberulent adaxially on the tube, barbulate on the throat, glabrescent toward the apex of the lobes; lobes oblong, 0.9–1.4 cm long, twisted, patent. Corona lobes scale-like to widely oblong, cleft, corniculate adaxially. Corpusculum spathulate, keeled to involute, 2.5–2.6 mm long; pollinia 0.65–0.85 mm long. Apex of the gynostegium prolongation coroniform, slightly bilobate. Follicles wooly to velutinous.

Oxypetalum rusticum, *O. insigne* (Decaisne) Malme, and *O. glabrum* (Decaisne) Malme, the last of which is sometimes considered a variety of *O. insigne* (Fontella-Pereira & Schwarz, 1983; Fontella-Pereira et al., 1984), form a complex of twining species with the gynostegium prolongation cup-shaped or coroniform to bilobate at apex. The new species differs from these two by its wooly (vs. glabrous to hispid) indumentum of the branches and mainly by its longer corpusculum (2.5–2.6 mm long vs. up to 2.1 mm long in the other two species). Due to the leaves usually broad, villous abaxially, and especially the wooly branches, *O. rusticum* is not subtle when compared with its closely related and relatively slender species (see Rapini, 2000, for photos of the three species), which is the reason for the specific epithet.

Phenology. *Oxypetalum rusticum* has been found with flowers between November and April, and with fruits in April.

Distribution and habitat. The species is restricted to the Diamantina Plateau, in the northern range of its closely related taxa: *O. glabrum* extends into the southern Diamantina Plateau and *O. insigne* to Serra do Cipó, also in the Espinhaço Range of Minas Gerais. *Oxypetalum rusticum* occurs only in *campos rupestres*, an open vegetation on quartzite or sandstone formations that appears at elevations above 900 m, and which is known for its high level of plant endemism (Giulietti et al., 1987, 1997; Rapini et al., in press).

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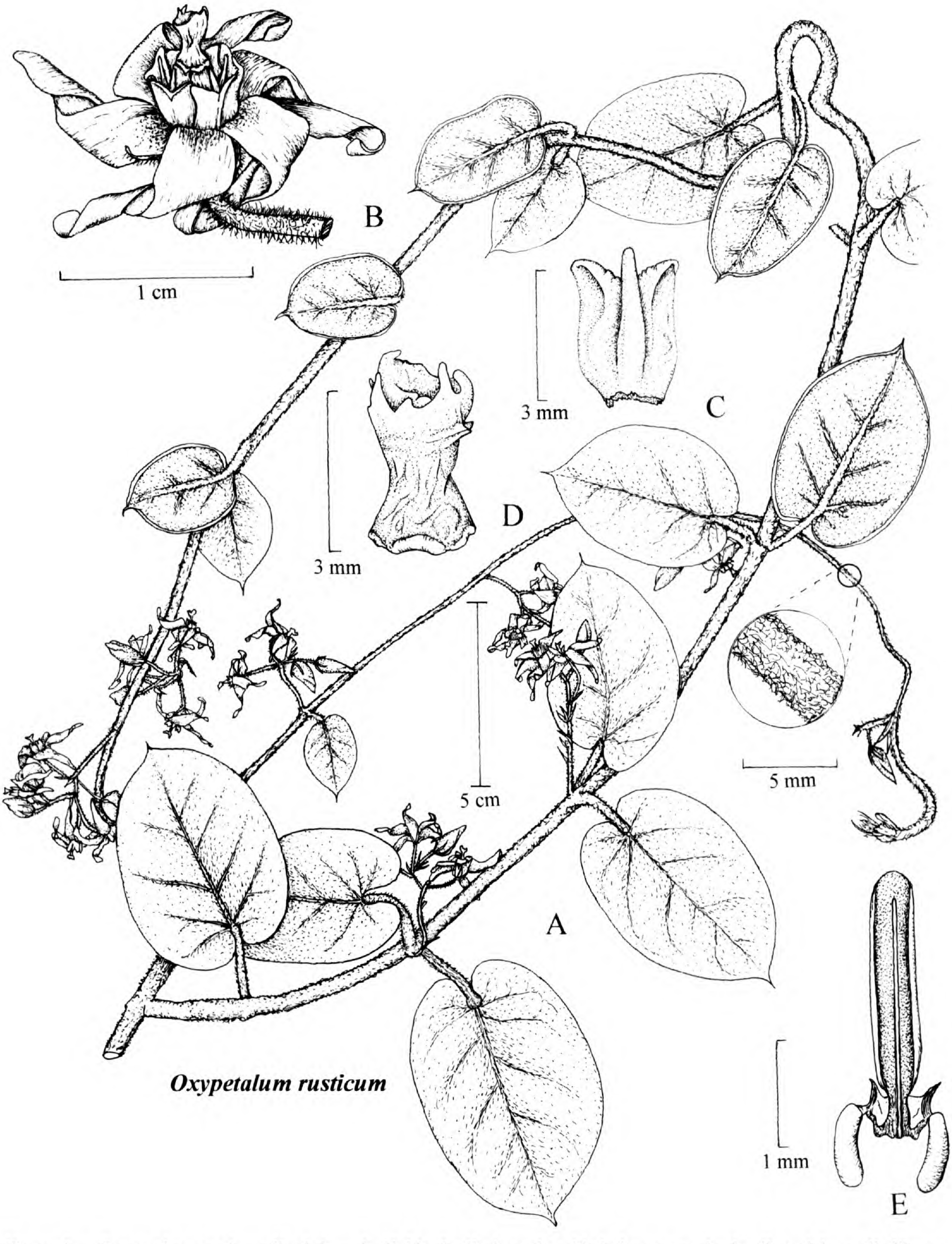

Figure 1. *Oxypetalum rusticum* Rapini. —A. Habit, fertile branch, with indumentum in detail at right. —B. Flower. —C. Lobe of corona, adaxial view. —D. Appendage of gynostegium. —E. Pollinarium. Drawn by the author from the holotype, *Costa et al. 35* (SPF).

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Additions to *Neocuatrecasia* (Eupatorieae: Asteraceae)

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ABSTRACT. *Neocuatrecasia sandiensis* H. Robinson and *N. yungasensis* H. Robinson from high elevations in Peru and Bolivia and *N. tysonii* H. Robinson from lower elevations in Bolivia are described as new. A key is furnished to the 12 species of the as yet inadequately collected genus.

Key words: Asteraceae, Bolivia, Eupatorieae, *Neocuatrecasia*, Peru.

The genus *Neocuatrecasia* was described by King and Robinson in 1970 on the basis of four species from the eastern slopes of the Andes in Peru and Bolivia that had superficial resemblance to small members of the widespread genus *Ageratina* Spach. *Neocuatrecasia* can be distinguished from *Ageratina* by the hairs on the base of the style. This character, along with the ornamented cell walls of the anther collar and the usually stipitate bases of the achenes, places the genus far from *Ageratina* and in the subtribe Gyptidinae (King & Robinson, 1987). A fifth species was transferred and four additional species were described in following years (King & Robinson, 1972, 1974, 1986, 1988), but no key has been provided since 1972 when there were only six known species in the genus. Since new collections of the genus have often proved to be new species, one presumes that many further species remain to be discovered. Three more new species are described herein, and a key is provided for the 12 species now known in this Peruvian and Bolivian genus.

KEY TO THE SPECIES OF *NEOCUATRECASIA*

1a. Peduncles with numerous long-stipitate glands longer than any non-glandular hairs.
  2a. Leaves sessile; pappus of ca. 20 long fragile very slender setae not contiguous at bases (Peru) . . . . *N. sessilifolia* R. M. King & H. Robinson
  2b. Leaves distinctly short-petiolate or petioliform at base; pappus of 25 to 35 persistent setae that are short or with nearly contiguous bases.
    3a. Inflorescence broadly cymiform, with alternate branching; involucral bracts mostly narrowly elliptical, outer bracts bicostate in basal half or more; corollas with throats less than twice as wide as basal tube; base of style enlarged; style branches scarcely twice as wide as shaft; pappus bristles a third or less as long as the corolla; plants occurring at elevations of 500 m or less (Bolivia) . . . . *N. tysonii* H. Robinson, sp. nov.
    3b. Heads few or single, terminal, with subtending leaves opposite; involucral bracts broadly oblong, only weakly veined, not costate; corollas with throats nearly three times as wide as basal tubes; base of style not broadened except by hairs; style branches three or more times as broad as shaft; pappus bristles half as long as corolla or longer; plants occurring at elevations of 2000–3500 m (Bolivia) . . . . *N. yungasensis* H. Robinson, sp. nov.
1b. Stipitate glands of peduncles, when present, scarcely longer than non-glandular hairs.
  4a. Corolla throat 3 or more times as long as lobes.
    5a. Leaf blades deeply lobed or dissected (Bolivia) . . . . *N. lobata* (B. L. Robinson) R. M. King & H. Robinson
    5b. Leaf blades not deeply lobed or dissected.
      6a. Heads with ca. 50 florets, with 15 or more involucral bracts (Peru) . . . . . *N. weddellii* (B. L. Robinson) R. M. King & H. Robinson
      6b. Heads with ca. 25 to 30 florets, with 10–12(–14) involucral bracts.
        7a. Involucral bracts with acute tips; veins of leaves densely hirtellous abaxially (Bolivia) . . . . *N. feuereri* R. M. King & H. Robinson
        7b. Involucral bracts broadly rounded at tips; veins of leaves puberulous with small hairs abaxially (Peru) . . . . *N. sandiensis* H. Robinson, sp. nov.
  4b. Corolla throat 2 or less times as long as the lobes.
    8a. Stems and peduncles hirsute to hispidulous with spreading pale hairs; sessile glandular dots red; petioles of main leaves to 15 mm long; achenes with small setulae or scabrae along ribs (Peru) . . . . *N. dispar* (B. L. Robinson) R. M. King & H. Robinson
    8b. Stems and peduncles hirtellous to puberulous with often darkened hairs; glandular dots yellowish to brownish; petioles of leaves only 1–5 mm long; achenes with distinct elongate setulae.

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9a. Corolla throats abruptly expanded at base to twice or more as wide as constriction of basal tube; style with pubescence restricted to base.
  10a. Corollas with few or no hairs on lobes; leaves with few coarse serrations, with few hairs adaxially, abaxial puberulence of main veins not coarser than pubesence on remainder of surface (Peru) . . . . *N. cuzcoensis* R. M. King & H. Robinson
  10b. Corollas with numerous hairs on lobes; leaves entire or with shallow crenations, minutely puberulous adaxially, abaxial hairs of midvein and proximal secondary veins larger than those of remainder of surface (Bolivia) . . *N. thymifolia* (Britton) R. M. King & H. Robinson
9b. Corolla throats less than twice as wide as constriction of basal tube; style with pubescence continuing on to lower part of shaft.
  11a. Leaf blades elliptical, subsessile; peduncles with short-stipitate glands among the non-glandular hairs (Peru) . . . . . *N. mancoana* (B. L. Robinson) R. M. King & H. Robinson
  11b. Leaves blades broadly ovate with subtruncate bases, petiolate; peduncles without stipitate glandular hairs (Peru) . . . . *N. hirtella* R. M. King & H. Robinson

The following species are described as new.

Neocuatrecasia tysonii H. Robinson, sp. nov. TYPE: Bolivia. Beni: Mamore, frequent in tree margin of lagoon, spreading 1 mi. SW San Joaquin, 19 Mar 1964, *E. L. Tyson & M. Kuns 997* (holotype, MO). Figure 1A–D.

A speciebus aliis in inflorescentiis laxe cymiformibus et in bracteis involucri anguste ellipticis externe ad medium bicostatis et in ramis stylorum angustioribus et in setis pappi perbrevioribus et in basibus stylorum inflatis et in distributio non andina differt.

Herbs to 1 m tall, moderately branched at ca. 45° angles; stems brown, covered with dense felt of stipitate glands; internodes mostly 2–7 cm long. Leaves opposite; petioles 2–5 mm long; blades narrowly ovate to lanceolate, 1.5–7.5 × ca. 0.5–1.5 cm, base broadly acute to narrowly acuminate, margins with 5 to 15 often irregularly sized and irregularly spaced serrations, apex narrowly acute, adaxial surface pilose with slender pale hairs, abaxial surface paler green, pilosity mostly on veins, with numerous dark glandular dots; trinervate with slender ascending lateral veins from near base. Inflorescence laxly cymiform with alternate branching; peduncles 2–22 mm long, covered with slender stipitate glands. Heads broadly campanulate, ca. 5 mm high and wide; involucral bracts ca. 20, most narrowly elliptical, innermost ones linear-lanceolate, bicostate in basal half or more, ca. 3 mm long, ca. 0.5 mm wide, acute, puberulous with non-glandular hairs abaxially, few stipitate glands at base and along costae. Florets 25 to 30; corollas white to pale violet, 2.0–2.4 mm long, tube 0.3–0.4 mm long, throat cylindrical to narrowly funnelform, scarcely twice as wide as basal tube, 1.2–1.5 mm long, lobes narrowly triangular, 0.4–0.5 mm long, with glandular dots and no hairs outside; anther thecae ca. 1 mm long; style base inflated, with hairs, no hairs on shaft; style branches narrow, scarcely twice as wide as shaft. Achenes 1.8–2.5 mm long, with short basal stipe ca. 0.3 mm long, with scattered short setulae on ribs and surfaces; pappus bristles usually 10 to 12, length ca. 0.3–0.8 mm, very slender and often not contiguous at base.

Neocuatrecasia tysonii is the most phyletically divergent member of the genus with its broadly cymiform inflorescence, its narrow more strongly bicostate involucral bracts, and its occurrence at low elevations in Bolivia. The narrow style branches and distinctly broadened style base are also distinctive. Still, all essential characteristics are those of *Neocuatrecasia*. There is alternate branching in the inflorescences of other species of the genus, but the inflorescences are not as large or spreading as in *N. tysonii*. The pappus is short in some specimens of a number of the other species, but usually not less than half as long as the corolla. The achenes of the present species have a basal stipe, although it is very short compared to most of those in the genus. The higher elevation *N. feuereri* of Bolivia, which lacks stipitate glands, may be the closest relative on the basis of its pointed involucral bracts and comparatively narrow style branches.

The species occurs at elevations of 150–500 m in flat grasslands, grazed natural savanna with scattered shrubs and small tortuous trees, in areas bordering on granitic outcrops, and in semideciduous forests.

Paratypes. BOLIVIA. **Beni:** Itenez, S side of Río Guapore, "Campo Verde," ca. 15 km ESE of Costa Marques [Edo. Rondonia, Brazil], 150 m, 31 Mar. 1987, *M. Nee 34624* (MO, NY, US). **Santa Cruz:** Velasco, Reserva Forestal Bajo Paragua, Cero Diamantina, 10 km al S del Aserradero Cero Pelado, laja granitica grande (inselberg), 350 m, 13 May 1994, *T. Killeen & Wellens 6368* (MO, US, USZ); Prov. Nuflo de Chavez, Lomerio, comunidad Las Trancas, 500 m, 11 Nov. 1994, *T. Killeen, Jardim, Freire, Vriesendorp & Medina 7124* (US, USZ); area de estudio del proyecto "BOLFOR," Las Trancas-95, 450 m, 12 Dec. 1994, *F. Mamani & A. Jardim 404* (MO, USZ).

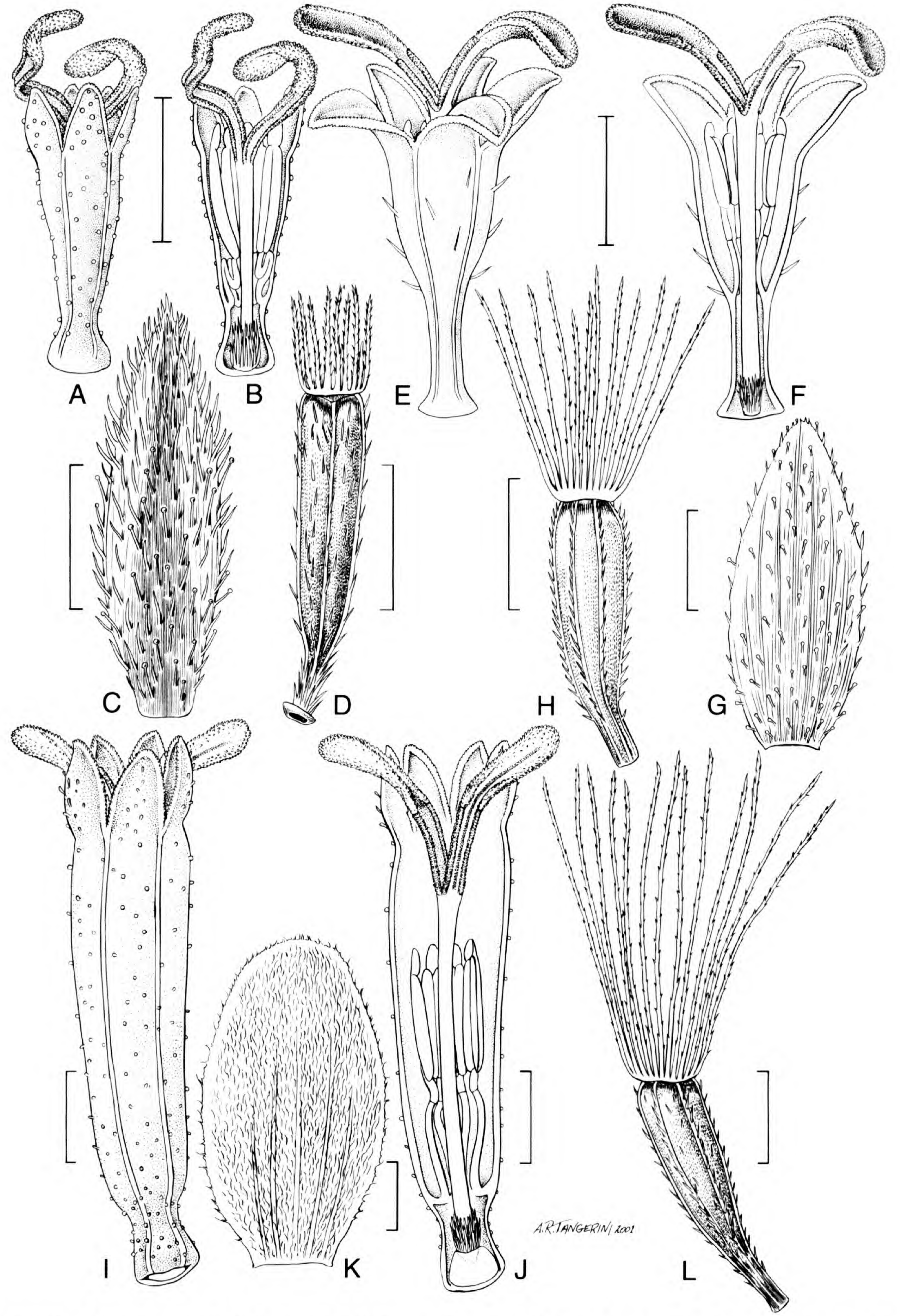

Figure 1. *Neocuatrecasia*. A–D. *N. tysonii* H. Robinson, drawn from *Killeen & Wellens 6368* (US). —A. Corolla with style branches. —B. Corolla in longitudinal section with stamens and style. —C. Involucral bract. —D. Achene.

Neocuatrecasia yungasensis H. Robinson, sp. nov. TYPE: Bolivia. Dpto. La Paz: Prov. Sud Yungas, Nor-Oeste de Chojlla valle del Río Pongo Pampa 2230 m, exposición SO, ladera rocosa vertical, hierba −8 cm, flores blancas, 7 Sep. 1987, *E. Vargas & R. Seidel 505* (holotype, US; isotype, LPB). Figure 1E–H.

Ad *N. feuererii* similis sed in caulibus et foliis et pedunculis et bracteis involucri longe stipitate glanduliferis et in faucibus corollarum late infundibularibus distincta.

Erect herbs over 8 cm tall (only a piece of stem seen, branching not seen); stems, petioles, leaf blades, peduncles, and involucral bracts with slender stipitate glands. Leaves opposite; blades membranaceous, ovate, 0.7–1.5 × 0.6–1.0 cm, base subtruncate, margins with usually 3 blunt teeth, apex short-acute with extreme tip blunt, with scattered stipitate glands adaxially, stipitate glands on margins and abaxially on main veins, glandular dots on lamina abaxially; weak trinervation from near base. Inflorescence (as seen) a single terminal pedunculate head; peduncle ca. 14 mm long, densely covered with stipitate glands. Heads ca. 6 mm high, ca. 4.5 mm wide; involucral bracts ca. 12, subequal, oblong, weakly veined, non-costate, 3.0–3.5 × 1.2–1.5 mm, apices rounded, outer bracts with stipitate glands abaxially. Florets 20 to 25; corollas white, ca. 3.5 mm long, basal tube ca. 1.3 mm long, slender, throat broadly funnelform, ca. 1.3 mm long, lobes oblong-ovate, ca. 0.8 mm long, with few short hairs outside; anther thecae ca. 0.8 mm long; style with hairs restricted to base; style branches 5–6 times as broad as shaft when fully expanded. Achenes 2.5–3.0 mm long, with basal stipe ca. 0.5 mm long, with distinct setulae; pappus of 25 to 30 bristles 1.5–1.8 mm long, bases contiguous or nearly so.

The small piece from which *Neocuatrecasia yungasensis* is described is thoroughly distinctive in its stipitate glands on all stemlike or foliiform parts, in the distinctly petiolate leaves, and in the broad corolla throats. The corollas are particularly distinct from those of the possible near relative from the same area, *N. feuereri*, which has long cylindrical corolla throats much longer than the lobes or the small anthers.

Neocuatrecasia sandiensis H. Robinson, sp. nov. TYPE: Peru. Dept. Puno: Prov. Sandia, Uraayllu, trail on W-facing slope above quarry, 14°08′S, 69°32′W, 3510 m, high elevation grassland, plant to 40 cm, suffrutescent, flower disc only, white, 25 Jan. 1986, *B. Bennet 1994* (holotype, NY). Figure 1I–L.

A *N. hirtella* aspectu simili sed in faucibus corollarum longioribus et in pilis stylorum omnino basilaribus differt.

Small subshrubs to 40 cm tall, with many lateral branches ascending at ca. 25–30° angles; stems reddish, densely puberulous to hispidulous with often reddish hairs, with interspersed dark to sometimes reddish glandular dots; internodes 0.4–2.0 (–6.0) cm long. Leaves opposite; petioles 0.2–1.0 cm long; blades ovate, 1–2 × 0.4–1.0 cm, bases abruptly obtuse, margins with 3 to 5 shallow blunt teeth, apex short-acute, densely gland-dotted on both surfaces, densely minutely puberulous adaxially, densely puberulous on veins abaxially; trinervate with strongly ascending proximal secondary veins from near base of blade. Inflorescence terminal on stems and branches, with 1 to 3 pedunculate heads; peduncles to 2.5 cm long, slender, puberulous with dark hairs and with glandular dots. Heads broadly campanulate, 8.0–9.5 mm high; involucral bracts 12 to 14, broadly oblong, non-costate, 5.5–8.0 × 2.2–3.0 mm, outer bracts with rounded tips, densely puberulous with dark hairs and with pale glandular dots abaxially, inner bracts paler, mostly glabrous, more scarious and gland-dotted toward erose tips. Florets 20 to 25 in a head; corollas white, ca. 6.5 mm long, basal tube ca. 0.8 mm long, throat ca. 5 mm long, cylindrical, scarcely twice as broad as tube, lobes ca. 0.8 mm long, oblong-ovate; anther thecae ca. 1.3 mm long; style with hairs only at base, style branches when fully expanded 5–6 times as broad as shaft. Achenes 3.0–3.5 mm long, basal stipe ca. 1 mm long, setulae short and widely spreading; pappus of 29 to 32 bristles, ca. 3.5 mm long, contiguous or nearly so at base.

The corollas of *Neocuatrecasia sandiensis* are very similar to those of *N. feuereri* of Bolivia, with the long cylindrical throats and the much shorter anther thecae. The present species differs most ob-

←

E–H. *N. yungasensis* H. Robinson, *Vargas & Seidel 505* (holotype, US). —E. Corolla with style branches. —F. Corolla in longitudinal section with stamens and style. —G. Involucral bract with stipitate glands. —H. Achene. I–L. *N. sandiensis* H. Robinson, *Bennet 1994* (holotype, NY). —I. Corolla with tips of style branches. —J. Corolla in longitudinal section with stamens, style, and nectary. —K. Involucral bract. —L. Achene. Scale bars all = 1 mm.

viously by the smaller non-velvety leaf blades and the broader non-pointed involucral bracts.

Paratype. PERU. **Dept. Puno:** Sandia, trail on W-facing slope beginning at slate quarry in Ura-ayllu, 14°08′S, 69°32′W, 3470 m, 22 Feb. 1986, *Bennet 2261* (NY).

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Three New Species of *Piptocarpha* (Asteraceae: Vernonieae) from Ecuador and Peru

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ABSTRACT. *Piptocarpha geraldsmithii* H. Robinson, *P. klugii* G. Lom. Smith ex H. Robinson, and *P. vasquezii* H. Robinson are described as new from northern Peru and southern Ecuador. The first relates to an otherwise strictly Guyana Highland group of species, and the third has terminal panicles with uniquely formed urn-shaped heads.

Key words: Asteraceae, Ecuador, Peru, *Piptocarpha*, Vernonieae.

A series of collections of Asteraceae from northern Peru, recently sent for identification by the Missouri Botanical Garden, contained a number of undescribed species. Three of these species proved to be in one genus, *Piptocarpha* R. Brown, with one species, *P. klugii*, extending into southern Ecuador. The specimens could not be determined as any of the seven species of the genus recognized by Gerald L. Smith in his treatment of the genus for Peru (Jones, 1980). The substantial addition to the number of species in Peru seems to justify the presentation of a new key to the ten species of *Piptocarpha* now known from the country.

The present study brings to almost 50 the number of species in the Neotropical Vernonian genus *Piptocarpha*. The genus is distributed from Central America and the West Indies to southeastern South America. Most species are scandent or scrambling with some shrubby species in southern Brazil. The habitats are montane temperate forests to savannas.

The species treated by Smith (Jones, 1980) as *P. sprucei* Baker is a synonym of *P. leprosa* (Lessing) Baker. One of the species validated here has proven to be the same as one included by Gerald Smith in his unpublished thesis work. It is validated here as a Smith species in order to complete the coverage of the Peruvian species.

KEY TO THE SPECIES OF *PIPTOCARPHA* IN PERU AND ECUADOR

1a. Inflorescence a terminal branching panicle.

2a. Heads ca. 8 mm high; inner involucral bracts not broadened distally, obtuse to shortly acute; abaxial surfaces of leaves discolorous, glands obscured by dense scales or hairs . . . . . . *P. gutierrezii* Cuatrecasas

2b. Heads ca. 10 mm high; inner involucral bracts broadened distally, apical margins broadly rounded; abaxial surfaces of leaves concolorous, without obvious hairs or scales, with obvious glandular dots . . . *P. vasquezii* H. Robinson, sp. nov.

1b. Inflorescence of heads clustered in glomerules or clumps in axils of full-sized leaves.

3a. Stems strongly angular . . . . *P. leprosa* (Lessing) Baker

3b. Stems terete or nearly terete.

4a. Heads with 9 to 35 florets.

5a. Branches and undersurfaces of leaves with stalked stellate hairs . . *P. asterotrichia* (Poeppig) Baker

5b. Branches and undersurfaces of leaves densely covered with small fringed sessile scales.

6a. Axillary groups of heads subumbellate with heads on stout short peduncles 4–8 mm long . . . . *P. lechleri* (Schultz Bipontinus) Baker

6b. Axillary groups of heads rather glomerulate with heads borne on short ramified branches and very short peduncles 1–2 mm long . . . . *P. opaca* (Bentham) Baker

4b. Heads with up to 7 florets.

7a. Heads with 3 florets; basal appendages of anthers with blunt tips . . *P. geraldsmithii* H. Robinson, sp. nov.

7b. Heads with 6 or 7 florets; basal appendages of anthers with sharp points.

8a. Pappus with slender bristles darkened toward tips; heads sessile in dense glomerules . . . . *P. klugii* G. Lom. Smith ex H. Robinson, sp. nov.

8b. Pappus white; heads with distinct peduncles or branched stalks.

9a. Lower leaf surfaces with appressed hairs or scales; stems and branches with mostly appressed minute tomentum . . . . *P. poeppigiana* (DC.) Baker

9b. Lower leaf surfaces with stalked stellate hairs; stems and branches with short but coarse spreading fascicles of hairs . . . . *P. canescens* Gleason

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The four species presently known for Ecuador are all included in the above key, *Piptocarpha gutierrezii*, *P. lechleri*, *P. klugii*, and *P. poeppigiana*. The three new species of *Piptocarpha* are as follows. All three possess the extremely deciduous involucral bracts, nodes at the bases of the styles, and the indurated or sclerified tails of the anthers that are characteristic of the genus. All have the spinulose tricolporate type A pollen that is characteristic of the subtribe Piptocarphinae. All have corolla lobes coiling or curling backward at anthesis, a characteristic found in the Vernonieae most commonly in the subtribe Piptocarphinae.

Piptocarpha geraldsmithii H. Robinson, sp. nov. TYPE: Peru. Amazonas: Bagua Prov., Distrito Imaza, comunidad Aguaruna de Wanás, km 92 carretera Bagua–Imacita, Cherros Chinim, bordes quebrada rocosa, ambas márgenes, 700–800 m, 29 Aug. 1996, *C. Díaz, Peña, Tsamajain & Roca 8065* (holotype, US; isotype, MO). Figure 1.

In habitu et in capitulis trifloribus et in caudis antherarum apice truncatis et in superficiebus adaxialibus foliorum reticulate prominule venulosis *P. auyantepuiensi* similis sed in caulibus rectioribus et in acheniis glabrioribus distincta.

Vines or scandent shrubs to 18 m high, with long, nearly straight, terete, brown stems and branches spreading at 90° angles, branches very slightly deflected at nodes, surfaces covered with many small fimbriate-margined scales, sparse or abraded on larger stems. Leaves alternate, petioles slender, 0.7–1.0 cm long; blades stiffly chartaceous, elliptical to broadly elliptical, 4.0–7.5 × 1.6–2.5 cm, base acute, margins entire, apex acute to slightly acuminate, extreme tip blunt, adaxial surface glabrous, alveolate with close reticulum of prominulous veinlets, abaxial surface concolorous, sparsely lepidote with minute scales and with dark glandular punctations; venation pinnate, with 4 to 7 secondary veins on each side, spreading at ca. 60° angles. Inflorescences glomerulate, in axils of leaves, each cluster with 8 to 10 sessile heads. Heads ca. 1 cm high; involucral bracts ca. 15, imbricate in 4–5 series, ovate to narrowly elliptical, 1.5–5.0 × 1.0–1.5 mm, mostly glabrous abaxially, tomentellous at tip. Florets 3 in a head; corollas white, ca. 7 mm long, mostly glabrous, with few glandular dots on distal part of tube, tube ca. 4 mm long, narrow in basal 2 mm, broadened and funnelform in distal 2 mm, throat essentially lacking, with filaments inserted just below sinuses, lobes linear, 3.0–3.5 × 0.7–0.9 mm, anther thecae ca. 2.5 mm long, including basal tails ca. 0.7 mm long, blunt at tip; apical appendage small, ca. 0.15 mm long and wide, glabrous. Achenes 3.5–4.0 mm long, mostly glabrous, with few hairs distally above sharpest 2 angles of achene; pappus white, 5.5–6.0 mm long, of ca. 60 bristles, slightly broadened distally, with outer series of shorter bristles 1–2 mm long. Pollen grains ca. 37 μm diam.

Piptocarpha geraldsmithii was provisionally identified as *P. opaca* (Bentham) Baker on the basis of the 1994 collection. True relationship is closer to two Venezuelan species, *P. auyantepuiensis* Aristeguieta (Steyermark, 1967) and *P. jauaensis* Aristeguieta & Steyermark (Steyermark & Brewer-Carias, 1976), endemic to the Guayana Highland region. The new species seems rather individually distinct from the two relatives by the comparatively straight stems. The related species are more deflected at the nodes, especially in the branches. The new species is more like *P. jauaensis* in the lack of numerous hairs at the top of the achene just below the callus and pappus. Hairs are present, however, restricted to the areas over the lateral achene margins, a situation that proves to be true of the type of *P. jauaensis* also, contrary to the original 1976 description. The new species is most like *P. auyantepuiensis* in the adaxial surfaces of the leaves with a close reticulum of prominulous veinlets. The adaxial surface of the leaves of *P. jauaensis* has a more hardened and smooth appearance without prominulous veinlets. Both *P. auyantepuiensis* and *P. jauaensis* are described with young stems densely covered with tomentose arachnoid hairs or arachnoid scales, but the type specimens show the same lepidote condition with margins of the scales shortly fimbriate as seen in the present new species. A note provided by Gerald Smith states that the species and its Venezuelan relatives are in *Piptocarpha* subg. *Hypericoides*.

The new species is named after Gerald L. Smith, student of the genus *Piptocarpha* who contributed the treatment cited here from Peru (Jones, 1980). Smith has published notes and new taxa in the genus in two additional papers (Smith, 1981, 1982). Unfortunately, the Smith dissertation on *Piptocarpha* remains unpublished.

Paratype. PERU. **Amazonas:** Distrito Imaza, Región Nororiental del Marañon, comunidad de Kampaenza, ribera de la quebrada Shimutaz, Río Marañon, 04°55′S, 78°19′W, 320 m, 24 Sep. 1994, *N. Jaramillo, Apanu & Katip 498* (MO, US).

Piptocarpha klugii G. Lom. Smith ex H. Robinson, sp. nov. TYPE: Peru. Loreto: Pumayacu, between Balsapuerto and Moyobamba, 600–1200 m, Aug.–Sep. 1933, *Klug 3167* (holotype, GA; isotype, US).

PERU

ASTERACEAE

Piptocarpha geraldsmithii H.Rob. Holotype:

Amazonas: Bagua Province

Dtto. Imaza. Comunidad Aguaruna de
Wanás (Km 92 Carretera
Bagua-Imacita): Cherros Chinim. Bordes
Quebrada rocosa. Ambas márgenes.
700-800 m

Liana. Flores blancas.
29 Agosto 1996

Camilo Diaz. Antonio Peña,
Luis Tsamajain y Melanio Roca 8065
Proyecto auspiciado por la John D. and
Catherine T. MacArthur Foundation
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

Figure 1. *Piptocarpha geraldsmithii* H. Robinson, sp. nov. Holotype, Peru: Amazonas, *Díaz et al. 8065* (US).

A speciebus pluribus in floribus ca. 7 in capitulo et in setis pappi fulvescentibus et in caudis antherarum argute acutis distincta.

Scandent shrubs or vines, with sparse branching at ca. 80° angles; stems brown, terete, with slight deflection at nodes on stems and branches, surfaces lepidote with small scales, sparse on larger stems, dense on branches. Leaves alternate, petioles 0.7–0.9 cm long; blades stiffly chartaceous, oblong-elliptical, mostly 6–13 × 2.0–4.5 cm, base acute, margins entire, apex short-acuminate with extreme tip narrowly obtuse, adaxial surface rather lustrous, with sparse minute scales, with elongate areolation formed by prominulous veinlets, abaxial surface either concolorous with sparse minute scales or pale with dense cover of scales; venation pinnate, with ca. 6 secondary veins on each side, spreading at ca. 75° angles, arching upward nearer margins. Inflorescences glomerulate in axils of leaves; clusters of ca. 20 heads on short branching stalks 2–3 mm long. Heads ca. 7 mm high; involucral bracts ca. 15, imbricated in 4–5 series, ovate to broadly oblong-elliptical, 1–4 × 1.5–2.0 mm, tips obtuse to rounded, glabrous abaxially, darkened toward tips. Florets ca. 7 in a head; corollas white or greenish white, 5.5–6.0 mm long, basal tube slender in basal 1.5–2.0 mm, broadened and funnelform in distal 1.5 mm, glabrous below, with scattered short-stalked capitate glands on distal part, throat essentially lacking, with filaments inserted just below sinuses, lobes linear, ca. 2.5 × ca. 0.7 mm; anther thecae 2.3–2.5 mm long, including pale sharply pointed basal tails ca. 0.5 mm long; apical appendage pale, ca. 0.7 mm long, broadly oblong-ovate, glabrous. Achenes ca. 3 mm long, glabrous, with 2 sharper lateral angles, with 3 weak costae outside, 2 inside; pappus ca. 5.5 mm long, of ca. 50 bristles, very slender and pale below, broadened and brownish distally, without an evident shorter outer series. Pollen grains ca. 37 μm diam.

Piptocarpha klugii is one of the Andean species with axillary clusters of heads, pointed anther tails, and the lepidote rather than stellate pubescence, but it is distinct by the slender pappus bristles that darken distally. Except for the pale and densely lepidote abaxial surfaces of the leaves of *Díaz & Peña 8754*, the four specimens included here are similar in every respect, and they are treated as conspecific.

At the time that the description was prepared, there was some suspicion the unpublished name *P. klugii* of Gerald Smith might apply. This has subsequently been confirmed by Smith, who agrees to have it validated here. The Smith name has previously been used on annotations and it appears in print as a nomen nudum in the *Catalogue of the Flowering Plants and Gymnosperms of Peru* (Brako & Zarruchi, 1993).

The habitat is consistently cited as primary forest. In one form it was cited from "bosque primario sobre pendientes de 30%, arboles cubiertos de musgos, suelos lentizoles."

Paratypes. ECUADOR. **Morona-Santiago:** Gualaquiza Cantón, Cordillera del Cóndor, ridge top above Banderas, near disputed Ecuador–Peru border, 03°28′S, 78°15′W, 1350 m, 17 July 1993, *A. Gentry 79959* (MO, US). PERU. **Amazonas:** Luya Prov., Camporedondo, Tullanya, base Cerro Huicsocunga, La Laguna, 06°06′33″S, 78°20′55″W, 2080 m, 1 Dec. 1996, *C. Díaz & Peña 8754* (MO, US) (form with leaves discolorous and densely lepidote below); Bagua Prov., Distrito Imaza, Tayu Mujaji, comunidad de Wawas, 05°15′25″S, 78°21′41″W, 800 m, 23 Oct. 1997, *R. Rojas, Peña, Anag & Yagkuag 403* (MO, US).

Piptocarpha vasquezii H. Robinson, sp. nov. TYPE: Peru. Amazonas: Bagua Prov., Distrito Imaza, comunidad de Yamayakat, 05°03′24″S, 78°20′17″W, 600 m, 9 July 1997, *R. Vásquez, Peña & Chávez 23981* (holotype, US; isotype, MO). Figure 2.

A speciebus pluribus in inflorescentiis paniculatis et in capitulis majoribus urceolatis in bracteis interioribus apice late rotundatis et in appendicibus antherarum glanduliferis differt.

Coarse scandent shrubs or vines, with branches spreading at 55–75° angles; stems and branches brown, terete, closely shallowly striated, covered with dense granular pubescence of nearly sessile, peltately attached, shallowly stellately lobed cells. Leaves alternate, petioles 1–2 cm long; blades broadly elliptical to obovate, mostly 12–17 × 4–9 cm, base broadly acute, usually somewhat unequal, margins entire, apex shortly and sharply acuminate, surfaces concolorous, sparsely pitted or lepidote with minute scales or stellately lobed cells, adaxial surface shinier than abaxial surface; venation pinnate, with 8 or 9 secondary veins on each side, spreading at 65–75° angles. Inflorescences terminal panicles with paniculate branches, branchlets in corymbiform clusters of few heads; peduncles 2–6 mm long, with densely granular pubescence. Heads 10–11 mm high; involucre cylindrical below, slightly constricted distally, terminating with somewhat spreading expanded tips of longest bracts; bracts in ca. 7 imbricated series, ovate to oblong, 1.5–7.0 × 1.5–2.0 mm, with granular pubescence on lowest bracts and on distal dark areas of median bracts, inner longest bracts glabrous or nearly glabrous, castaneous, distally scarious with broadly rounded

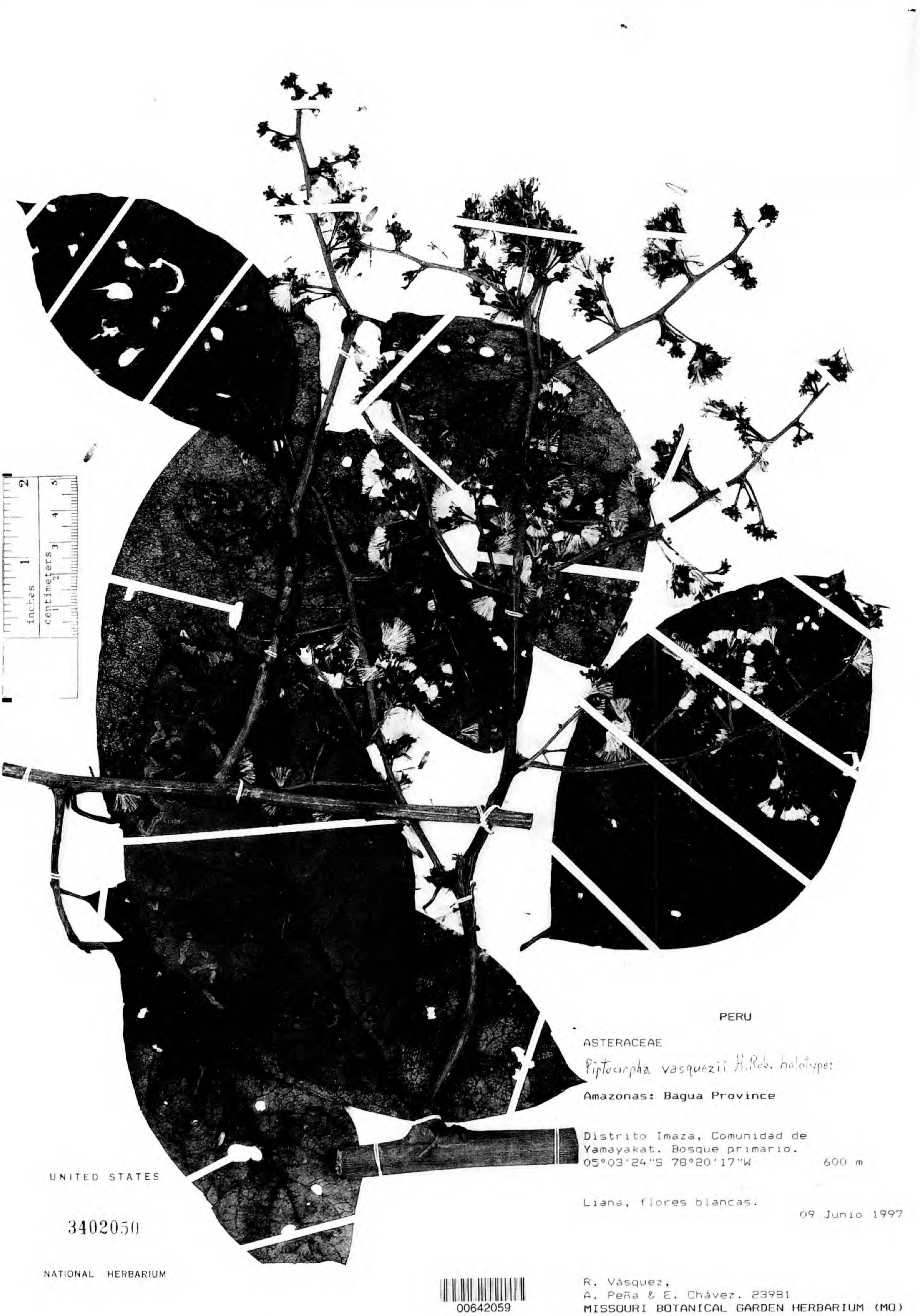

Figure 2. *Piptocarpha vasquezii* H. Robinson, sp. nov. Holotype, Peru: Amazonas, *Vásquez et al. 23981* (US).

apices. Florets 6 or 7 in a head; corollas white, ca. 7 mm long, mostly glabrous, with few glandular dots on upper tube and toward tips of lobes, basal tube ca. 3.5 mm long, lower narrow part ca. 1.5 mm long, upper 2 mm broadened, funnelform, throat ca. 0.8 mm long, between insertion of stout filaments and sinuses, with many transverse undulations, lobes linear, ca. 3 mm long, 0.5 mm wide; anther thecae 3.3–3.5 mm long, including basal whitish, sclerified, sharply pointed tail ca. 0.5 mm long; apical appendages pale, triangular-ovate, ca. 0.5 mm long, with a number of stalked glands outside near base and middle. Achenes ca. 3 mm long, cylindrical when immature, becoming somewhat obcompressed, with many glandular dots when young; pappus white, ca. 6 mm long, with ca. 80 slender bristles, broadened distally, with outer series of some shorter bristles or narrow scales ca. 0.8 mm long. Pollen grains ca. 40 μm diam.

Piptocarpha vasquezii is a remarkably distinctive new species presently known only from the two collections from primary forest in the Imaza District of Amazonas, Peru. The species belongs to the group with heads in terminal panicles, but the heads are much larger than other such species and the involucral bracts form a vase-like structure constricted above and then broadened apically with enlarged rounded tips on the longer bracts. The apical appendages of the anthers have a number of glands, a characteristic found in many members of the subtribe Vernoniinae, but very rare in the Piptocarphinae. Single glands have been seen previously on anther thecae beside apical appendages in one Venezuelan specimen of *Piptocarpha triflora* (Aublet) Bennett ex Baker (*Wurdack & Adderley 43490*, US). A wider sample may show that the characteristic is more common. The new species is distinct among those named here by the insertion of the anther filaments ca. 0.8 mm below the bases of the corolla sinuses instead of immediately below the sinuses. The area between, the throat, has marked transverse undulations.

Gerald L. Smith has examined the type of the species and places it in *Piptocarpha* subg. *Oocephalus.*

Paratype. PERU. Bagua Prov., Distrito Imaza, Yamayakat, 05°03′20″S, 78°20′23″W, 350 m, 7 June 1996, *R. Vásquez & A. Vásquez 21064* (MO, US).

Acknowledgments. Susan Hunter is thanked for the preparation of the scans of the types, Katherine Rankin is thanked especially for her perseverance in mounting the specimens of *Piptocarpha vasquezii* with their extremely fragile heads, and Marjorie Knowles is thanked for many other details regarding the preparation of the paper.

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New Taxa and a New Combination in *Tidestromia* (Amaranthaceae) from North America

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ABSTRACT. A new species and a new subspecies of *Tidestromia* are described and illustrated. *Tidestromia valdesiana*, restricted to Coahuila, Mexico, is characterized by the absence of an involucre and tepals lanceolate, aristate at the apex with a prominent midnerve and subulate trichomes. *Tidestromia lanuginosa* subsp. *eliassoniana* is characterized by having trichomes with the terminal cell projections either irregular (as those of the subsp. *lanuginosa*) or spreading, and microspinulose pollen, which is unique within the genus. A distribution map for the two recognized subspecies of *T. lanuginosa* is provided. The new combination *T. suffruticosa* var. *oblongifolia* is proposed, and *T. oblongifolia* subsp. *cryptantha* is reduced to synonymy under the former; both names are lectotypified.

RESUMEN. Se describen e ilustran una especie y una subespecie nuevas de *Tidestromia*. *Tidestromia valdesiana*, endémica de Coahuila, México, se caracteriza por los tépalos lanceolados de ápice aristado con la vena media prominente y tricomas subulados, así como por no tener involucro. *Tidestromia lanuginosa* subsp. *eliassoniana* se caracteriza por tener tricomas con proyecciones de las células terminales irregulares (como en la subsp. *lanuginosa*) o patentes, así como polen microespinuloso que es único en el género. Se incluye un mapa de distribución de las dos subespecies reconocidas de *T. lanuginosa*. Además se propone la combinación nueva *T. suffruticosa* var. *oblongifolia*, reduciéndose como sinónimo *T. oblongifolia* subsp. *cryptantha*; ambos nombres son lectotipificados.

Key words: Amaranthaceae, Froelichiinae, Gomphreneae, North America, pollen, *Tidestromia*.

Tidestromia Standley is a small genus of six species in the Amaranthaceae, subfamily Gomphrenoideae, tribe Gomphreneae, subtribe Froelichiinae (Schinz, 1893), occurring in North American deserts (Standley, 1916; Robertson, 1981; Eliasson, 1988; Henrickson, 1993), frequently on salty, gypseous, and calcareous soils. *Tidestromia* has been circumscribed by having the flowers arranged in small axillary glomerules and leaves that subtend the inflorescence becoming hard and more or less connate in age, thus forming an involucre (Standley, 1916; Eliasson, 1988). The pollen in *Tidestromia* has been considered unique among Amaranthaceae (Eliasson, 1988; Borsch, 1998). It differs from that of other genera by being metareticulate, with mesoporia continuously narrowed distally (triangular in cross section), tectate, with perforations concentrated close to the apertures (Borsch, 1998). Although psilate pollen has been considered diagnostic of *Tidestromia*, Martin and Drew (1970) described ornamented pollen of *T. lanuginosa* (Nuttall) Standley, which was never taken into consideration for the taxonomy of the genus.

Tidestromia has trichomes with a single row of cells (uniseriate) with the upper cells usually with sinuous interlocking junctions, thick cellulose walls, and usually with projections. As was indicated by Carolin (1983), one subtype of this uniseriate trichome has projections, if they occur, apparently at random, and the other subtype, which we are calling candelabriform in this paper, is characterized by large projections arranged in a whorl in the center of the cells. In *Tidestromia*, while the size of the projections is characteristic of a particular trichome, there are trichomes whose cells have projections of differing size. We found also notable differences in the apical cells of the trichomes.

In an ongoing revision of *Tidestromia*, observations on the habit, the nature of the pubescence, characters of the trichomes, tepals and involucre, as well as pollen micromorphology led us to recognize an undescribed species and to propose a new subspecies of *T. lanuginosa*. We also propose a new combination for *T. suffruticosa* (Torrey) Standley, and we designate lectotypes for two names.

Tidestromia valdesiana Sánchez-del Pino & Flores Olvera, sp. nov. TYPE: Mexico. Coahuila: Mpio. Parras, ejido el Durazno, xerophytic scrub on limestone mesa, 25°27′20″N, 102°06′36″W, 1635 m, 15 Oct. 2000, *I. Sánchez-del Pino 93, H. Flores Olvera & C. Gómez-Hinostrosa* (holotype, MEXU; isotypes, ANSM, MO, NY, TEX). Figures 1, 2A, 3A, 3C.

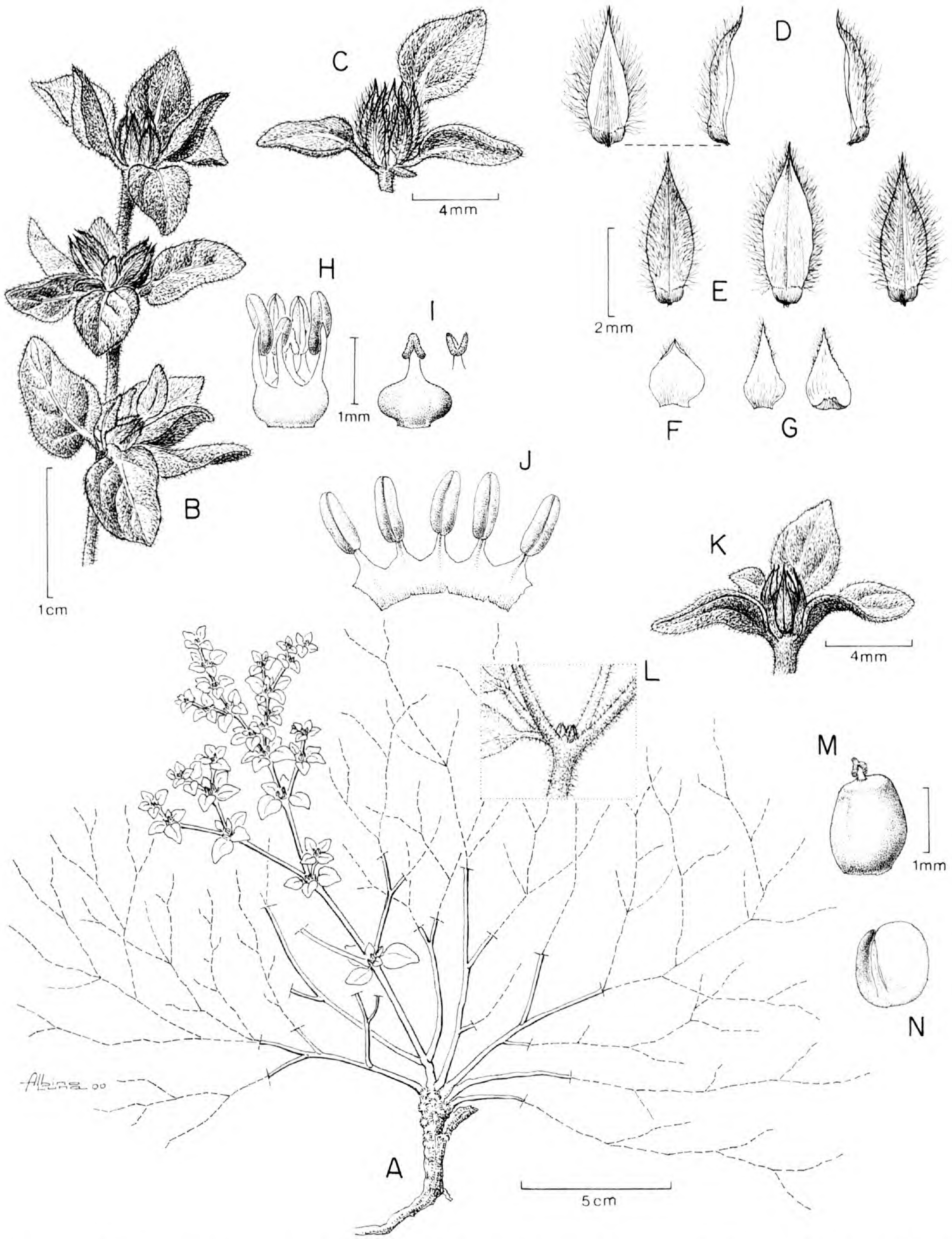

Figure 1. *Tidestromia valdesiana* Sánchez-del Pino & Flores Olvera. —A. Habit. —B. Flowering branch. —C. Leaf and involucral leaves surrounding the inflorescence. —D. Inner tepals, abaxial and lateral views. —E. Outer tepals, abaxial view. —F. Bract. —G. Bracteoles. —H. Sexual verticils. —I. Pistil. —J. Androecium. —K. Leaf and involucral leaves in fruit. —L. Inflorescence. —M. Utricle. —N. Seed. Drawn from the holotype (*Sánchez-del Pino 93 et al.*, MEXU).

Herba perennis rhizomatosa, caulibus ascendentibus vel decumbentibus, plerumque base gemmis lanatis, dense lanuginosa, trichomatibus omnino vel partim candelabriformibus; inflorescentia plerumque per duo folia involucralia inclusa, his ad maturitatem non induratis nec connatis, involucrum non formantibus, vel raro inflorescentia foliis involucralibus carens ad nodos ubi duo vel plures rami orientes; tepala lanceolata, apice aristata, trichomatibus barbatis subulatisque, nervo mediano conspicuo.

Herbaceous perennial from rhizome, up to 22 cm tall, canescent, richly lanuginose, trichomes completely or partially candelabriform. Stems gray-green or red, ascending or decumbent, usually bearing wooly to conspicuously wooly gemmae at the base. Leaves alternate, gray-green, sometimes red-shaded, ovate to widely ovate, 0.8–2.2 × 0.7–2.0 cm, thick, veins prominent beneath; apex acute or obtuse, base cuneate, cordate or attenuate; petioles up to 1 mm long. Inflorescence reduced to a few, mostly 3 flowers; surrounded by two involucral leaves that do not become indurate or connate with age, thus not forming an involucre, or rarely involucral leaves absent; involucral leaves gray-green, sometimes red, ovate, broadly ovate, or lanceolate, 0.1–0.6 × 0.1–0.7 mm, thick, veins prominent beneath, apex acute or obtuse, base cuneate or attenuate; petiole up to 0.3 cm long, densely lanuginose. Flowers 4.5–5.5 mm long; bracts widely depressed ovate, 2.5 × 1.5 mm, lanuginose above to glabrous, apex obtuse or rounded; bracteoles ovate, 1.9–2.2 × 1.2–1.5 mm, lanuginose above to glabrous, apex acute; tepals yellow-tinged, lanceolate, 4–4.5 × 1–2 mm, coriaceous, apex aristate, midrib prominent, thicker at the base, densely lanuginose; trichomes subulate, barbed; staminal cup 0.6–0.9 mm long, filaments 1 mm long, anthers 0.8–1.2 mm long, pseudostaminodia short or absent; ovary 0.8–1.2 mm long and wide, style 2–3 mm long, stigma bifid, deltoid, dark brown, 0.3–0.4 mm long. Utricle 2.1 × 1.4–1.6 mm. Seeds red-brown, 1.5–1.7 × 1.4 mm. Pollen psilate (Fig. 2A).

Distribution and habitat. This is a narrowly endemic species of the Chihuahuan Desert Region, known only from the type locality in Coahuila, Mexico, at 1635–1700 m. It is locally common restricted to calcareous sites. *Tidestromia valdesiana* is restricted to the limestone mesa where it grows with *Agave lechuguilla* Torrey, *Dasylirion* sp., *Fouquieria* sp., and *Larrea* sp. Flowers have been observed from September to November. *Tidestromia suffruticosa* is sympatric with *T. valdesiana*.

Etymology. *Tidestromia valdesiana* is named in honor of Javier Valdés Gutiérrez, whose support and enthusiasm motivated our interest in the study of the xerophytic flora of Mexico.

Discussion. *Tidestromia valdesiana* is the only species in the genus with lanceolate tepals having an aristate apex, prominent midnerve, and subulate trichomes (Fig. 3A). These trichomes have small projections mostly reflexed with a barbed appearance. This last character is also present in *T. tenella* I. M. Johnston, restricted to Coahuila, Mexico, but its trichomes are round-tipped (Fig. 3B). *Tidestromia valdesiana* is unique in the genus in that the two leaves surrounding the inflorescence do not become indurate and connate in age and do not form an involucre. An extreme condition in this species is the absence of leaves surrounding some inflorescences borne at nodes where two or more branches originate (Fig. 1L). *Tidestromia valdesiana* is similar to *T. gemmata* I. M. Johnston, which is considered conspecific with *T. suffruticosa* (Torrey) Standley (Sánchez-del Pino, 2001). Although both species are perennial herbs, usually with gemmae at the base, the gemmae densely wooly, and hirsute vestiture due to the abundance of trichomes partially candelabriform with the terminal cells lacking projections (Fig. 3C), they differ by other vegetative and reproductive characters. *Tidestromia suffruticosa* is suffrutescent, without a rhizome; it has ovate tepals with an acute or obtuse apex, midnerve not prominent, in addition to completely or partially candelabriform trichomes (Fig. 3D), and with projections at random (Fig. 3E). The inflorescence in this species is always surrounded by two involucral leaves that become indurate and connate with age forming an involucre.

Paratypes. MEXICO. **Coahuila:** Mpio. Parras, Ejido Mesa del Durazno, *Capó 1978* (ANSM), *Capó 1979* (ANSM), *I. Sánchez-del Pino 94 et al.* (CAS, MEXU, TEX).

Tidestromia lanuginosa subsp. **eliassoniana** Sánchez-del Pino & Flores Olvera, subsp. nov. TYPE: Mexico. Sonora: Mpio. Guaymas, 15 km N of Guaymas on the road to Hermosillo, 1 Nov. 1985, *B. Bartholomew 3654, L. R. Landrum, H. W. Li & T. S. Ying* (holotype, MEXU; isotypes, ASU, CAS, GH). Figures 2B, 2C, 3G–I, 4, 5.

A subspecie *lanuginosa* differt pollinis granis exina microspinulosa, cellula terminali trichomatum caulium, foliorum et foliorum involucralium duarum classium: communi, irregulariter ramificanti, et atypica, ramis patentibus.

Stems light brown to gray-green, generally red; stems, leaves, and involucral leaves covered by completely candelabriform trichomes, with the terminal cell projections either irregular, as those of the subspecies *lanuginosa*, or spreading. Leaves

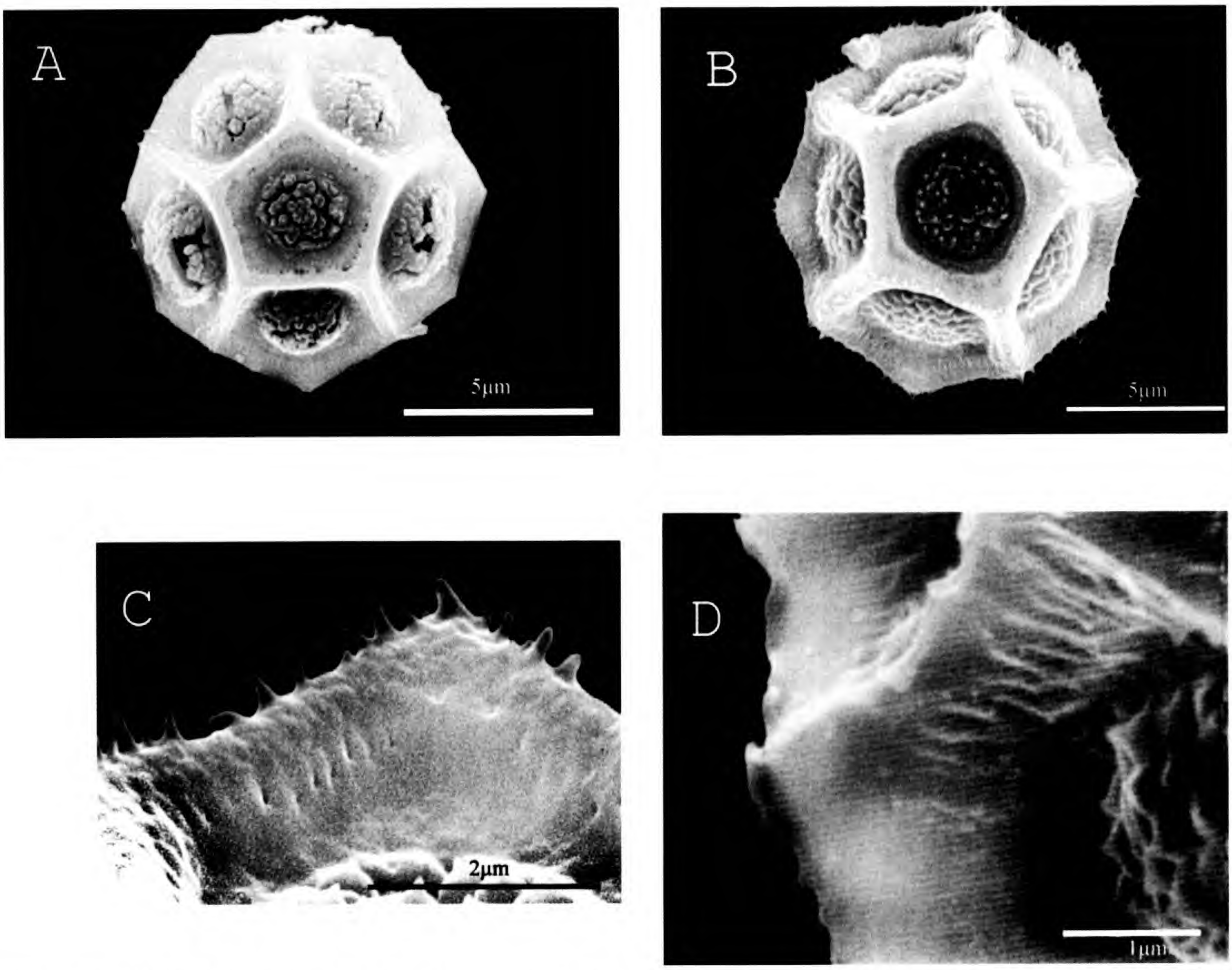

Figure 2. SEM photomicrographs of pollen grains. —A. *Tidestromia valdesiana* (*Capó 1978*, ANSM). —B, C. *Tidestromia lanuginosa* subsp. *eliassoniana* (*Bohrer 1189*, ARIZ). —D. *Tidestromia suffruticosa* var. *suffruticosa* (*Sánchez-del Pino 77 et al.*, MEXU).

widely obovate or generally ovate-trullate or lanceolate; apex acute or rarely obtuse. Pollen microspinulose (Fig. 2B, C).

Distribution and habitat. *Tidestromia lanuginosa* subsp. *eliassoniana* is known from the southwestern United States in Utah, California, Arizona, and New Mexico, to northwestern Mexico in Sonora, Chihuahua, Baja California Sur, and Sinaloa (Fig. 5). It occurs in primary and disturbed vegetation in grassland, xerophytic scrub, coastal thorn scrub, thorn forest, and tropical deciduous forest, dwelling on roadsides or in cultivated fields, from sea level to 1463 m. The soils throughout its distributional range are alluvial, sandy to clayey, gravelly, limestone, silty, igneous, salty, or gypseous.

Etymology. *Tidestromia lanuginosa* subsp. *eliassoniana* is named in honor of Uno H. Eliasson in recognition of his contributions to the taxonomy of Amaranthaceae, including pollen morphology.

Discussion. *Tidestromia lanuginosa* is the most widely distributed species of the genus. It is characterized by having, on the secondary branches, an involucre formed by involucral leaves in which the petiole becomes indurate with age and connate with

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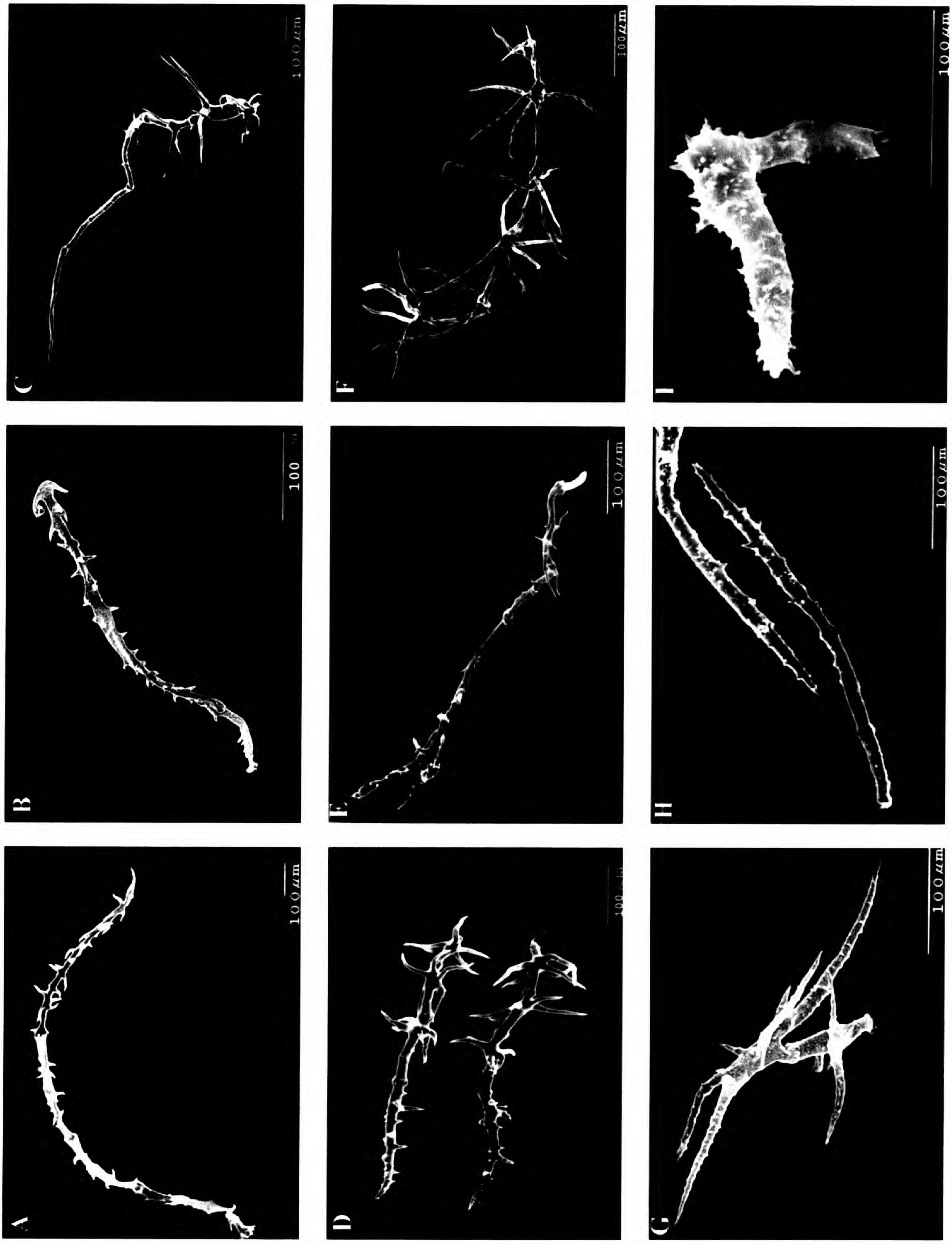
Figure 3. SEM photomicrographs of trichomes. —A. Subulate barbed trichome of *Tidestromia valdesiana* (*Capó 1978*, ANSM). —B. Round-tipped barbed trichome of *T. tenella* (*Villarreal 4459 et al.*, ANSM). —C. Partially candelabriform trichome of *T. valdesiana* (*Capó 1978*, ANSM). —D. Partially candelabriform trichome of *T. suffruticosa* (*Chiang 9277*, NY). —E. Trichome with projections at random of *T. suffruticosa* (*Johnston 10674*, MEXU). —F. Trichome with the terminal cell projections irregular of *T. lanuginosa* subsp. *lanuginosa* (*Ekman 9861*, GH). —G. Trichome with the terminal cell projections spreading of *T. lanuginosa* subsp. *eliassoniana* (*Bartholomew 3654 et al.*, CAS). —H. Uniseriate macroform osteolate conical trichome of *T. lanuginosa* subsp. *eliassoniana* (*Clark 8499*, ARIZ). —I. Uniseriate macroform osteolate T-shaped trichome of *T. lanuginosa* subsp. *eliassoniana* (*Clark 8499*, ARIZ).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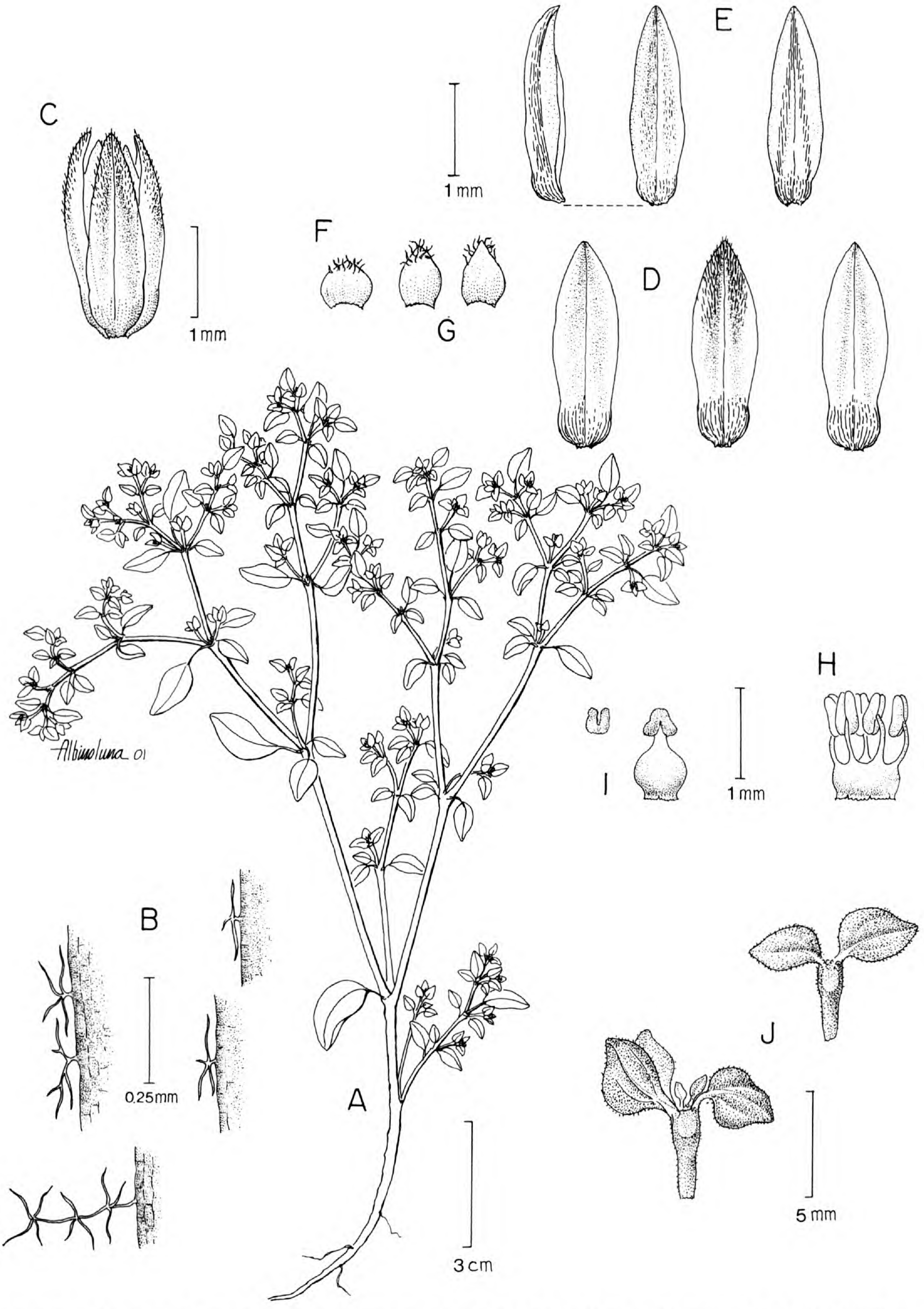

Figure 4. *Tidestromia lanuginosa* subsp. *eliassoniana* Sánchez-del Pino & Flores Olvera. —A. Habit. Drawn from *Wiggins & Rollins 131*, GH. —B. Trichomes. —C. Flower. —D. Outer tepals, abaxial view. —E. Inner tepals, abaxial and lateral views. —F. Bract. —G. Bracteoles. —H. Androecium. —I. Pistil. —J. Leaf and involucral leaves in fruit. B–J, drawn from the holotype (*Bartholomew 3654 et al.*, MEXU).

the stem or with the leaf petiole and the stem. This is an annual species, with leaves and involucral leaves chartaceous or less commonly fleshy, stems usually gray-green or red to yellow-green in the field, usually richly lanuginose to glabrate, and completely candelabriform trichomes. The tepals present this type of trichome as well as trichomes with small projections that occur in some cells. Due to the wide morphological variation of the species, some authors (Steyermark, 1932; Cory, 1936; Correll & Johnston, 1970; Robertson, 1981) recognized two varieties: *T. lanuginosa* var. *lanuginosa* and variety *carnosa* (Steyermark) Cory. Nevertheless, we agree with Johnston (1943), who recognized *T. carnosa* as a distinctive species. This species has the involucre on the secondary branches formed by the connation of involucral leaf bases with or without the leaf base, but never with the stem. In addition, the young parts and the tips of the leaves are glabrous or slightly pubescent; the stems, leaves, and involucral leaves are fleshy and yellow-green in the field.

Tidestromia lanuginosa is herein proposed to be separated into two subspecies on the basis of pollen and trichome features. *Tidestromia lanuginosa* subsp. *lanuginosa* has the characteristic psilate pollen of the genus as described by previous authors (Eliasson, 1988; Borsch, 1998), whereas *T. lanuginosa* subsp. *eliassoniana* is characterized by the occurrence of microspines on the tectum (Fig. 2B, C), which is unique in the genus but not in the tribe. *Tidestromia lanuginosa* subsp. *eliassoniana* also differs from the other subspecies by having stems, leaves, and involucral leaves with trichomes that have the terminal cell projections either irregular, as in those of the subspecies *lanuginosa* (Fig. 3F), or spreading (Fig. 3G). The collection *Clark 8499* (ARIZ) from Arizona has a different type of trichome with cuticle granules and without projections that were described by Reddy et al. (1998) as uniseriate macroform osteolate. Among these, some are conical (Fig. 3H) and others are T-shaped (Fig. 3I), resembling trichomes sometimes present in *T. carnosa* and *T. tenella*. Because this specimen also has microspinulose pollen, the trichomes are considered an extreme variation for subspecies *eliassoniana*.

Based on the known morphological variation of pollen present within genera of the Amaranthaceae, the microspinulose pollen in *T. lanuginosa* subsp. *eliassoniana*, unique within the genus, is of high significance. Preliminary studies indicate that there might be intermediate stages between psilate and microspinulose pollen within *Tidestromia*. We observed parts of the tectum with nanoverrucae of some samples of *T. suffruticosa* var. *suffruticosa* (Fig. 2D), suggesting the need to do exhaustive palynological studies in the genus. Shifts between completely smooth to sculptured tecta are extremely rare within genera of Amaranthaceae and as currently known otherwise only occur in the genus *Cyathula* (Borsch, 1998).

Because the pollen of all other genera of Gomphreneae is generally microspinulose, it would appear that this is a plesiomorphic condition within the genus *Tidestromia*, but phylogenetic studies are needed to test this. Pollination studies are also needed to test whether the sculptured pollen is related to a shift in pollen dispersal mechanisms potentially related to an increase in the amount of pollen kit.

Tidestromia lanuginosa subsp. *lanuginosa* occurs from the central United States to northern Mexico and the West Indies (Antilles), from Illinois to the Dominican Republic, whereas subspecies *eliassoniana* ranges from the southwestern United States to northwestern Mexico (Sánchez-del Pino, 2001) (Fig. 5).

Paratypes. U.S.A. **California:** Riverside Co., 21 mi. W of Tonopah along I-10, Sep. 1991, *Atwood 17084* (NY). **Utah:** Washington Co., 3 mi. S of Saint George, Sep. 1941, *Gould 1413* (ARIZ, DS, GH, NY, UC). **Arizona:** Cochise Co., Escala San Simon Valley, Aug. 1912, *Gooding 1290* (ARIZ, NY); Coconino Co., along Grand Canyon, airport road, 100 yards W of junction with Arizona 64-180, ca. 8 mi. S of Grand Canyon Village, Sep. 1981, *Sauleda 6495 & Sauleda* (ASU); Gila Co., near Canyon of the Sallymay, Sierra Ancha foothills, Sep. 1946, *Gould 3883* (ARIZ, NY, UC); Graham Co., hwy. 666, 0.2 mi. E of junction with hwy. 70, Sep. 1968, *Pinkava 13425 et al.* (ASU, NY); Greenlee Co., along U.S. hwy. 70, 8 6/10 mi. E of Solmonville on road to Duncan, Oct. 1942, *Wolf 11414 & Everett* (UC); Maricopa Co., Tempe, on rocky slopes of Double Butte, Sep. 1964, *Fryxell 101* (ENCB, NY); Mohave Co., E of Blythe, Sep. 1929, *Jones 24819* (CAS, GH, MO, NY); Pima Co., Tucson, Oct. 1894, *Toumey 1894* (ARIZ, CAS, GH, NY, UC); Pinal Co., along hwy. 10 between Phoenix and Tucson, Sacaton rest stop, Oct. 1982, *Neese 12529* (ASU, NY); Santa Cruz Co., between Sopori Scool and Arivaca, July 1966, *Tate 278* (ASU); Yuma Co., SE of Alamo Lake, May 1980, *Butterwick 6322 & Hillyard* (ARIZ, ASU). **New Mexico:** Hidalgo Co., 1 mi. N of Rodeo, Aug. 1966, *Cazier 407* (ASU). MEXICO. **Baja California Sur:** Mpio. Mulegé, Bajada 6 mi. SW of Mulege, Oct. 1962, *Wiggins 17964 & Wiggins* (DS, US). **Sonora:** Mpio. Agua Prieta, Colonia Morelos, region of the Rio de Bavispe, Aug. 1941, *White 4145* (ARIZ, GH, NY); Mpio. Alamos, near Tepistate N of Alamos, Nov. 1939, *Gentry 4838* (ARIZ, NY); Mpio. Altar, Hacienda Oquitoa (Cutting's Ranch) 6 mi. E of Altar, Oct. 1932, *Wiggins 5965* (DS, US); Mpio. Arizpe, across the Rio Bacanuchi from Tauichopa, Tauichopa is 2.7 mi. by road N of Arizpe, Aug. 1958, *Turner 183 & Lowe* (ARIZ); Mpio. Bacoachi, along wash about 14 mi. S of Divisaderos, Sep. 1934, *Wiggins 7474* (DS, GH, US); Mpio. Benjamín Hill, Santa Ana km 145 Hermosillo–San-

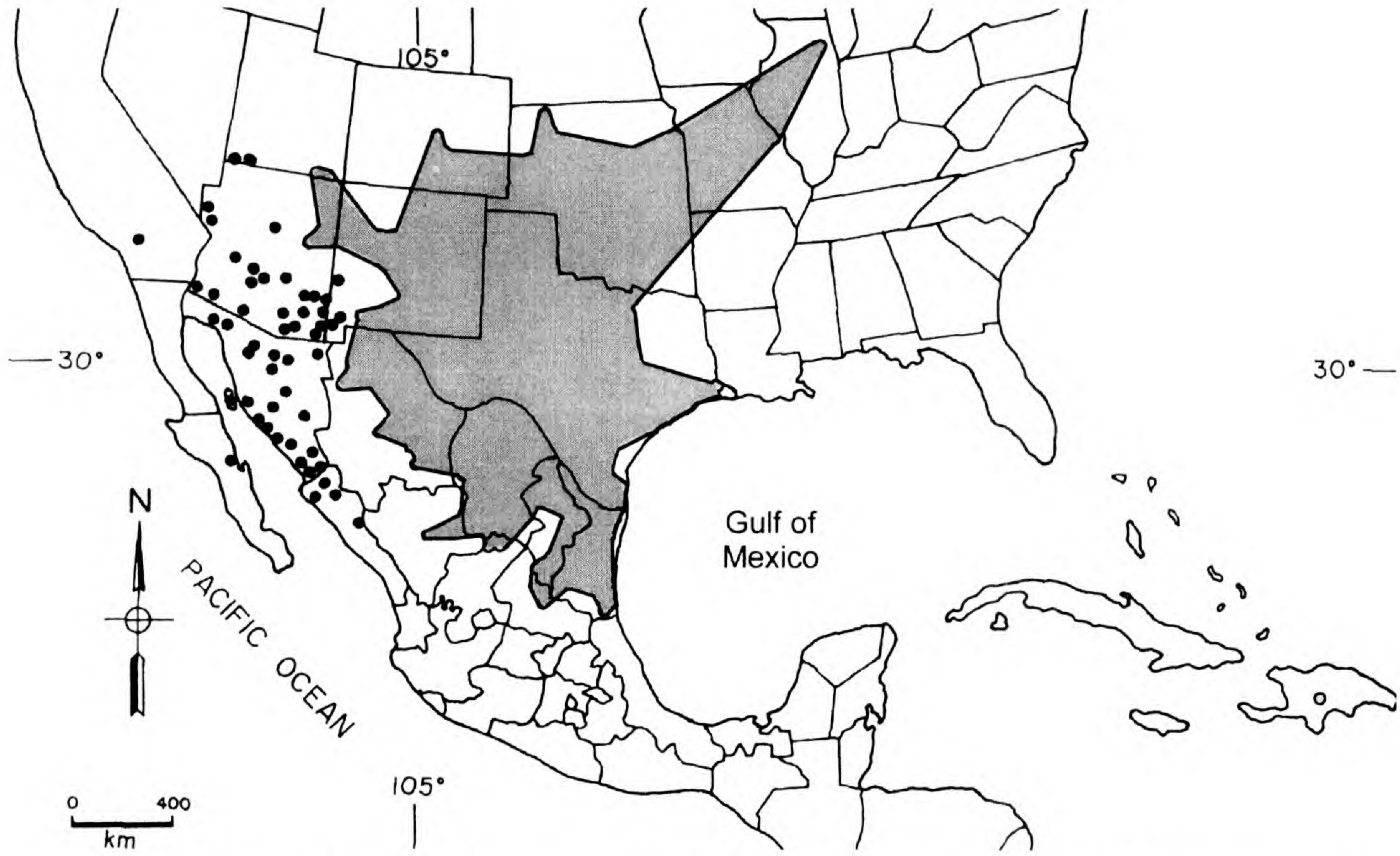

Figure 5. Distribution of *Tidestromia lanuginosa* subsp. *lanuginosa* (line outlining range) and *T. lanuginosa* subsp. *eliassoniana* (●).

ta Ana, 13.7 mi. (21.9 km) N of Benjamin Hill, Aug. 1985, *Cowan 5524 et al.* (NY); Mpio. Carbó, Potrero 7 rancho La Granada CIPES, Sep. 1984, *Miranda RLG-068* (ANSM, SLPM); Mpio. Cajeme, about 2.2 mi. NE of hwy. 15 (toward a microwave tower), about 6.9 mi. SE of Ciudad Obregon, Sep. 1973, *Stevens 2067 & Fairhurst* (DS, ENCB, GH, MO, NY); Mpio. Guaymas, ca. 15 mi. SE of Guaymas, June 1979, *Webster 17001 & Lynch* (GH, MEXU, MO); Mpio. Hermosillo, 27 mi. W of Hermosillo on the road to Kino Bay, Aug. 1941, *Wiggins 131 & Rollins* (ARIZ, DS, GH, MO, NY, UC); Mpio. Huatabampo, Nescotahueca vicinity 5 km (by air) N-NE of Camahuiroa, 6.7 km N on Bachoco road from Diez de Abril road, 1.9 km S-SW (by air) Nescotahueca, Jan. 1995, *Friedman 179-95 & Zittere* (ASU); Mpio. La Colorada, La Colorada, May 1905, *Clokey 1915* (UC); Mpio. Magdalena, bank of Rio Sasobe, 10 mi. E of Magdalena, Sep. 1934, *Wiggins 7110* (DS, GH); Mpio. Navojoa, turnoff to microwave road on Cerro Prieto, 17 km E of Navojoa on road to Alamos, Mar. 1993, *Van Devender 93-248 et al.* (ARIZ); Mpio. Onavas, Onavas, graphite mine NE of pueblo, Oct. 1986, *Rea 1248* (ARIZ); Mpio. Pitiquito, Pitiquito, May 1925, *Kennedy 7069* (CAS, UC); Mpio. Puerto Peñasco, ca. 7 km N of Puerto Peñasco, at ca. 2 km N of airport, June 1985, *Felger 85-790* (ARIZ, MEXU); Mpio. Soyopa, NE side of Río Yaqui bridge on Mex. 16, just S of Tonichi, Sep. 1996, *Van Devender 96-350 et al.* (ARIZ); Mpio. Ures, along hwy. 14 leading NE out of Hermosillo, ca. 37.5 km SW of Ures, Aug. 1995, *Snow 6593 & Prinzie* (MEXU). **Chihuahua:** along New Mexico–Chihuahua border 0.9 mi. W of monument #3, July 1986, *Worthington 14398* (NY). **Sinaloa:** Mpio. Culiacán, Culiacán, Oct. 1904, *Brandegee s.n.* (GH, UC); Mpio. El Fuerte, Valle del Carrizo, street 800, near San Francisco, Aug. 1975, *Rodríguez 1607* (ARIZ, CAS, ENCB, MEXU, MO); Mpio. Salvador Alvarado, on Cerro Tasirogojo, 9 km S Estación Luis, 1 km W (by air) Francisco Sarabia, 5.5 km (by air) SE Melchor Ocampo, Aug. 1994, *Friedman 210-94 & Espinosa* (ASU); Mpio. Sinaloa, Sinaloa de Leyva ca. 1 km N of Lagunilla, to Santa Fe, Nov. 1990, *Bojórquez 758* (MEXU).

Tidestromia suffruticosa var. **oblongifolia** (S. Watson) Sánchez-del Pino & Flores Olvera, comb. et stat. nov. Basionym: *Cladothrix oblongifolia* S. Watson, Proc. Amer. Acad. Arts 17: 376. 1882. *Tidestromia oblongifolia* (S. Watson) Standley, J. Wash. Acad. Sci. 6: 70. 1916. TYPE: U.S.A. Arizona: Yuma Co., Yuma, 25 June 1881, *Pringle 1881* (lectotype, here designated, GH; isolectotypes, G, K, NY, US).

Tidestromia oblongifolia subsp. *cryptantha* (S. Watson) Wiggins, Contr. Dudley Herb. 4: 16. 1950. Basionym: *Cladothrix cryptantha* S. Watson, Proc. Amer. Acad. Arts 26: 125. 1891. TYPE: U.S.A. California: San Diego Co., Canso Creek, Nov. 1890, *Orcutt 2186* (lectotype, here designated, GH; isolectotype, K).

Tidestromia oblongifolia was recognized as a separate species (e.g., Standley, 1917; Correll & Johnston, 1970) based on minor differences in staminodia and leaf characters, which are variable. Also, two subspecies were proposed for *T. oblongifolia* (Wiggins, 1950) based on characters of leaf form and size, and depth of the involucre. We recognize *T. oblongifolia* as conspecific with *T. suffru-*

ticosa and propose two varieties based on characters of leaves and internodes of the secondary branches, which subtend fruiting involucres. *Tidestromia suffruticosa* var. *suffruticosa* has leaves usually ovate, rarely lanceolate, very broadly ovate, or reniform, and internodes usually well defined, not crowded. *Tidestromia suffruticosa* var. *oblongifolia* has leaves usually oblong, rarely ovate-oblong, circular, lanceolate or ovate, and internodes usually reduced, crowded. These varieties are geographically isolated: *T. suffruticosa* var. *suffruticosa* ranges through New Mexico, Texas, Chihuahua, Durango, and Coahuila, whereas *T. suffruticosa* var. *oblongifolia* ranges through California, Baja California, Utah, Nevada, Arizona, and Sonora.

In the protologue of *Cladothrix oblongifolia* and *C. cryptantha,* Watson cited syntypes. For the former name Watson cited: "on the banks of Colorado, near Chimney Peak (Dr. Newberry) and at Yuma (C. G. Pringle) and in the Mohave Desert (S. B. & W. F. Parish)." Specimens cited for *C. cryptantha* are: *Parry 274* collected in 1881 at Colton, California, and *Orcutt 2186* collected in 1890 at Canso Creek, San Diego County. We chose the best-preserved specimens at GH to lectotypify both these names.

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A New *Tassadia* (Apocynaceae, Asclepiadoideae) from Bolivia and Brazil

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ABSTRACT. *Tassadia capitata,* from Santa Cruz, Bolivia, and Pará, Brazil, is described and illustrated. This new species is most closely related to *T. guianensis* Decaisne, and the two species are somewhat intermediate between *Tassadia* and *Stenomeria.*

Key words: Apocynaceae, Asclepiadoideae, Bolivia, Brazil, *Stenomeria, Tassadia.*

Tassadia Decaisne is a genus of about 25 species of tropical and subtropical South America, with one species, *T. obovata* Decaisne, ranging through Central America to Veracruz, Mexico. *Tassadia* belongs to the tribe Asclepiadeae and is most closely related to the genus *Stenomeria* Turcz. The two genera share, in particular, an unusual arrangement of the inflorescences. The true inflorescence is an extra-axillary cyme, which is the normal inflorescence of the Asclepiadoideae. However, these sessile or nearly sessile, congested cymes are mostly arranged along leafless axillary branches; cymes associated with leafy nodes are also occasionally produced. These inflorescences have been described as thyrses or pleiothyrses (Fontella, 1977; Morillo, 1990), but those terms refer to mixed inflorescences in which the primary axes are paniculate and the ultimate axes cymose (Jackson, 1928). Liede and Weberling (1995) also considered the leafless branches to be inflorescences and erroneously compared them with the true, extra-axillary inflorescences of *Tylophora,* which are superficially similar. Liede and Meve (2001) repeated the error in considering the inflorescences of *Tassadia* to be "lax." *Stenomeria* differs from *Tassadia* in having rostrate and glabrous style apices, strongly contorted corolla lobes, and slender and symmetrical follicles. In *Tassadia,* only this new species and *T. guianensis* have elongate style apices and in both cases they are penicillate, the corolla lobes are slightly to not at all contorted, and the follicles, when known, tend to be broad and/or asymmetrical.

Tassadia capitata W. D. Stevens, sp. nov. TYPE: Bolivia. Santa Cruz. Velasco Prov.: Parque Nacional Noel Kempff Mercado, Arroyo Las Londras, a 15 km al N del empalme hacia el aserradero Choré, bosque inundado temporalmente, siempreverde, 14°24′18″S, 61°08′40″W, 150 m, 10 Oct. 1996, *A. M. Carrión, R. Guillén, M. Garvizú, P. Solíz, J. Huffman & L. Saucedo 360* (holotype, MO; isotype, USZ). Figure 1A–D.

A *Tassadia guianensi* Decaisne apice styli capitato dignoscenda.

Twining (to right) vine, lower parts unknown, stems densely puberulent with curved, multicellular, red-tipped hairs 0.2–0.4 mm long; sap white. Leaves opposite, without pseudostipules, blade 3.6–7.5 × 1.7–4.2 cm, elliptic, apex abruptly acuminate, base acute to obtuse or nearly rounded, glabrous above except with a line of hairs on midrib, densely and uniformly puberulent below, lateral veins 4 to 7, colleters 2; petiole 4–8 mm long, puberulent. Inflorescence extra-axillary, 1 per node, congested-cymose, arranged on leafless or nearly leafless axillary or terminal branches with the appearance of inflorescences or occasionally with isolated inflorescences at leafy nodes, peduncle absent to 1 mm long, pedicel 0.5–1.2 mm long, bracts 0.6–0.7 × 0.4–0.7 mm, ovate; calyx divided to base, with 0–2 colleters per sinus, lobes ovate to lanceolate with acute to obtuse tips, 0.8–1.4 × 0.5–0.9 mm, apparently green, glabrous to sparsely puberulent along midrib outside, glabrous inside; corolla campanulate at base, aestivation weakly contorted and dextrorse, white with a yellow or green tint, tube 0.7–1.5 mm long, glabrous outside, barbate inside with glassy, unicellular hairs ca. 0.1 mm long, lobes narrowly lanceolate with acute tips, erect, 2.6–3.6 mm long, 0.8–0.9 mm wide at base, glabrous outside, inside with margins densely puberulent with white, unicellular hairs ca. 0.05 mm long; androecium and gynoecium entirely fused and forming a short-stipitate gynostegium; corona gynostegial, adnate to gynostegium at base, of 5 free lobes opposite the anthers, these rounded and with

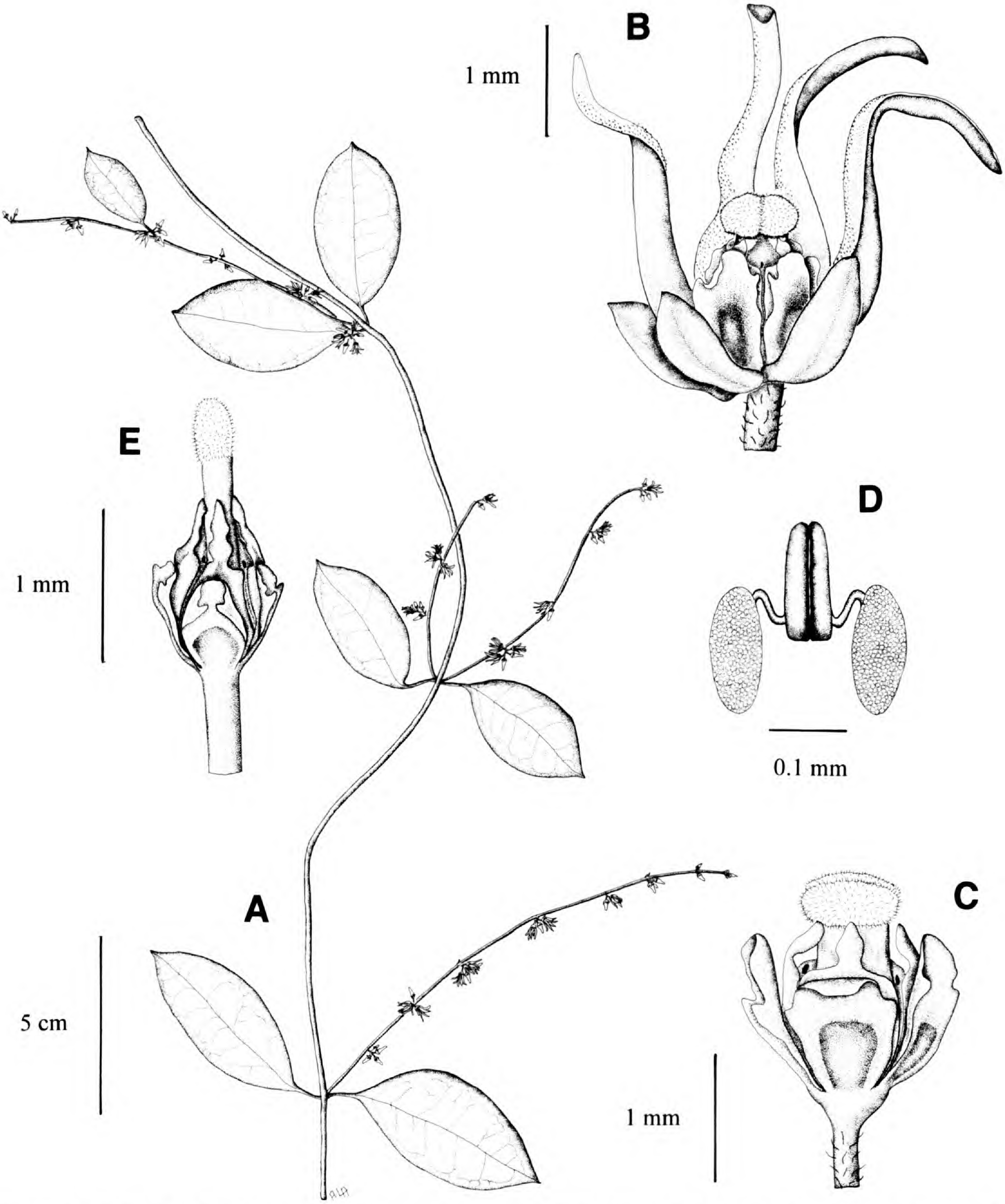

Figure 1. A–D, *Tassadia capitata* W. D. Stevens (*Carrión et al. 360,* MO). —A. Flowering branch. —B. Flower with corolla partially removed. —C. Corona and gynostegium. —D. Pollinarium. —E. *Tassadia guianensis* (*Kappler 1410,* Suriname: Para, Feb. 1844, MO). Corona and gynostegium.

2 small lateral teeth, 0.6–0.9 mm long, 0.5–0.8 mm wide at base; anthers quadrate, ca. 0.5 mm long and wide, 2-celled, terminal appendages ovate, appressed to base of style apex, guide rails linear, ca. 0.5 × 0.05 mm; corpusculum 0.12–0.13 × 0.06–0.09 mm, ellipsoid, pale brown, translators 0.05–0.08 mm long, terete, somewhat sigmoid, pollinia pendent, 0.15–0.18 × 0.05–0.08 mm, ellipsoid; style apex capitate, somewhat bilobed, 0.7–0.8 mm long, 0.5–0.8 mm wide at tip, dilated apex densely penicillate with projections ca. 0.1 mm long. Fruits and seeds unknown.

This new species is similar to *Tassadia guianen-*

sis (Fig. 1E) and probably closely related. The two species share an elongate and penicillate style apex, otherwise unknown in the genus. *Tassadia capitata* differs from *T. guianensis* in many details, including having the corolla lobes longer and narrower with shorter, more appressed hairs, having the corolla tube barbate within, as opposed to glabrous, having larger corona lobes that exceed in length and cover the anthers, having quadrate rather than radially trapezoidal anthers and consequently the guide rails are vertical instead of flaring, and by a style apex that is distinctly capitate and prominently penicillate, as opposed to subcylindrical to conical and obscurely penicillate. Fontella (1977) revised the genus and cited specimens of *T. guianensis* from the Guianas, Amazonian Peru, and the Brazilian state of Pará, and it has since been discovered in Amazonian Ecuador, while this new species is known from Bolivia and Pará, Brazil.

Both Fontella (1977) and Morillo (1990) have pointed out the close relationship of *Tassadia* and *Stenomeria*, with *T. guianensis* being the most intermediate. This new species is likewise intermediate but again the preponderance of characters suggests keeping the genera separate and placing the new species in *Tassadia*.

Paratypes. BOLIVIA. **Santa Cruz:** Velasco Province, Parque Nacional Noel Kempff Mercado, Arroyo Las Londras, bosque de sartenejal, estacionalmente inundado, 14°24′09″S, 61°08′35″W, 150 m, 10 Oct. 1996, *M. Garvizú, A. M. Carrión & R. Guillén 184* (MO, USZ). BRAZIL. **Pará:** Parque Nacional do Tapajós, Km 60 da estrada Itaituba–Jacarecanga, ilha em frente ao Pimental, mata de várzea, 26 Nov. 1978, *M. G. Silva & C. Rosário 3976* (MO).

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Una Especie Nueva y Notas sobre una Especie Notable de *Dioscorea* (Dioscoreaceae) para México

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RESUMEN. *Dioscorea omiltemensis*, una nueva especie del estado de Guerrero, México, es descrita. Se ubica en la sección *Hyperocarpa*, esta especie nueva se distingue de *D. oreodoxa* de México, así como de *D. niederleinii* y *D. grisebachii* de Sudamérica dentro de la misma sección por su morfología, distribución geográfica y preferencias ecológicas distintas. Además, en este trabajo, se describen e ilustran las flores estaminadas de *D. tacanensis* por primera vez, de ejemplares de la localidad tipo. Se discuten sus relaciones con *D. cyphocarpa*, se brindan datos de su distribución geográfica y preferencias ecológicas.

ABSTRACT. *Dioscorea omiltemensis*, a new species from the State of Guerrero, Mexico, is described. Assigned to section *Hyperocarpa*, the new species is distinguished from *D. oreodoxa* of Mexico, as well as *D. niederleinii* and *D. grisebachii* of South America within the same section, by its different morphology, its geographic distribution, and its ecological preferences. In addition, in this paper the staminate flowers of *D. tacanensis* are described and illustrated for the first time from the collections from the type locality; its relationship with *D. cyphocarpa* is discussed, as well as its geographic distribution and ecologic preferences.

Key words: *Dioscorea*, Dioscoreaceae, Mexico.

Dioscorea omiltemensis O. Téllez, sp. nov. TIPO: México. Guerrero: Mpio. Chilpancingo de Los Bravo, Omiltemi, barranca Agua Fría, 17°33′30″N, 99°4′52″W, alt. 2250 m, bosque mesófilo de montaña, cañada con corriente permanente de agua, asociada a *Croton*, *Monnina*, *Carpinus* y *Ostrya*, 19 dic. 1993, *C. González 300* ♀ (holótipo, MEXU; isótipo, FCME). Figura 1.

Herba caule sinistrorsum volubili. Folia (3.5–)4.0–6.5 cm longa, (2.0–)3.0–4.5 cm lata, ovato-cordata, 7- vel 9-nervata. Inflorescentia staminata incognita. Inflorescentia pistillata 3.0–5.2 cm longa, pauciflora. Flos pistillatus viridis; perianthi 1.5 mm longo, viridi; tepalis 1.0–1.5 mm longis, 0.5–1.0 mm latis, ovatis vel oblongo-lanceolatis; staminodis 3; stylis filiformibus. Capsula 0.6–0.8 cm longa, 0.35–0.45 cm lata, oblongoidea vel oblanceoloidea, viridis, base acuta, apice rotundato; seminibus immaturis brevi-alatis.

Rizomas desconocidos. Herbácea trepadora delicada, glabra; tallos levovolubles; pecíolos 2.3–3.6 cm de largo, sulcados, glabros. Hojas (3.5–)4–6.5 × (2–)3–4.5 cm de ancho, alternas, ovado-cordadas, membranáceas, glabras, 7- a 9-nervadas, nervaduras no prominentes, ápice agudo a acuminado, base cordada, seno basal campanulado. Inflorescencias estaminadas desconocidas. Inflorescencias pistiladas 1 por axila, de 3–5.2 cm de largo, con 1 ó 2 flores por inflorescencia; pedicelos 2–4 cm de largo; brácteas 1–1.5 × 0.3–0.4 mm, lanceoladas; flores verdes; perianto en dos series, una interna y otra externa, tépalos 6, 1–1.5 × 0.5 mm, ovado a oblongo-lanceolados; estaminodios 3, filamentos ca. 1 mm de largo, restos de las anteras extrorsas persistentes; estilos 3, libres desde la base. Cápsulas inmaduras 0.6–0.8 × 0.35–0.45 cm, verdes oblongas a oblanceoladas, base aguda, ápice redondeado; semillas inmaduras casi totalmente carentes de un ala, colapsadas.

Distribución. *Dioscorea omiltemensis* es endémica del estado de Guerrero al suroeste de México. Habita el bosque mesófilo de montaña, a una altitud de ca. 2250 m. La fructificación ocurre durante diciembre.

Dioscorea omiltemensis pertenece a la sección *Hyperocarpa* Uline, subgénero *Helmia* (Kunth) Bentham, por poseer 3 estambres, los frutos oblanceolados, largo pedicelados, y las semillas prácticamente carentes de un ala, características sólo

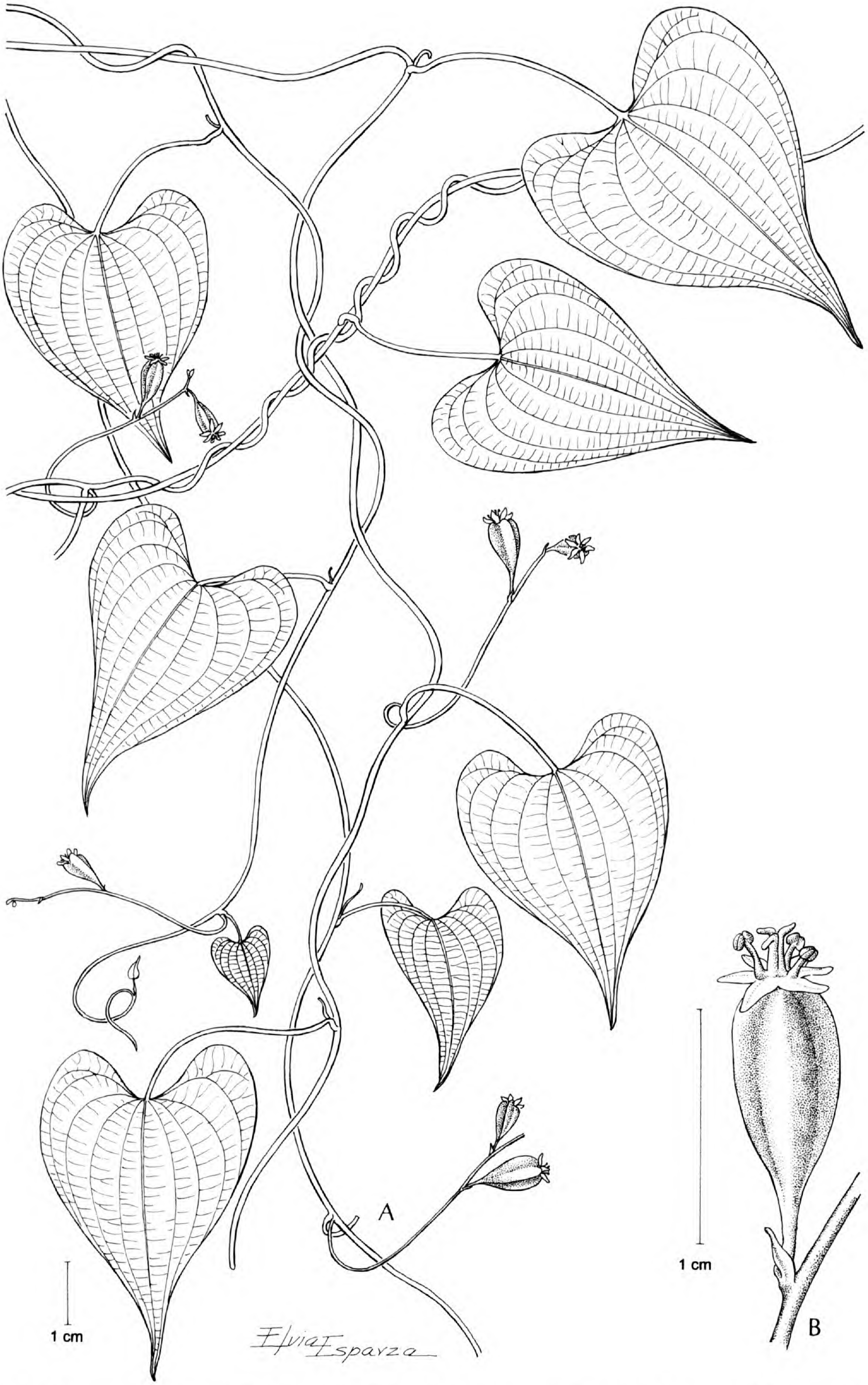

Figura 1. *Dioscorea omiltemensis* O. Téllez. —A. Hábito de la planta. —B. Flor pistilada mostrando los estaminodios, los restos de las anteras y las ramas del estilo (de *C. González 300*, MEXU).

compartidas por otras 3 especies conocidas en la sección (*D. grisebachii* Kunth, *D. oreodoxa* Schubert y *D. niederleinii* Knuth). Dos de estas especies se distribuyen en Sudamérica (de Brasil al norte de Argentina), y una más en el occidente de México. Estas distribuciones ampliamente discontinuas no son raras, ya que algunas secciones cómo *Apodostemon* Uline, *Macrogynodium* Uline, *Strutantha* Uline y *Trigonobasis* Uline (Burkill, 1960; Knuth, 1924) comparten un importante número de especies entre México y Sudamérica.

Dioscorea omiltemensis está cercanamente relacionada con *D. oreodoxa*, la cual crece en el cercano estado de Colima, también en el occidente de México. Sin embargo, ambas especies difieren en algunas características, *D. omiltemensis* tiene hojas 7- a 9-nervadas, pecíolos lisos, flores verdes, y las inflorescencias pistiladas son de 3–5.2 cm de largo, con 1 a 2 flores por inflorescencia. En contraste, *D. oreodoxa* tiene hojas 7-nervadas, pecíolos serrulados, flores purpúreas, y las inflorescencias pistiladas son de 10–25 cm de largo, con 5 a 10 flores por inflorescencia. Además, *D. omiltemensis* habita en el bosque mesófilo de montaña a una altitud de 2250 m, y florece y fructifica en diciembre; mientras que *D. oreodoxa* habita en el bosque tropical caducifolio a una altitud de 500 m, y florece y fructifica de agosto a septiembre.

Además, en este mismo trabajo se describen las características de las plantas estaminadas de *Dioscorea tacanensis* Lundell, una especie endémica, muy rara y notable por sus probables relaciones.

Dioscorea tacanensis ha sido comúnmente confundida y hasta sinonimizada bajo *D. cyphocarpa* Robinson por Matuda (1953), la especie más cercanamente relacionada a esta, y probablemente la única. Sin embargo, Schubert (1968) y Burkill (1960) la consideran como una especie diferente. Actualmente, es fácil distinguir a cada una de estas especies, *D. tacanensis* tiene flores purpúreas, estambres sésiles, las flores pistiladas, y los frutos son puberulentos, mientras que *D. cyphocarpa* tiene flores verdes, los estambres forman una columna, y las floras pistiladas y los frutos son glabros. Además, *D. tacanensis* habita en el bosque mesófilo de montaña a una altitud entre 1500 y 2300 m, y es endémica del estado de Chiapas, mientras que *D. cyphocarpa* habita en el bosque tropical caducifolio y los matorrales espinosos, a una altitud entre 1000 y 1390 m, y se distribuye en los estados de Guerrero y Oaxaca exclusivamente.

Por lo anterior, parece pertinente reubicar a *D. tacanensis* nuevamente como un taxón válido, ya que definitivamente esta especie representa un taxón distinto a *D. cyphocarpa*.

Dioscorea tacanensis Lundell, Lloydia 2: 78. 1939. TIPO: México. Chiapas: Unión Juárez, la falda sur del Volcán Tacaná, Chiquihuites, a la orilla de bosque mixto, alt. 1500 m, *E. Matuda 2416* ♀ (holótipo, MICH; isótipo, MEXU). Figura 2.

Rizomas deconocidos. Tallos levovolubles, sulcados, esparcidamente puberulentos a glabrescentes. Hojas 8.0–15.5 × 5.0–10.5 cm, alternas, ampliamente ovadas a suborbiculares, 11- a 15-nervadas, la base profundamente cordada, ápice abruptamente caudado-acuminado, glabro; pecíolos 5.0–7.5 cm de largo, esparcidamente puberulentos a glabrescentes, sulcados. Inflorescencias estaminadas 1 ó 2 racimos, 2.0–5.0 cm de largo; ráquis ligeramente fractiflexo (en zigzag); flores 1 por brote; pedicelos 1.0–1.5 mm de largo; brácteas 1, 1.0–1.5 mm de largo, linear-lanceoladas; perianto ca. 1.0 mm de largo, purpúreo; tépalos 0.5–0.6 mm de largo, lanceolados, patentes; estambres 3, sésiles, anteras extrorsas; pistilodio ausente. Inflorescencias pistiladas 1 ó 2 racimos por axila, 11.0–15.0 cm de largo, ráquis glandular-puberulento; flores una por brote, pedicelos ca. 1.0 mm de largo; perianto 1.5–2.0 mm de largo; tépalos ca. 1.0 mm de largo, insertos muy cerca de la base de la columna estilar, columna estilar ca. 0.8 mm de largo, estilos simples, teretes, delgados; estigmas 3; pedicelos acrescentes en fruto, de 7.0–10.0 mm de largo. Cápsulas samaroides ca. 1.4 cm de largo, ca. 1.1 cm de ancho, con dos de los lóculos abortados, el tercero acrescente, membranáceo, oblongo a suborbicular, castaño-claro, puberulento; semilla 1, 6.0–7.0 mm de largo, ca. 5.0 mm de ancho, oblonga a reniforme, castaño-claro, lisa; prácticamente no alada o con escasa reminiscencias de lo que aparentemente fue un ala.

Colecciones examinadas. MÉXICO. **Chiapas:** Unión Juárez, Volcán Tacaná, subiendo por Talquian, bosque mesófilo de montaña, alt. 1700–2300 m, 8 julio 1991, *L. M. González V., R. Ramírez D., R. González T. y R. González A. 4138* ♂ (IBUG).

Distribución. Esta especie está restringida al Volcán Tacana, en los límites entre el estado de Chiapas y Guatemala. Habita en el bosque mesófilo de montaña, a una altitud entre 1500 y 2300 m. Se encuentra comúnmente asociada con *Quercus*, *Alnus*, *Clethra*, *Fuchsia*, *Peperomia*, *Bomarea*, *Begonia*, *Gaultheria* y *Cuphea*. La floración y la fructificación ocurren durante julio y agosto.

Estas dos especies *D. tacanensis* y *D. cyphocarpa* que están muy estrechamente relacionadas por compartir el mismo tipo de flores pistiladas, pedicelos largos acrescentes, un fruto modificado con dos de las

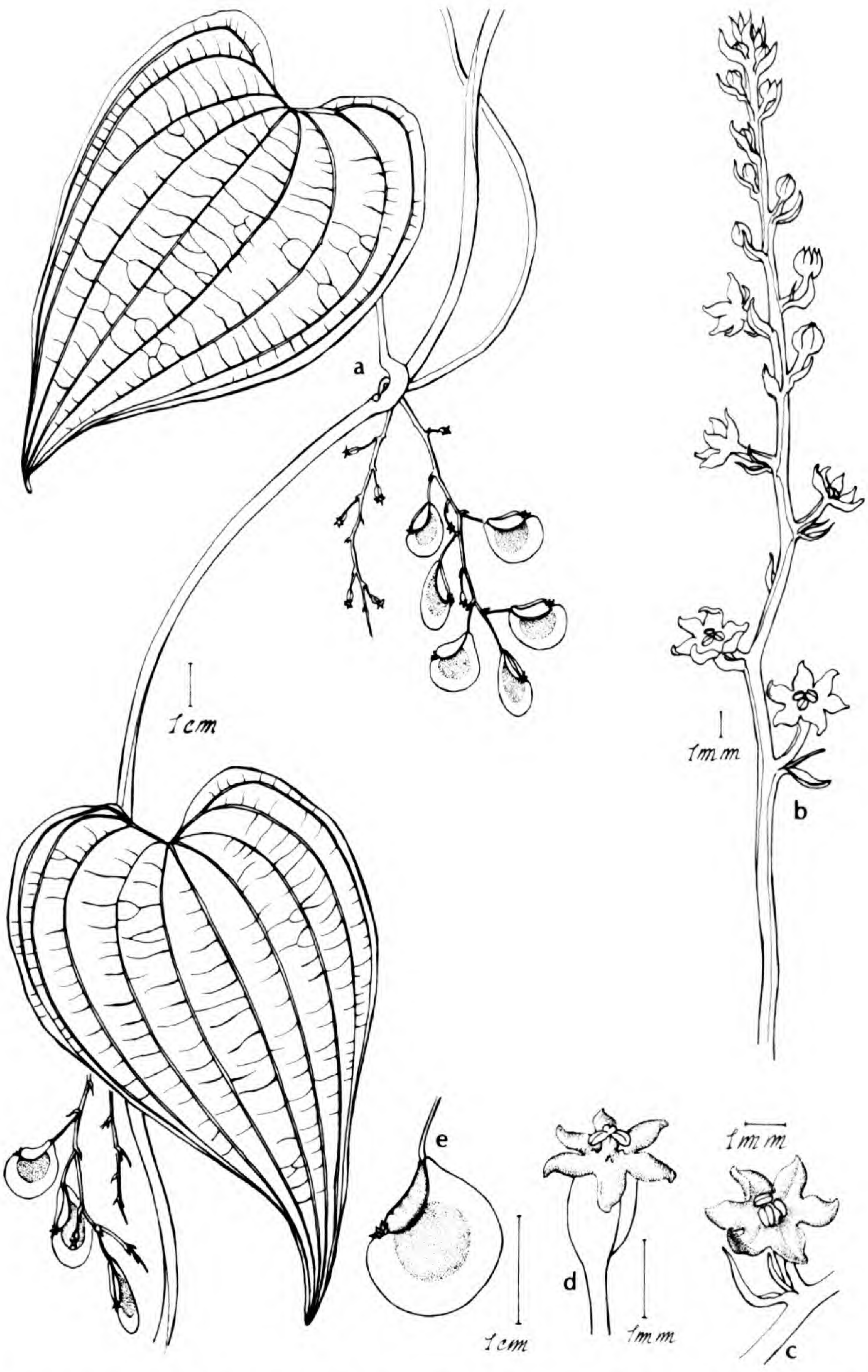

Figura 2. *Dioscorea tacanensis.* —a. Rama con frutos. —b. Inflorescencia estaminada. —c. Flor estaminada. —d. Flor pistilada. —e. Fruto. (a y d de *E. Matuda 2416*, MEXU; b y c de *L. M. González V. et al. 4138*, IBUG.)

tres cavidades abortadas, y las semillas no aladas, deben conformar un grupo diferente, al menos al nivel de sección dentro de *Dioscorea.* Por tales características, Burkill (1960) y Schubert (1968) las han considerado como un posible estado intermedio y una liga entre los géneros *Dioscorea* y *Rajania,* debido a que el fruto es sumamente semejante al del género *Rajania,* principalmente por los pedicelos largos, las cavidades abortadas, y la semilla no alada.

Agradecimientos. Agradezco a Elvia Esparza el dibujo de *D. omiltemensis*, y a Regina O'Huges el de *D. tacanensis*, en los dos casos excelentes. A Barry Hammel por fungir como revisor de este manuscrito, así como a un revisor anónimo. Al herbario IBUG del Instituto de Botánica, de la Universidad de Guadalajara por facilitar colecciones para el desarrollo de este trabajo.

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Arnaldoa argentea (Barnadesioideae: Asteraceae), a New Species and a New Generic Record for Ecuador

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Abstract. A new species of Asteraceae, *Arnaldoa argentea* C. Ulloa, P. Jørgensen & M. O. Dillon, from southern Ecuador is described and illustrated. It is characterized by its cream-white to light orange corollas and red-brown phyllaries covered by a dense silvery pubescence, especially on the adaxial surface. The genus was previously known only from northern Peru. A key to the species of *Arnaldoa* is presented.

Resumen. Se describe e ilustra una nueva especie de Asteraceae, *Arnaldoa argentea* C. Ulloa, P. Jørgensen & M. O. Dillon, del sur de Ecuador. Esta especie se caracteriza por las corolas de color blanco-crema a anaranjado pálido y las filarias café-rojizas cubiertas por un denso tomento argénteo especialmente en la superficie adaxial. El género anteriormente se conocía solo del norte de Perú. Se presenta una clave para todas las especies de *Arnaldoa*.

Key words: Andes, *Arnaldoa*, Asteraceae, Barnadesioideae, Ecuador.

Recent collecting efforts in the Andean region of southern Ecuador have revealed the presence of the genus *Arnaldoa* Cabrera in the country (Ulloa Ulloa & Jørgensen, in press). The genus was previously known only from northern Peru (Ferreyra, 1995; Stuessy & Sagástegui Alva, 1993). *Arnaldoa* is a small genus of three species of shrubs, with long axillary spines, solitary, terminal, homogamous, discoid capitula, and pseudobilabiate corollas. It belongs to the South American subfamily Barnadesioideae (formerly included as Barnadesiinae in the Mutisieae, see Cabrera, 1977; Harling, 1991). The members of this monophyletic subfamily, sister group to the rest of the Asteraceae, are characterized by a unique indumentum of barnadesioid villous hairs (a long filiform cell attached to a swollen cell, which is held by a basal epidermal cell, see Erbar & Leins, 2000) on the corollas, achenes, and pappus of most species (Bremer, 1994). Most members also have peculiar spines in pairs, sometimes solitary or three to five together between the subtending leaf and the axillary bud (Bremer, 1994). Various affinities with other, mainly Andean, genera of this subfamily have been suggested for *Arnaldoa.* Morphologically the genus has been placed between *Chuquiraga* and *Dasyphyllum* (Cabrera, 1962, 1977), and an intergeneric hybridization between *Barnadesia* and *Chuquiraga* has been suggested (Stuessy et al., 1996). A recent molecular phylogeny (Gustafsson et al., 2001) reveals a well-supported *Arnaldoa* clade also comprising *Fulcaldea* and *Dasyphyllum* subg. *Archidasyphyllum.* Although this group is morphologically heterogeneous, the placement of *Arnaldoa* based on morphological characters is inconclusive and neither strongly contradicts nor supports the molecular results (Gustafsson et al., 2001).

The species of *Arnaldoa* have narrow distributions and grow on wooded or shrubby slopes in more or less xerophytic habitats, between 1370 and 3000 m. The species known in Peru have showy bright orange-red or purple corollas, whereas the specimens from Ecuador have cream-white or light orange ones. Further comparison revealed that the latter represent a new species.

Arnaldoa argentea C. Ulloa, P. Jørgensen & M. O. Dillon, sp. nov. TYPE: Ecuador. Loja: Amaluza, road to the antennas above town, at the top, 5 Nov. 2000, 2400 m, 79°26′26″W, 4°33′58″S, *P. M. Jørgensen, C. Ulloa, J. Caranqui, J. Madsen & O. Sánchez 2234* (holotype, QCNE; isotypes, F, LOJA, MO, QCA, USM, WU). Figures 1, 2.

Haec species habitu *Arnaldoae weberbaueri*, filamentis pubescentibus *A. macbrideanae* similis, sed a hac capitulo multo majore, ab illa filamentis pubescentibus atque co-

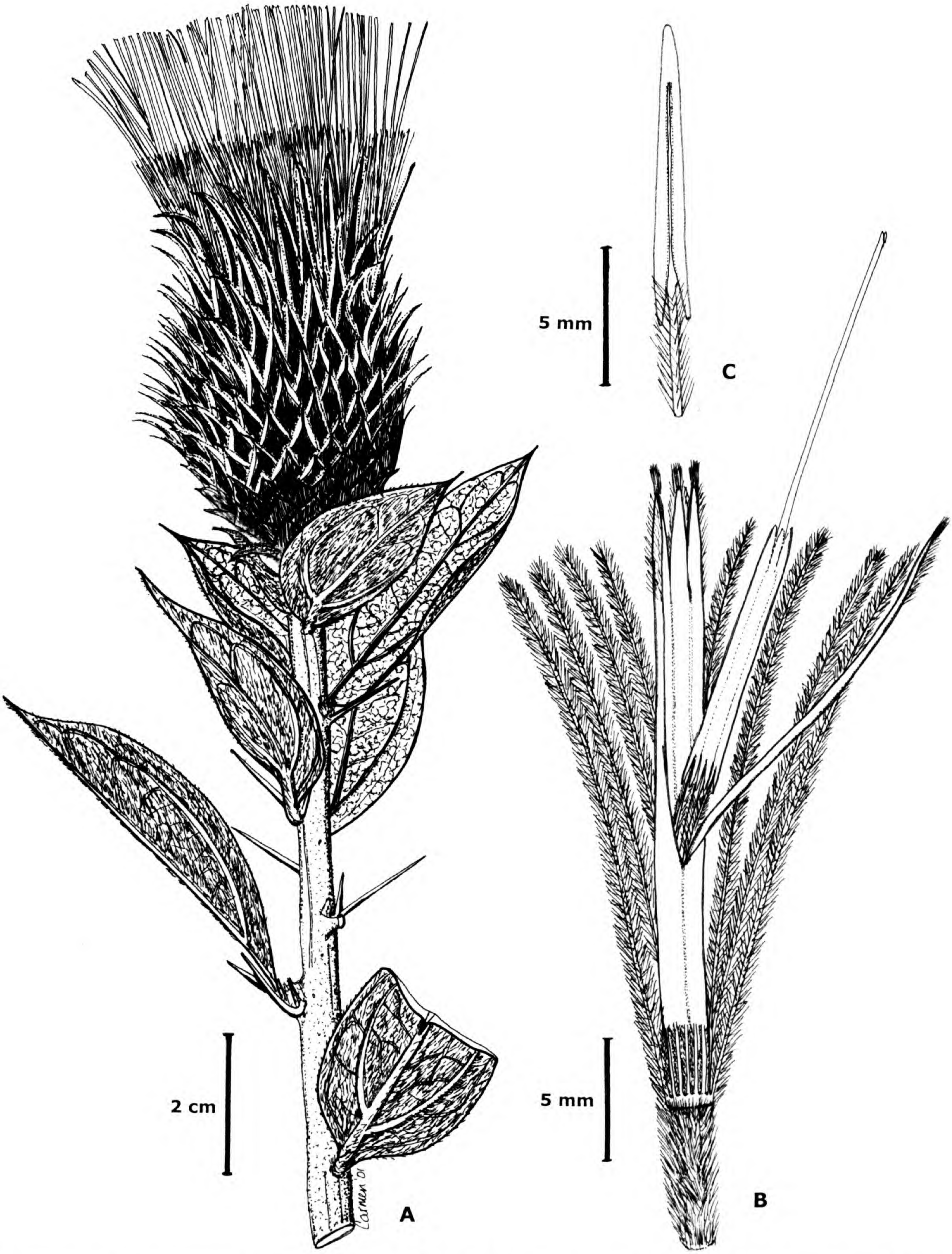

Figure 1. *Arnaldoa argentea* C. Ulloa, P. Jørgensen & M. O. Dillon. —A. Habit. —B. Floret with some pappus bristles removed. —C. Stamen. Drawing based on photographs taken at the type locality and the isotypes of *Jørgensen et al. 2234*.

Figure 2. *Arnaldoa argentea.* Flowering branch (left). Habit. Photographs by Jens Madsen taken at the type locality, 2001.

rolla ex pappo vix exserta, ab ambabus corollae colore distinguitur.

Tall, slender shrubs, up to 3.5 m tall, the branches striate, densely rufous hirsute-tomentose, glabrescent with age, with paired axillary spines, the longest to (17–)27 mm long, projecting at about 90° at the base of the petiole, generally with two additional pairs of shorter ones, 4–11 mm long. Leaves simple, alternate, decreasing in size toward the base of the capitula; petioles 3–6 mm long, densely tomentose, with long tan hairs, glabrescent with age; blades elliptic-oblong to ovate, (2.0–)4.3–7.8 × 1.2–4.1 cm, coriaceous, apex obtuse, spiny-mucronate, mucro 1.5–3 mm long, base unequal, entire, tomentose to sparsely tomentose at the base of the main nerve and becoming shiny adaxially, densely tomentose abaxially and velvety to the touch, with long pale yellow to argenteous hairs especially along the veins and margins, glabrescent with age, 3-veined from near the base, tertiary venation finely reticulate. Capitulescence of solitary, terminal, sessile capitula, these homogamous, discoid, 40–58 × 35–50 mm, the involucre campanulate; phyllaries 11–15-seriate, slightly recurved at apex and spreading with age, the outer series dark green and progressively becoming red- to orange-brown toward the median and inner series, all densely argenteous tomentose in the 1/2–2/3 upper portion adaxially, and along the margins, glabrous at the base, sparsely tomentose to glabrescent on the abaxial surface, the outer phyllaries ovate to triangular, 6–12 × 5–6 mm, acuminate to cuspidate, with a spiny apex 3–5 mm long, the median phyllaries ovate, 15–18 × 3–5 mm, long-acuminate with a spiny apex 4–6 mm long, the margins slightly reflexed, the inner phyllaries lanceolate, 35–38 × 2–3 mm, the margins reflexed. Florets 55 to 70, the corollas 25–28.5 mm long, cream-white to light orange, pseudobilabiate, with a 4-lobed expanded limb and a single adaxial slender lobe, the tube 9–10.5 × 2.5 mm, glabrous, the limb 16–17 mm long, the lobes 4–8 mm long and densely white villous outside, the adaxial lobe filiform, as long as the limb, densely white-villous on the apical 5–6 mm; filaments free, white-villous, the anthers 10–13 mm long, caudate, the tails 1.5–2 mm long; style 30–44 mm long, the stigmas cream becoming dark orange-brown. Achenes cylindrical, 6–7.5 × 2 mm, densely white-villous; pappus of 21–26 villous bristles, 22–25 mm long.

Paratypes. ECUADOR. **Loja:** vicinity of Bellavista, at "Las Antenas" (6–7 km from Amaluza), 31 May 2001, 2200–2300 m, 79°27′024″W, 4°33′421″S, *J. E. Madsen & C. Rosales 8175* (LOJA not seen, MO), 14 Aug. 2001, 2400 m, *J. E. Madsen et al. 8341* (LOJA not seen, MO).

Distribution, habitat, and conservation. This species has only been collected on the top of a small mountain just outside the town of Amaluza, in a dry inter-Andean valley in the Province of Loja, between 2200 and 2400 m. It was collected in flower in May and June, less so in November, and in fruit in August and November (Madsen, pers. comm.). The area is heavily disturbed with only small patches of natural vegetation on the hillsides. The long spines may protect these plants from the cattle and from being cut for fuel-wood; however, they may not survive fires. These factors combined with a so far very restricted distribution make this species extremely vulnerable.

Etymology. The specific epithet refers to the pubescence of the phyllaries and of the pappus, which gives the capitula an overall silvery appearance.

This new species can be readily recognized from the other species of *Arnaldoa* by its large silvery capitula, with red- to orange-brown phyllaries, the corollas barely exserted from the pappus, and the villous filaments. It resembles *A. weberbaueri* (Muschler) Ferreyra (including *A. coccinasantha* (Muschler) Ferreyra) by the large capitula and densely pubescent stems and leaves, but it differs by having broader phyllaries (outer ones 5–6 mm vs. 2–3 mm wide) that are more densely pubescent on the adaxial surface (vs. the abaxial), villous filaments (vs. glabrous), and the corollas just slightly exserted from the pappus (vs. much exserted). From *A. macbrideana* Ferreyra it may be distinguished by the pubescent leaves and stems (vs. glabrous) and much larger capitula and florets. The corollas of this new species are very similar to, but larger than, those of *A. macbrideana* in their deeply lobed limb with villous lobes, while the rest of the corolla is glabrous both inside and outside; in *A. weberbaueri* the limb is only shortly 4-toothed at the apex and the corolla is densely villous on its upper half on the outside, and the tube is villous within. Although the corollas and styles of this new species turn light orange to dark brown with age, they cannot compare with the bright red-orange to purple showy corollas and styles of the other two species. The pubescence of the filaments was suggested as a species character (Erbar & Leins, 2000) to separate *A. macbrideana* Ferreyra from *A. weberbaueri* with glabrous ones. The species of this genus may be separated by the following key.

KEY TO THE SPECIES OF *ARNALDOA*

1a. Filaments glabrous; corollas 32–50 mm long, much exserted form the pappus, orange (rarely purple), the tube villous inside, the limb shortly 4-toothed and longer than the adaxial slender lobe; Peru (Ancash, Amazonas, Cajamarca, and La Libertad) . . . . *A. weberbaueri*
1b. Filaments densely villous; corolla slightly exserted from the pappus, the tube glabrous inside, the limb deeply 4-lobed and as long as the adaxial slender lobe.
    2a. Corollas 15–19 mm long, purple; capitula 2.5–4.5 cm long; Peru (Lambayeque and Piura) . . . . *A. macbrideana*
    2b. Corollas 25–28.5 mm long, cream-white to light orange; capitula 4.0–5.8 cm long; Ecuador (Loja) . . . . *A. argentea*

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Two New Species of *Spiradiclis* (Rubiaceae) from China

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ABSTRACT. Two new species, *Spiradiclis loana* R. J. Wang and *S. chuniana* R. J. Wang, from Guangxi, China, are newly described and illustrated. *Spiradiclis loana* is perhaps related to *S. spathalata* X. X. Chen & C. C. Huang by its oblanceolate, elliptic, or obovate and rosette-like leaves, but distinguished by its long petioles, fewer secondary veins, and white coronas. *Spiradiclis chuniana* is probably related to *S. tomentosa* D. Fang & D. H. Qin by its hairy leaves but distinguished by its truncate leaf bases, long internodes and bracts, short pedicels, and a ring of hair inside the middle of long-styled flowers.

Key words: China, Rubiaceae, *Spiradiclis*.

The genus *Spiradiclis* Blumea (Rubiaceae–Hedyotideae) comprises 31 annual or perennial herbaceous species native to southern and southwestern China and northern India (Lo, 1999; Deb & Rout, 1989) and mainly grows in mountainous, especially limestone, areas. It is characterized by a cincinnus cyme, heterostylous and 5-merous flowers, and globose, ovoid or linear-oblong dehiscent capsules with four twisted or untwisted valves. Two subgenera, subgenus *Sinospiradiclis*, characterized by subglobose capsules and untwisted valves when matured, and subgenus *Spiradiclis*, characterized by ovate or linear-oblong and twisted valves, were recommended (Lo, 1998). An expedition searching for the *Spiradiclis* species in the Guangxi limestone area was held in 2000 in order to discover more about its biodiversity.

In the tribe Hedyotideae, the genus *Spiradiclis* is very similar and closely related to such Chinese genera as *Hedyotis* L. (s.l.) and *Ophiorrhiza* L. in morphological characters, but differs from the former by its 5-merous heterostylous not 4-merous homostylous flowers, and from the latter by its subglobose not obcordate or obconical capsules.

Spiradiclis loana R. J. Wang, sp. nov. TYPE: China. Guangxi: Nonggang Nature Reserve, alt. 280 m, 15 Aug. 2000 (fl & fr), *R. J. Wang 390* (holotype, IBSC; isotype, MO). Figure 1.

Species affinis *S. spathalatae* X. X. Chen & C. C. Huang, sed petiolis 1–4.5 cm longis, nervis secundariis utrinque ca. 10 paribus, corollarum tubis ca. 5 mm longis, albis differt.

Herbs to 15 cm in height; stems erect, simple, stout, pubescent. Leaves rosette-like, petiolate, the blade 6–12 × 1.2–3 cm, oblanceolate, elliptic or obovate, acute at apex, narrowed at base, spiny pilose adaxially, glaucous abaxially; secondary veins ca. 10 pairs, slender, alternate or subopposite, conspicuous beneath; petiole 1–4.5 cm long, slender, pubescent; stipules persistent, interpetiolar, 1–2 mm wide at base, bilobed or not at apex, lobes linear, 0.5–1 cm long, pubescent; internodes ca. 2 mm long. Inflorescence a terminal cyme; peduncle 6–10 cm long, pubescent; bracts ca. 1 mm long, pubescent. Flowers heterostylous, corollas white; long-styled flowers: calyx tubes ca. 1 mm long, obconic, pubescent, calyx lobes ± as long as the tube, triangular, acute, pubescent; corolla tubes 5–10 mm long, enlarged a little at middle, puberulous outside, glabrous inside except with a pubescent ring of long hairs at the middle and sparse simple hairs above; lobes ca. 1 mm long, acute, pubescent adaxially; stamens ca. 3.5 mm long, adnate a little higher than the base of the corolla; anthers ca. 1.2 mm long, linear, situated near the ring of hairs; ovaries ca. 0.6 mm long, bilocular; styles slender, ca. 7 mm long; stigmas 2-lobed, ca. 0.8 mm; short-styled flowers: calyxes as in long-styled flower; corolla tubes ca. 5.5 mm long, pubescent inside but without a ring of long hairs, lobes ca. 1.2 mm long; stamens adnate near the middle of the tube, ca. 2.5 mm long, anthers situated near the throat of the tube; styles ca. 3 mm long. Capsules subglobose, ca. 2 mm diam., septicidal and loculicidal dehiscence when mature. Seeds ca. 25, angled cylindric, ca. 0.6 mm long, brown.

This species belongs to *Spiradiclis* subg. *Sinospiradiclis* Lo because it has globose capsules and four untwisted valves when the capsules mature. Its oblanceolate, elliptic, or obovate and rosette-like leaves make it look like *S. spathalata* X. X. Chen & C. C. Huang, which has 5–8 mm long petioles, 15–25 secondary veins, and purplish red coronas, but it differs from *S. spathalata* by its 1–4.5 cm

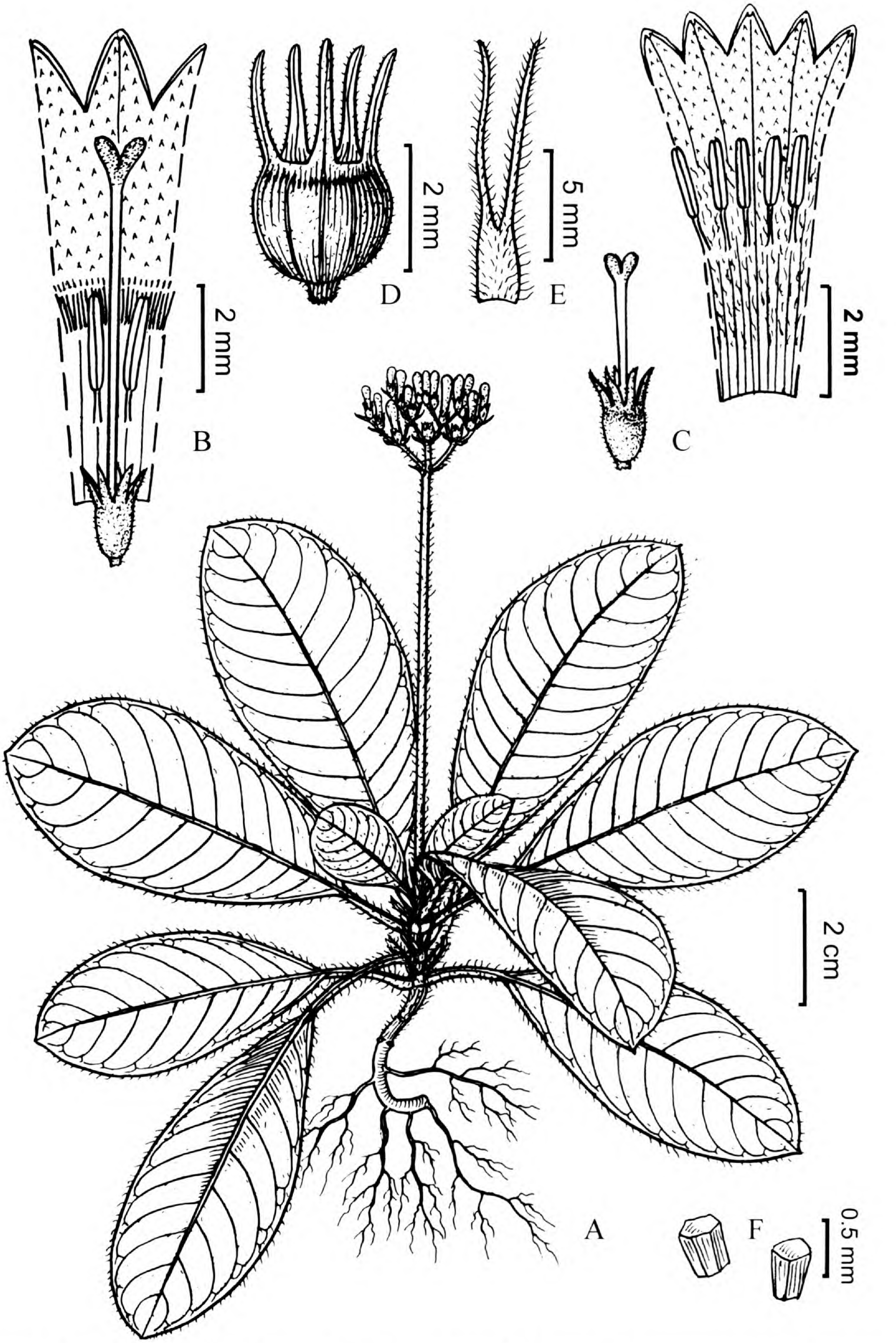

Figure 1. *Spiradiclis loana* R. J. Wang. —A. Habit. —B. Long-styled flower split and opened to show floral parts. —C. Short-styled flower split to show floral parts. —D. Capsule. —E. Stipule. —F. Seeds. (Drawn from the type.)

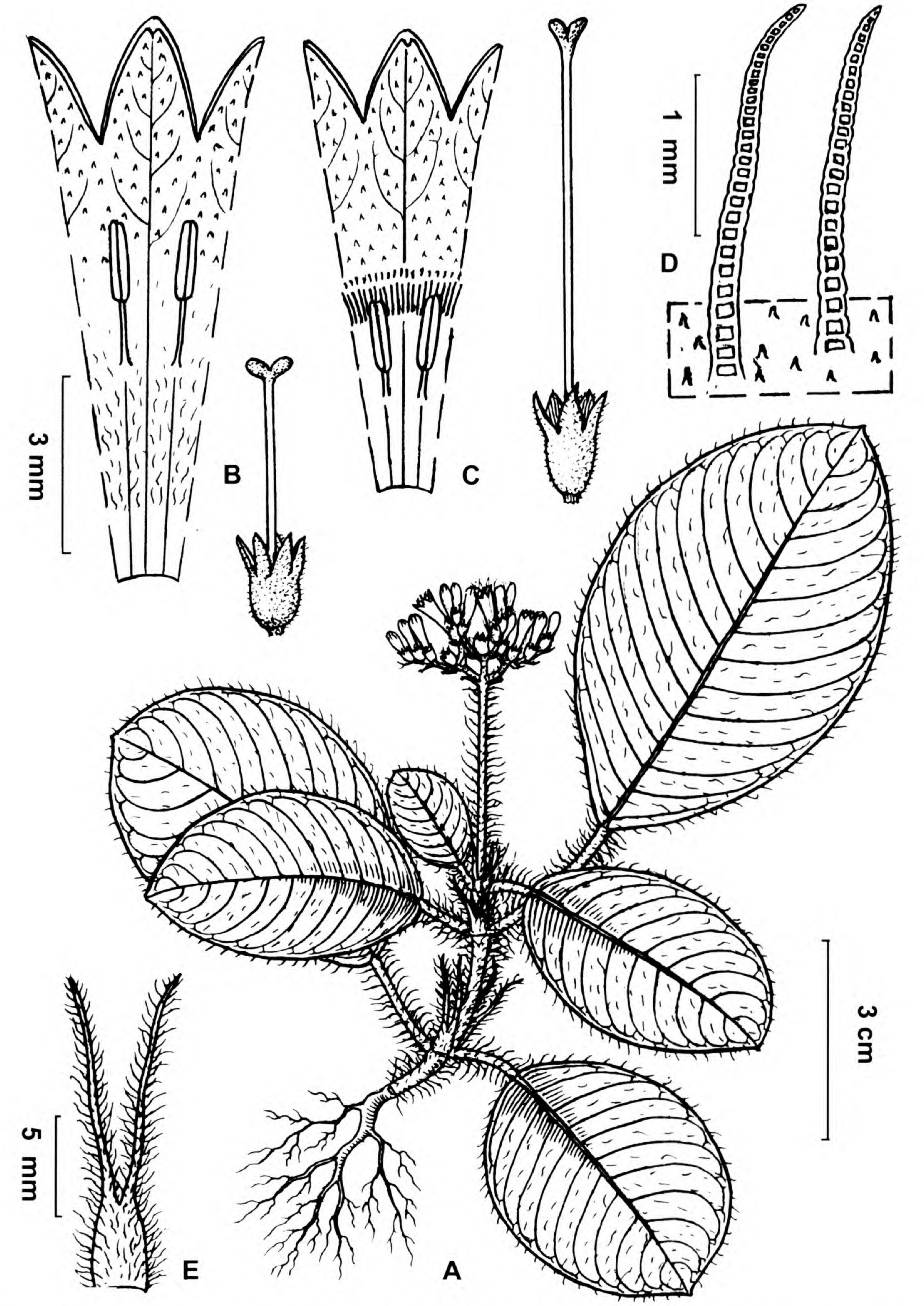

Figure 2. *Spiradiclis chuniana* R. J. Wang. —A. Habit. —B. Short-styled flower opened to show floral parts. —C. Long-styled flower split to show floral parts. —D. Articulated hairs on the surface of the leaf. —E. Stipule. (Drawn from the type.)

long petioles, 10 secondary veins, and white coronas.

Distribution and ecology. This species, collected from Nonggang Nature Reserve, Guangxi, China, grows under the secondary limestone forests at an altitude of 200–280 m, where it is very common. At the time it was found, the plant bore both white flowers and green fruits. Therefore, the flowering season might be from late July or early August to the end of August or early September, and the fruiting season might be half a month later.

Notes. This species is named after Lo Hsien-shui (IBSC), a Chinese taxonomist studying the Rubiaceae family.

Paratype. CHINA. **Guangxi:** Minqiangshe village, Shanglong Xiang, Longzhou county, in densely mountainous forest, on stone, alt. 200 m, 4 Sep. 1958, *Zhao-Qian Zhang 11831* (IBSC).

Spiradiclis chuniana R. J. Wang, sp. nov. TYPE: China. Guangxi: Nonggang Nature Reserve, alt. 390 m, 15 Aug. 2000 (fl & young fr), *R. J. Wang 392* (holotype, IBSC; isotype, MO). Figure 2.

Species nova *S. tomentosae* D. Fang & D. H. Qin, similis, sed foliis ovatis, basi truncatis, bracteis brevioribus 1.2–2 mm longis, inflorescentiis densioribus, tubo corollae floris longstylosi intus ad medium annulo piloso instructo differt.

Annual herbs to 8 cm in height; stems simple, stout, pubescent. Leaves ovate, 3–6.5 × 1.6–3 cm, mucronate at apex, truncate at base, oblique, sparsely covered with articulate villose hairs abaxially and adaxially, secondary veins 10 to 12 pairs, distinct abaxially; petiole 1–3 cm long, pubescent; stipules persistent, interpetiolar, 2- to 5-lobed, lobes linear, 0.5–1 cm long, pubescent; internodes 1–1.5 cm long. Inflorescence a terminal cyme; peduncle 2.5–6 cm long, pubescent; pedicel 0–5 mm long; bracts 1.2–2 mm long. Flowers heterostylous, corollas white; long-styled flowers: calyx tubes ca. 1 mm, obconic, pubescent; calyx lobes ± as long as the tube, acute, pubescent; corolla tubes ca. 7.5 mm long, enlarged a little at the middle, puberulous outside, glabrous inside except bearing a ring of ca. 1 mm long white hairs at the middle and sparsely pubescent above; lobes ca. 1.5 mm long, pubescent inside; stamens ca. 3 mm long, adnate a little higher than the base of the corollas; anthers ca. 1.2 mm long, linear, situated adjacent to the ring of hairs; ovaries bilocular; styles ca. 5 mm long, slender; stigmas bilobed. Short-styled flowers: calyx tubes as in long-styled flowers; corolla tubes pubescent inside but without a ring of long hairs; stamens ca. 4 mm long, adnate nearly at the middle of the tube, anthers situated lower than the throat; styles ca. 2.5 mm long. Capsules immature.

This species might belong to *Spiradiclis* subg. *Sinospiradiclis* Lo because its immature capsules look subglobose. Only after the capsules mature can its position be assigned properly. In its habit and leaf indument it is closely related to *S. tomentosa* D. Fang & D. H. Qin, which has obovate or oblanceolate leaves with an attenuate base, ca. 2 mm long internodes, 3–7 mm long bracts, and a sparse inflorescence with distinct pedicels; the new species is distinguished from the latter by its truncate leaf bases, 1–1.5 cm long internodes, 1.2–2 mm long bracts, the crowded inflorescence with indistinct pedicels, and the corolla tube in long-styled flowers bearing a hairy ring at the middle inside. It differs from *S. loana* by its ovate leaves with a truncate base and bearing articulate villose hairs abaxially and adaxially.

Distribution and ecology. This species, collected from Nonggang Nature Reserve, Guangxi, China, grows in the shade of rocky and humid slopes under secondary limestone forests at ca. 390 m altitude, where it is apparently restricted. Based on field observations, its flowering and fruiting season is mainly from August to September.

Notes. This species is named after Chun Woon-young, a former Academician of the Chinese Academy of Sciences (CAS) and one of the pioneers of plant taxonomy in China.

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Nomenclatural Novelties in Chinese *Elymus* (Poaceae, Triticeae)

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ABSTRACT. In the treatment of the Triticeae (Poaceae) for the *Flora of China, Roegneria* K. Koch is recognized as a synonym of *Elymus* L. This decision led to the following 18 nomenclatural novelties: *E. abolinii* (Drobow) Tzvelev var. *nudiusculus* (L. B. Cai) S. L. Chen & G. Zhu, comb. et stat. nov.; *E. angustispiculatus* S. L. Chen & G. Zhu, nom. nov.; *E. caianus* S. L. Chen & G. Zhu, nom. nov.; *E. cheniae* (L. B. Cai) G. Zhu, comb. nov.; *E. curtiaristatus* (L. B. Cai) S. L. Chen & G. Zhu, comb. nov.; *E. debilis* (L. B. Cai) S. L. Chen & G. Zhu, comb. nov.; *E. gmelinii* (Ledebour) Tzvelev var. *macrantherus* (Ohwi) S. L. Chen & G. Zhu, comb. nov.; *E. hongyuanensis* (L. B. Cai) S. L. Chen & G. Zhu, comb. nov.; *E. kamoji* (Ohwi) S. L. Chen var. *macerrimus* G. Zhu, var. nov.; *E. laxinodis* (L. B. Cai) S. L. Chen & G. Zhu, comb. nov.; *E. magnipodus* (L. B. Cai) S. L. Chen & G. Zhu, comb. nov.; *E. serpentinus* (L. B. Cai) S. L. Chen & G. Zhu, comb. nov.; *E. shouliangiae* (L. B. Cai) G. Zhu, comb. nov.; *E. sinicus* (Keng) S. L. Chen var. *medius* (Keng) S. L. Chen & G. Zhu, comb. nov.; *E. sinoflexuosus* S. L. Chen & G. Zhu, nom. nov.; *E. strictus* (Keng) Á. Löve var. *crassus* (L. B. Cai) S. L. Chen & G. Zhu, comb. et stat. nov.; *E. trichospicula* (L. B. Cai) S. L. Chen & G. Zhu, comb. nov.; and *E. yushuensis* (L. B. Cai) S. L. Chen & G. Zhu, comb. nov.

Key Words: China, *Elymus*, Poaceae, *Roegneria*, Triticeae.

The grass tribe Triticeae is complex for its taxonomy at the generic level mainly because of the existence of many natural and artificial intergeneric hybrids (Stebbins, 1956; Dewey, 1982; Barkworth & Dewey, 1985; Kellogg, 1989). It has been suggested by different authors that the tribe consists of a single genus or up to 38 genera (Löve, 1984). The generic limits of *Roegneria* K. Koch and *Elymus* L. are among the well-known taxonomic problems in the tribe (Dewey, 1982, 1983, 1984; Löve, 1984; Kellogg, 1989; Zhu et al., 1990; Zhu & Yang, 1990; Baum et al., 1991; Cai, 1997; Yang et al., 2001).

Linnaeus (1753) included five species within *Elymus*, which was lectotypified by Hitchcock (in Hitchcock & Green, 1929) on *E. sibiricus* L. Since 1753, the generic name has been adopted by most authors, but with very different taxonomic concepts. Traditionally, this genus consists of grass species with more than one (often two) spikelets at each node. Based on such a concept, Hitchcock (1935) included *Leymus* Hochstetter and *Psathrostachys* Nevski in his delimitation of *Elymus*. Nevski (1934) placed these traditional *Elymus* species under *Clinelymus* (Grisebach) Nevski, and included some unrelated rhizomatous species under *Elymus*. This treatment was accepted by Keng (1959). In addition to these traditional species, Tzvelev (1976) also included in *Elymus* those self-pollinated species with clustered habit and always one spikelet per node.

The name *Roegneria* K. Koch was published in 1848, based on *R. caucasica* K. Koch, and was mostly ignored for almost a century afterward. Its species, characterized by a single spikelet per node, were mostly treated in *Agropyron* Gaertner sensu lato (Bentham & Hooker, 1880; Hitchcock, 1935; Bor, 1960). When redefining the generic limits within the Triticeae, Nevski (1934) limited the generic concept of *Agropyron* to only the typical wheatgrass species and revived the name *Roegneria*. *Agropyron* sensu stricto has been widely accepted since then. The genus *Roegneria* has been accepted principally by Chinese and Japanese authors (Ohwi, 1941, 1942; Keng, 1959; Keng & Chen, 1963; Yang, 1980, 1987; Zhu et al., 1990; Zhu & Yang, 1990; Zhang et al., 1991; Baum, 1991; Cai, 1997), but has been treated in the synonymy of *Elymus* by others (Melderis, 1980; Dewey, 1982; Löve, 1984; Clayton & Renvoize, 1986; Chen, 1997). In the treatment of the Triticeae for the *Flora Reipublicae Popularis Sinicae*, Yang (1987) included only those species with two spikelets per node under *Elymus* and included all those with one spikelet per node in *Roegneria*. Yang's concepts are widely accepted in China. The genus *Roegneria* is recognized in all present Chinese local floras, and new species are continually being described under this name (Zhu et al., 1990; Zhu & Yang, 1990; Cai, 1994, 1996a, 1996b, 1997; Cai & Wang, 2001).

The aim of this article is not to justify the inclusion of *Roegneria* within *Elymus*. One may argue both ways due to the taxonomic complexity of the whole tribe. As coauthors of the treatment of tribe Triticeae for the English-language *Flora of China* (Chen & Zhu, in prep.), we have decided to treat *Roegneria* as a synonym of *Elymus*. This requires the following 18 new names or new combinations to be made available for the *Flora*.

1. **Elymus abolinii** (Drobow) Tzvelev var. **nudiusculus** (L. B. Cai) S. L. Chen & G. Zhu, comb. et stat. nov. Basionym: *Roegneria nudiuscula* L. B. Cai, Acta Phytotax. Sin. 35: 171. 1997. TYPE: China. Xinjiang: Nileke, along bank of stream, alt. 1650 m, 6 July 1976, *Exped. Xinjiang 1746* (holotype, XJBI).

Only two collections are known of this variety. A second specimen cited in the protologue, *N. R. Cui 82987*, was collected from Xiyuan County, Xinjiang, but was not seen by the present authors. This specimen is presumably deposited in Xinjiang Normal University herbarium (XJNU), where the collector was employed. The holotype can be easily identified as *Elymus abolinii* and differs only in having spikelets with 4 or 5 florets each and anthers ca. 5 mm long. *Elymus abolinii* is a variable species. Other characters discussed in the protologue of *Roegneria nudiuscula*, such as spikes relatively short, glumes lanceolate and acute, lemma densely pubescent, and the length of lemma awns, all fall within the range of variation of *E. abolinii*. Therefore, the former taxon can only be accepted at the varietal level under the latter.

The basionym of *Elymus abolinii* is *Agropyron abolinii* Drobow, the epithet of which was spelled "*abolini*" in the protologue (Drobow, 1925). The species was named after the type collector, Robert Ivanovich Abolin, so according to Article 60.11 of the ICBN (Greuter et al., 2000), the epithet was correctly changed to "*abolinii*" when Tzvelev made the new combination under *Elymus*.

2. **Elymus angustispiculatus** S. L. Chen & G. Zhu, nom. nov. Replaced synonym: *Roegneria angusta* L. B. Cai, Acta Phytotax. Sin. 34: 332, fig. 3(1–9). 1996, non Trinius ex Ledebour, Fl. Altaic. 1: 119. 1829. TYPE: China. Qinghai: Xunhua, on mountain slope, alt. 2200 m, 8 July 1984, *G. X. Lei 841810* (holotype, HNWP).

A new name for this species is proposed here because the epithet "*angustus*" is not available for use in the genus *Elymus*. *Elymus angustispiculatus* is compared in its protologue for unknown reasons with *E. barbicallus* (Ohwi) S. L. Chen, which is not closely related. The latter is easily distinguishable by its awnless glumes. *Elymus angustispiculatus* is in fact closest to *E. tibeticus* (Melderis) G. Singh in having spikelets sessile, glumes shortly aristate, lemma with long awns, and palea nearly as long as the lemma. *Elymus angustispiculatus* differs from *E. tibeticus* in having spikes 8–10 cm long (vs. 10–16 cm long) and lemma sparsely pubescent (vs. glabrous) with awns strongly recurved (vs. straight or slightly curved).

3. **Elymus caianus** S. L. Chen & G. Zhu, nom. nov. Replaced synonym: *Roegneria gracilis* L. B. Cai, Acta Phytotax. Sin. 34: 328–330, fig. 1(9–15). 1996, non Philippi, Linnaea 33: 301. 1865. TYPE: China. Xizang [Tibet]: Gongbogyamda, along bank of river, alt. 3970 m, 21 Sep. 1988, *J. L. Yang et al. 880788* (holotype, SAUTI).

A new name for this species is proposed here because the epithet "*gracilis*" is not available for use in the genus *Elymus*. It is named in honor of Lianbing Cai, who first described this species. *Elymus caianus* was compared with *E. puberulus* (Keng) Á. Löve in its protologue. However, little similarity can be found between these two species. *Elymus caianus* is readily distinguishable from the sparsely tufted *E. puberulus* by its single-culmed habit. In addition, *E. caianus* has spikelets purple with 3 or 4 florets each and the lower glume much less than half as long as the lemma, whereas *E. puberulus* has spikelets green with 2 or 3 florets each and the lower glume about half as long as the lemma. *Elymus caianus* is similar to *E. hongyuanensis* L. B. Cai in the above characters, but differs in having spikes more or less pendulous, palea spiny but glabrous between the keels, and anthers yellow.

4. Elymus cheniae (L. B. Cai) G. Zhu, comb. nov. Basionym: *Roegneria cheniae* L. B. Cai, Acta Phytotax. 34: 333, fig. 3(10–18). 1996. TYPE: China. Xinjiang: Zhaosu, alt. 2300 m, 3 Aug. 1978, *K. Tuo 780875* (holotype, XJBI).

Although without an explicit indication, *Roegneria cheniae* was originally named in honor of Shouliang Chen. *Elymus cheniae* was compared with *E. sylvaticus* (Keng & S. L. Chen) S. L. Chen in the protologue. However, these two species share little similarity except that their glumes are relatively narrow for the genus, and the lower glume is more than half as long as the lemma. These characters are shared by many other species in the genus. *Elymus sylvaticus* is easily distinguished from the former as a much larger plant with shortly awned glumes. *Elymus cheniae* is similar to *E. magnicaespes* (D. F. Cui) L. B. Cai in having spikes narrow, 5–13 cm long, glumes narrow and awnless, and lemma blunt or slightly mucronate at the apex, but differs in having 2–4 florets per spikelet vs. 4–6 in *E. magnicaespes.*

5. Elymus curtiaristatus (L. B. Cai) S. L. Chen & G. Zhu, comb. nov. Basionym: *Roegneria curtiaristata* L. B. Cai, Guihaia 16: 200, fig. 1(10–15). 1996. TYPE: China. Xizang [Tibet]: Changdu, Xishan, alt. 3400 m, 22 Aug. 1973, *Exped. Xizang 1988* (holotype, HNWP).

Elymus curtiaristatus is compared in its protologue with *E. alashanicus* (Keng) S. L. Chen, as both have lower glumes half as long as the lemma. However, *E. curtiaristatus* is easily distinguishable by the awn of the lemma, whereas *E. alashanicus* has lemmas nearly awnless. *Elymus curtiaristatus* is closer to *E. calcicola* Keng in having spikes erect, glumes submuticate, lower glume half as long as the lemma, lemmas with conspicuous awns, and spikelets nearly sessile. *Elymus curtiaristatus* differs in having lemmas with awns erect and short (5–10 mm long) and culms 3-noded, whereas *E. alashanicus* has lemmas with awns strongly recurved and long (15–28 mm long) and culms often 5-noded.

6. Elymus debilis (L. B. Cai) S. L. Chen & G. Zhu, comb. nov. Basionym: *Roegneria debilis* L. B. Cai, Acta Phytotax. Sin. 34: 327, fig. 1(1–8). 1996. TYPE: China. Gansu: Sunan, in forest, alt. 2350 m, 29 July 1991, *T. N. He 2939* (holotype, HNWP).

Elymus debilis is only remotely similar to *E. calcicolus* (Keng) Á. Löve, with which it is compared in the protologue, in the slender appearance of the culms. *Elymus calcicolus* is a much larger plant (ca. 1 m tall), with spikes 12–20 cm long, whereas *E. debilis* is smaller (up to 60 cm tall) with spikes 9–11 cm long. *Elymus debilis* is closest to *E. schrenkianus* (Fischer & C. A. Meyer) Tzvelev in having glumes shortly aristate, less than half as long as the lemma, and lemma awns mostly straight or only slightly curved. *Elymus debilis* differs from *E. schrenkianus* in having culms slender with 5–7 nodes (vs. robust with 1–3 nodes), lemma 7–10 mm long (vs. 15–25 mm long), and palea longer than lemma (vs. as long as lemma).

7. Elymus gmelinii (Ledebour) Tzvelev var. **macrantherus** (Ohwi) S. L. Chen & G. Zhu, comb. nov. Basionym: *Agropyron turczaninovii* Drobow var. *macrantherum* Ohwi, Acta Phytotax. Geobot. 10: 98. 1941. TYPE: China. "Mongolia interior [Nei Mongol] boreali-orientalis (Kochito Orientalis)," *I. Hirayoshi 10277* (holotype, KYO).

Agropyron turczaninovii is regarded as a synonym of *Elymus gmelinii.* The latter species is characterized by having erect spikes, lemma awns divergent, palea nearly as long as the lemma, and anthers very short. Variety *macrantherus* differs from variety *gmelinii* in having much taller culms (up to 100 cm tall), longer spikes (5–25 cm long), broader glumes, and lemma awns 10–14 mm long.

8. Elymus hongyuanensis (L. B. Cai) S. L. Chen & G. Zhu, comb. nov. Basionym: *Roegneria hongyuanensis* L. B. Cai, Acta Phytotax. Sin. 35: 157, pl. 1, figs. 1–9. 1997. TYPE: China. Sichuan: Hongyuan, in meadow, alt. 3400 m, 23 Sep. 1979, *W. Z. Xie 005* (holotype, HNWP).

Elymus hongyuanensis is similar to *E. caianus* in having glumes awnless, lower glume less than half as long as the lemma, and lemma awns straight and long, but differs in having spikes arching, palea spiculose between the keels, and anthers black-yellow.

9. Elymus kamoji (Ohwi) S. L. Chen var. **macerrimus** G. Zhu, var. nov. *Roegneria kamoji* Ohwi var. *macerrima* Keng, in Keng & S. L. Chen, J. Nanjing Univ. (Biol.) 3: 17. 1963, nom. inval. (Art. 43.1). *Roegneria kamoji* subsp. *macerrima* (Keng) N. R. Cui, Claves Pl. Xinjiang. 1: 153. 1982, comb. inval. TYPE: China. Guangxi: "Hsing-an [Xing'an], along Li-Kiang [Lijiang]," 15 July 1937, *H. Fung 21054* (holotype, N).

Elymus kamoji var. *macerrimus* is validated by reference to the diagnosis of *Roegneria kamoji* var. *macerrima*. The latter is an invalid name under Article 43.1 of the ICBN (Greuter et al., 2000) because *R. kamoji* is itself invalid under Article 34.1(c), having been published merely as a synonym in the protologue of *Agropyron kamoji* Ohwi (Ohwi, 1942: 179). Several authors have mistakenly regarded *R. kamoji* as a valid name (Keng, 1959; Cui, 1982; Yang, 1987; Chen et al., 1987). Chen (in Chen et al., 1987) published the new combination *Elymus kamoji*, citing *R. kamoji* as the basionym with a full reference to its author and place of publication. This can be regarded as a bibliographic error of citation for *A. kamoji* under Article 33.4, and it does not invalidate the publication of the new combination.

Elymus kamoji is characterized by having lower glumes conspicuously shorter than the lemma, both glumes and lemma with broad, membranous margins, palea keels conspicuously winged, and lemma not ciliate. Variety *macerrimus* differs from variety *kamoji* in having leaf blades often recurved and ca. 2 mm wide (vs. 3–13 mm wide), spikes pale green or grassy yellow (vs. green tinged with purple) and 2–6 cm long (vs. 7–20 cm long), and spikelets with 2–5 (vs. 3–10) florets each.

10. Elymus laxinodis (L. B. Cai) S. L. Chen & G. Zhu, comb. nov. Basionym: *Roegneria laxinodis* L. B. Cai, Guihaia 16: 199, fig. 1(1–9). 1996. TYPE: China. Sichuan: Kangding, on mountain slopes, alt. 3700 m, 18 Sep. 1973, *Exped. Xizang 2599* (holotype, HNWP).

Elymus laxinodis is similar to *E. parviglumis* (Keng) Á. Löve in having awnless glumes conspicuously shorter than the lemma and lemma sparsely hirtellous with awns longer than the lemma body. *Elymus laxinodis* differs from *E. parviglumis* in having spikelets each with 2–5 (vs. 5–9) florets, the palea conspicuously shorter than the lemma (vs. nearly as long as the lemma), and the glumes 2- or 3-veined (vs. 3–5-veined).

11. Elymus magnipodus (L. B. Cai) S. L. Chen & G. Zhu, comb. nov. Basionym: *Roegneria magnipoda* L. B. Cai, Acta Phytotax. Sin. 35: 164, pl. 1, figs. 18–26. 1997. TYPE: China. Qinghai: Golmud, in gravelly places along river banks, alt. 3160 m, 19 June 1963, *Exped. Abandoned Land 001* (holotype, HNWP).

Elymus magnipodus is similar to *E. puberulus* (Keng) Á. Löve, but differs in having scapes slender, spikelets sessile, glumes submuticate, and lemma aristate, with awns straight or slightly curved. *Elymus magnipodus* differs from *E. puberulus* in having leaf blades recurved (vs. not recurved), spikes erect (vs. nodding or recurved), spikelets each with 6–8 (vs. 2–3) florets, and lemma awns about as long as (vs. twice as long as) lemma body.

12. Elymus serpentinus (L. B. Cai) S. L. Chen & G. Zhu, comb. nov. Basionym: *Roegneria serpentina* L. B. Cai, Acta Phytotax. Sin. 35: 167, pl. 2, figs. 1–9. 1997. TYPE: China. Hebei: Yuxian, along bank of river, alt. 2010 m, 10 July 1957, *Exped. Shanxi 10147* (holotype, HNWP).

Elymus serpentinus is similar to *E. serotinus* (Keng) Á. Löve in having lax, narrow spikes, oblong-lanceolate glumes, the lower glume aristate, and lemma with a strongly recurved awn. However, *E. serpentinus* differs from *E. serotinus* in having leaf blades sparsely pilose on the adaxial surface, glumes dentate on at least one side, the upper glume also aristate, the lemma glabrous on the abaxial surface, with an awn 14–18 mm long, and the palea much shorter than the lemma. *Elymus serpentinus* is also similar to *E. sinoflexuosus* S. L. Chen & G. Zhu in spike appearance and the shapes of the lemma and glumes, but both glumes are aristate in the former species and never dentate in the latter.

13. Elymus shouliangiae (L. B. Cai) G. Zhu, comb. nov. Basionym: *Roegneria shouliangiae* L. B. Cai, Acta Phytotax. Sin. 35: 161, pl. 1, figs. 10–17. 1997. TYPE: China. Xizang [Tibet]: Gyirong, river banks, alt. 2800 m, 6 July 1975, *C. Y. Wu et al. 678* (holotype, PE).

Roegneria shouliangiae was named in honor of Chen Shouliang. *Elymus shouliangiae* is similar to *E. brevipes* (Keng) Á. Löve in having spikelets subsessile, loosely arranged on the spike, glumes awnless, lanceolate or oblong-lanceolate, and lemma awns recurved. *Elymus shouliangiae* differs from *E. brevipes* in having much longer spikelets (2.6–3.2 cm long), more florets (8–10) in each spikelet, much longer glumes (7–9 mm long), the upper glume shortly aristate, and anthers brown, 4–5 mm long.

14. Elymus sinicus (Keng) S. L. Chen var. **medius** (Keng) S. L. Chen & G. Zhu, comb. nov. Basionym: *Roegneria sinica* var. *media* Keng, in Keng & S. L. Chen, J. Nanjing. Univ. (Biol.) 1: 35. 1963. TYPE: China. Shanxi: Mt. Wutai, roadside, alt. 3500–4000 m, 11 July 1929, *T. Tang 1045* (holotype, PE).

Elymus sinicus is characterized by having culms with 2 or 3 nodes, spikelets each with 4 or 5 florets, the lower glume only slightly shorter than the lemma, and the lemma sparsely pubescent, with the awn much longer than the lemma body. Variety *medius* differs from variety *sinicus* in having leaf blades up to 7 mm wide (vs. 3–4 mm wide) and glumes shortly aristate with awns 1–3 mm long (vs. 1–1.8 cm long).

15. Elymus sinoflexuosus S. L. Chen & G. Zhu, nom. nov. Replaced synonym: *Roegneria flexuosa* L. B. Cai, Acta Phytotax. Sin. 34: 330, fig. 2(1–9). 1996, non Tausch, Flora 20: 120. 1837. TYPE: China. Gansu: Zhangye, on mountain slope, alt. 1750 m, 1 Aug. 1957, *X. Z. Zhang 203* (holotype, WUK).

A new name for this species is proposed here because the epithet "*flexuosus*" is not available for use in *Elymus*. The species is similar to *E. serotinus* (Keng) Á. Löve in having lax, narrow spikes, oblong-lanceolate glumes, and the lemma with a strongly recurved awn. However, *E. sinoflexuosus* differs from *E. serotinus* in having glabrous leaf sheaths and glumes, glumes with 5–7 veins, the lower glume aristate, and the palea glabrous between the keels.

16. Elymus strictus (Keng) Á. Löve var. **crassus** (L. B. Cai) S. L. Chen & G. Zhu, comb. et stat. nov. Basionym: *Roegneria crassa* L. B. Cai, Acta Phytotax. Sin. 34: 332, fig. 2(10–16). 1996. TYPE: China. Ningxia: Yanchi, on mountain slope, alt. 1800 m, 21 July 1977, *Z. Y. Zhang & H. J. Wang 140* (holotype, WUK).

Variety *strictus* is characterized by having lemmas glabrous in the middle of the abaxial surface, more or less puberulous elsewhere, and paleas puberulous between the upper keels. Variety *crassus* differs from variety *strictus* in having lemmas abaxially glabrous or hirsute along the veins, the callus hirsute, and paleas glabrous between the keels.

17. Elymus trichospicula (L. B. Cai) S. L. Chen & G. Zhu, comb. nov. Basionym: *Roegneria trichospicula* L. B. Cai, Bull. Bot. Res., Harbin 14: 340, fig. 2. 1994. TYPE: China. Qinghai: Yushu, near forest, alt. 3500 m, 17 Aug. 1981, *Z. D. Wei 22414* (holotype, NWBI).

Elymus trichospicula is characterized by having glumes awnless with 3 keels, the lower glume about half as long as the lemma, and the lemma densely villous with an awn 6–12 mm long. In the protologue, *E. trichospicula* was compared with *E. sinicus* (Keng) S. L. Chen, but the latter has a much larger lower glume, which is much more than half as long as the lemma and can be easily distinguished. *Elymus trichospicula* is similar to *E. dolichaterum* (Keng) Á. Löve and *E. leiotropis* (Keng) Á. Löve in the above characters, but the latter two species have lemmas with much longer awns (15–40 cm long) and glumes with 3–5 keels.

18. Elymus yushuensis (L. B. Cai) S. L. Chen & G. Zhu, comb. nov. Basionym: *Roegneria yushuensis* L. B. Cai, Bull. Bot. Res., Harbin 14: 338, fig. 1. 1994. TYPE: China. Qinghai: Yushu, along roadside, alt. 3750 m, 24 Aug. 1980, *Z. D. Wei 22105* (holotype, NWBI).

Elymus yushuensis and *E. alashanicus* (Keng) S. L. Chen are similar and distinctive in the genus in having spikes short (5–11 cm long), narrow, and lax, glumes lanceolate or oblong-lanceolate, nearly awnless, and lemmas slightly mucronate. *Elymus yushuensis* differs from *E. alashanicus* in having spikes pendent (vs. erect), purple (vs. pale yellow), and hirsute (vs. glabrous).

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A New Species of *Oxytropis* (Leguminosae) from Xizang (Tibet) in China

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ABSTRACT. A new species of *Oxytropis* (Leguminosae) from Xizang (Tibet) in China, *O. qamdoensis* X. Y. Zhu, Y. F. Du & H. Ohashi, is described and illustrated. The new species is very similar to *O. ochrantha* (sect. *Baicalia* Steller ex Bunge) and shares with it verticillate and opposite leaflets and glandular hairs, but differs in having leaflets with 9–11 whorls per leaf, the standard bilobed at the apex, wings emarginate at the apex, the beak of the keel-petals 1.0–1.5 mm long, and pods with white-tinged hairs.

Key words: China, Leguminosae, *Oxytropis*.

Oxytropis DC., a genus belonging to the tribe Galegeae of Papilionoideae in the Leguminosae, comprises about 300 species occurring in cold mountainous regions of Europe, Asia, and North America, and is most numerous in Central Asia (Polhill, 1981). Bunge (1874) classified 181 species of *Oxytropis* into 4 subgenera and 19 sections. For Chinese *Oxytropis*, 125 species, 4 varieties, and 4 forms were grouped into 3 subgenera and 20 sections (Zhu & Ohashi, 2000). Section *Baicalia* Steller ex Bunge now contains 16 species (including the one described here), which are a part of 119 species in the subgenus *Oxytropis* in China. The section can be distinguished from the other sections by having verticillate and opposite leaflets and plants with glands (Zhu & Ohashi, 2000).

Oxytropis qamdoensis X. Y. Zhu, Y. F. Du & H. Ohashi, sp. nov. TYPE: China. Xizang (Tibet): Qamdo Xian, Karuo Zhen, Karuo Village, Jimu Shan, within shrubs on dry and stony slope, 3215–3250 m, 16 Aug. 2000, *X. Y. Zhu & Y. F. Du 20074* (holotype, PE; isotypes, PE, TUS). Figure 1.

Haec species ab *O. ochrantha* foliolis 9–11 verticillis, vexillo bilobo ad apicem, alis emarginatis ad apicem, rostris carinae 1.0–1.5 mm longis, legumine albo-pubescenti differt.

Acaulescent perennial herb, 7–20 cm tall. Leaves with white hairs, 5–8 cm long; leaflets verticillate, or opposite at the upper part of leaf axis, acuminate or acute at apex, 9 to 11 whorls per leaf, 4(6) per whorl, ovate or oblong-ovate, with white hairs on both surfaces, 4–7 mm long, 1.5–5.0 mm wide, young leaflets with densely gray-white hairs; stipules with white hairs, herbaceous, narrowly triangular, 3.5–8.8 mm long, 2.0–3.0 mm wide, connate with petiole at base. Racemes 5–13.5 cm long, longer than leaves at fruiting time, shorter than leaves at flowering time; bracts with white hairs, ovate, 4.5–7.5 mm long, 2.0–3.0 mm wide. Calyx with white hairs, campanulate, 10–12 mm long, 5-lobed, lobes lanceolate, 4.0–6.0 mm long, ca. 0.1 mm wide, tube ca. 6.0 mm long. Corolla white; standard broadly obovate, 16–19 mm long, 6.0–7.0 mm wide, bilobed at apex; lamina narrowed to base; wings clawed, lamina obovate, ca. 8 mm long, ca. 3 mm wide, emarginate at apex, tapering to a claw, claw ca. 7 mm long, ca. 0.5 mm wide, auriculate at base, auricle ca. 3 mm long, ca. 1.5 mm wide; keel-petals clawed, 11.5–17 mm long, lamina oblong, 4.5–8.0 mm long, 2.5–3.0 mm wide, claw 7.0–9.0 mm long, ca. 1.0 mm wide, auriculate at base, auricle 1–1.5 mm long, 1–1.5 mm wide, beak 1.0–1.5 mm long. Androecia diadelphous, ca. 11 mm long. Ovary pubescent, tubular, ca. 3 mm long, ca. 0.5 mm wide, style incurved, ca. 7.5 mm long. Pods with white hairs, ovoid, membranous, ca. 16.0 mm long, ca. 7.0 mm wide, with beak at the top of pod, ca. 6.5 mm long, seeds cordiform, 1.78–2.20 mm long, 1.50–1.68 mm wide. Flowering and fruiting July–August.

Distribution. Known only from Qamdo Xian, with shrubs on dry and stony slopes, Xizang, China; 3215–3250 m.

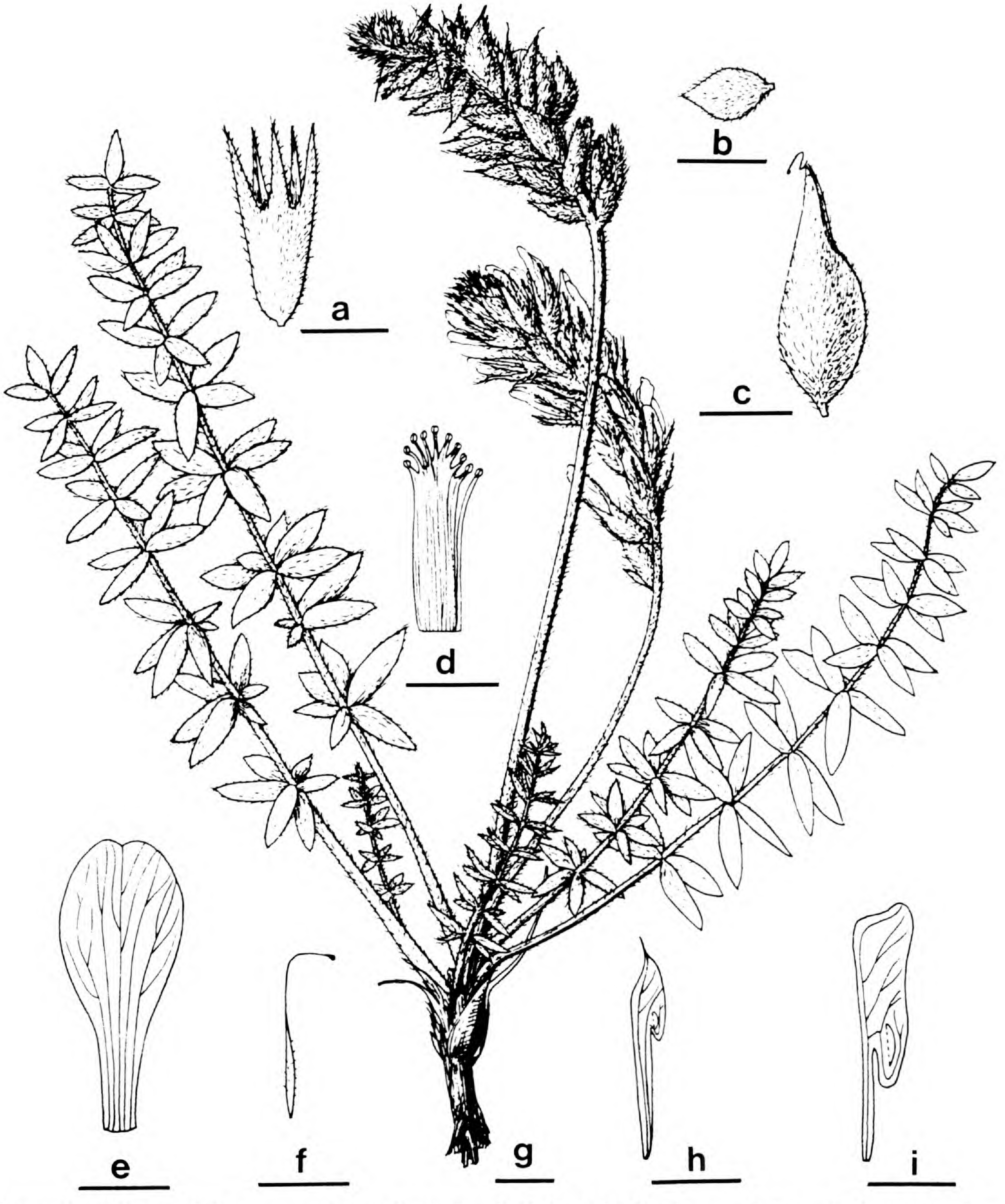

Figure 1. Holotype of *Oxytropis qamdoensis* X. Y. Zhu, Y. F. Du & H. Ohashi. —a. Calyx. —b. Bract (view from outside). —c. Pod. —d. Androecium (view from outside). —e. Standard (view from inside). —f. Gynoecium. —g. Whole of the type specimen. —h. Keel-petal (view from outside). —i. Wing (view from inside). Scale bars = 5 mm in a–f, h, i; 10 mm in g. Drawn from the holotype, *X. Y. Zhu & Y. F. Du 20074*.

Oxytropis qamdoensis differs from *O. ochrantha* by leaflets with 9–11 whorls per leaf (vs. 13–19 whorls per leaf), standard bilobed at apex (vs. rounded at apex), wings emarginate at apex (vs. rounded at apex), beak of keel-petals 1.0–1.5 mm long (vs. 1.5–2.0 mm long), and pods with white-tinged hairs (vs. yellow hairs); it is distinguished from *O. ochrolongibracteata* by plants small, less than 0.2 m tall (vs. more than 0.4 m tall), flowers white (vs. yellow), and most leaflets verticillate (vs. opposite). This species is also different from *O. bicolor* in having white flowers (vs. blue-purple or pale yellow), calyx lobes as long as its tube (vs. shorter), and pods membranous (vs. coriaceous).

The key to *Oxytropis qamdoensis* and related species is given below.

Main Differences between *Oxytropis qamdoensis* and Its Close Relatives

1a. Stipules membranous; pods coriaceous . . *O. bicolor*

1b. Stipules herbaceous; pods membranous.

2a. Plants large, more than 0.4 m tall; most leaflets opposite . . . . *O. ochrolongibracteata*

2b. Plants small, less than 0.2 m tall; most leaflets verticillate.

3a. Leaflets 13–19 whorls per leaf; standard rounded at apex; wings rounded at apex; beak of keel-petals 1.5–2.0 mm long; pods with yellow hairs . . . . *O. ochrantha*

3b. Leaflets 9–11 whorls per leaf; standard bilobed at apex; wings emarginate at apex; beak of keel-petals 1.0–1.5 mm long; pods with white hairs . . . . *O. qamdoensis*

In August of 2000, Zhu and Du traveled to Xizang and collected this new species. Its population occupied a small place with more or less 20 individuals, which were growing among shrubs on dry and stony slopes between 3215 and 3250 m and distributed in Qamdo Xian of Xizang. Its distribution in Xizang represents the western limit for this section within China. The species should be protected because of its small population and locality close to a village.

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Diplopanax vietnamensis, a New Species of Nyssaceae from Vietnam—One More Living Representative of the Tertiary Flora of Eurasia

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ABSTRACT. A new species of *Diplopanax*, *D. vietnamensis* (Nyssaceae, Cornaceae s.l.), was discovered in the mountains of southern Vietnam. It differs from the single known species, *Diplopanax stachyanthus*, by short, simple, densely pubescent inflorescences and large yellow-white flowers with five prominent bosses on the flower disc. This genus (with two species, *D. stachyanthus* and *D. vietnamensis*) is now regarded as congeneric with *Mastixicarpum*, representatives of which were an integral component of the *Mastixia*-like paratropical broad-leaved evergreen vegetation that covered much of the Northern Hemisphere from the uppermost Cretaceous to the late Miocene, about 65 to 7 million years ago.

Key words: *Diplopanax*, Nyssaceae, Tertiary flora of Eurasia, Vietnam.

The montane flora within the eastern part of the Indochinese Peninsula is still relatively unknown. Without a doubt it is diverse and conceals a great number of exciting discoveries. Floristically, the highland forests of this area represent relictual remnants of a primitive, tropical flora that occupied wide tropical and subtropical areas of Europe, Asia, and North America during the early Tertiary, approximately 40–70 million years ago (Axelrod et al., 1998; Kubitzki & Krutzsch, 1998; Zhang & Lu, 1998). Due to subsequent climate cooling and increased aridity, the European and North Asian representatives of this highland tropical flora and its corresponding climatic zone have disappeared almost completely. Small relictual and depauperate elements of it can still be found in Portugal, the Colchis, and in a few other orographically favored continental regions. The largest remaining humid warm Tertiary flora was shifted to Southeast Asia.

One of the richest assemblages of ancient, tropical Tertiary taxa may now be observed in highland tropical areas of Southeast Asia. Primary mountain forests of this region include a surprisingly large proportion of archaic genera well represented in the fossil record of the Upper Cretaceous and Lower Tertiary recorded from Europe, East Asia, and North America (Kubitzki & Krutzsch, 1998; Martinetto, 1998). Among them are numerous Actinidiaceae, Annonaceae, Berberidaceae, Chloranthaceae, Daphniphyllaceae, Fagaceae, Hamamelidaceae, Juglandaceae, Lardizabalaceae, Lauraceae, Magnoliaceae, Menispermaceae, Nyssaceae, Pentaphylacaceae, Platanaceae, Ranunculaceae, Rhoipteleaceae, Sabiaceae, Saururaceae, Theaceae, as well as a number of gymnosperm genera such as *Amentotaxus* Pilger (Cephalotaxaceae), *Cephalotaxus* Siebold & Zuccarini ex Endlicher (Cephalotaxaceae), *Glyptostrobus* Endlicher (Taxodiaceae), *Keteleeria* Carrière (Pinaceae), *Pseudolarix* Gordon (Pinaceae), and a great number of others (Axelrod et al., 1998; Martinetto, 1998; Nguyen, 1998; Nguyen & Nguyen, 1998; Wu

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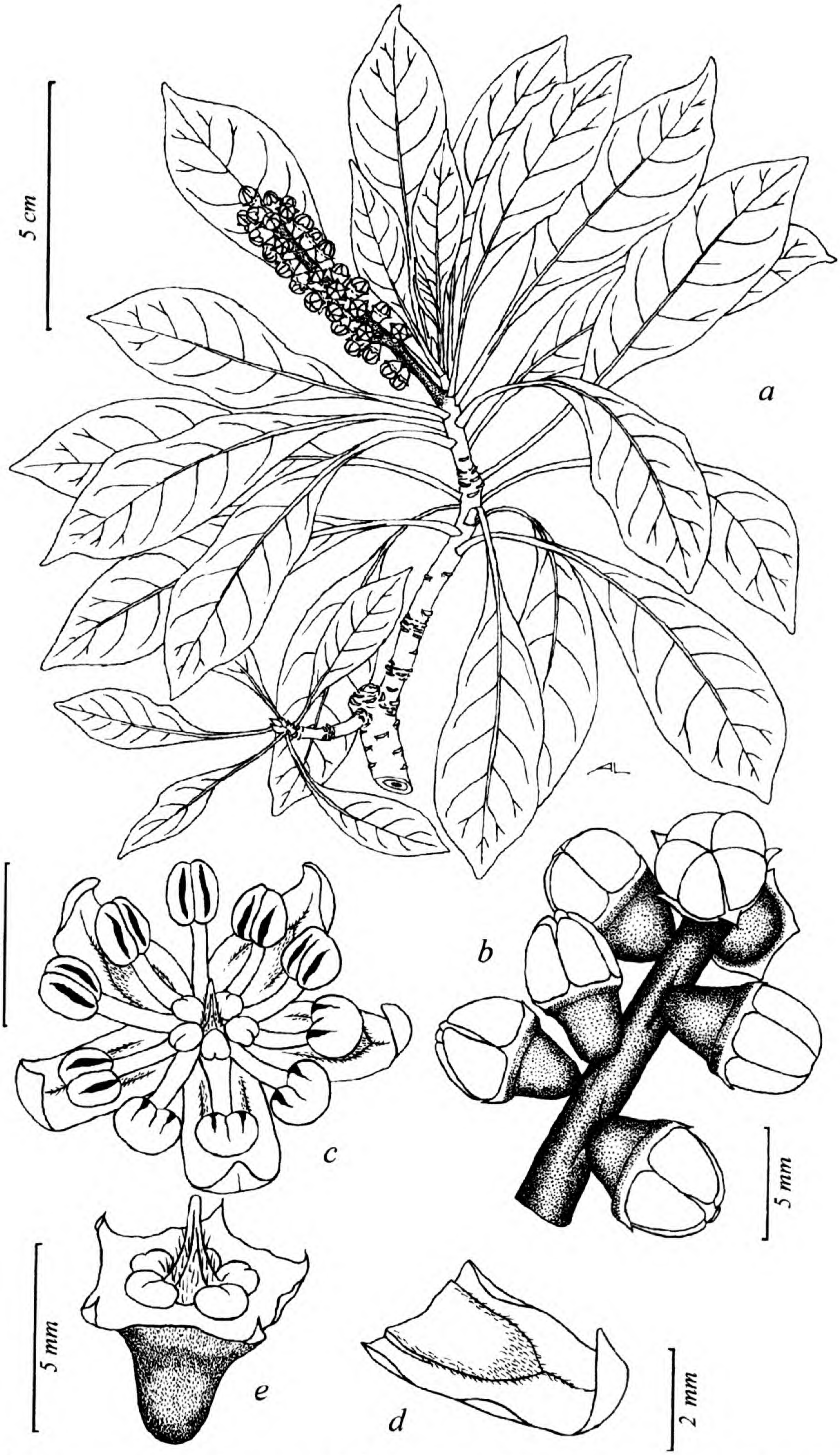

Figure 1. *Diplopanax vietnamensis* Averyanov & T. H. Nguyen. —*a*. Flowering leafy branchlet. —*b*. Portion of inflorescence with mature flower buds just before opening. —*c*. Open flower. —*d*. Adaxial surface of petal. —*e*. Calyx, style, and bosses on the disc. (All drawn from an isotype, *L. Averyanov & T. H. Nguyen VH 596*, LE.)

& Wu, 1998). These plants were widely distributed in the Northern Hemisphere during the Eocene and Miocene. Most of these plants from these areas existed during the past 5–10 million years including such famous "living fossils" as *Cathaya* Chun & Kuang (Pinaceae), *Metasequoia* Miki ex Hu & W. C. Cheng (Taxodiaceae), and *Pseudolarix* Gordon (Pinaceae) (Axelrod et al., 1998). Species of the genus *Diplopanax* Handel-Mazzetti are typical representatives of this flora.

Diplopanax (with a single species, *D. stachyanthus* Handel-Mazzetti) was described in 1933 from southern China and was initially placed in the Araliaceae (Handel-Mazzetti, 1933). Later, based on the study of fruit structure, it was suggested that the genus has affinities with *Mastixia* (Nyssaceae) and especially with some fossil Mastixiaceae (Hoo & Tseng, 1978; Tseng, 1983). Comparison of extant *Diplopanax* fruit pyrenes and fossil fruit remnants of Miocene species of *Mastixicarpum* M. E. J. Chandler gave evidence that the two genera may be congeneric (Eyde & Xiang, 1990). It is remarkable that species of *Mastixicarpum* were widespread and integral components of Tertiary European floras especially during the Miocene. Fruits of these plants are the most common fossils in lignite beds of Europe from the uppermost Cretaceous to the late Miocene, roughly 65 to 7 million years ago (Eyde & Xiang, 1990).

Woody fruits of *Diplopanax* and *Mastixicarpum* have a certain similarity and obviously represent the same woody-fruited evolutionary line in the family Nyssaceae (Cornaceae s.l.). It was long supposed that this line of woody-fruited relatives had died out in the later Miocene about 5–10 million years ago (Eyde & Xiang, 1990). With the description of the new species, at least two modern species still exist in Southeast Asia. The second extant species, *Diplopanax vietnamensis*, was recently discovered in southern Vietnam (Kon Tum Province). It was observed as an occasional co-dominant of the first forest stratum in primary, wet, evergreen, broad-leaved tropical mountain forests. Other common trees in these forests are also relictual genera of Tertiary age from such families as Betulaceae, Fagaceae, Hamamelidaceae, Lauraceae, Magnoliaceae, and Sabiaceae. This unique region represents a model for the study of the flora, vegetation, and climate reconstructions from now-extinct Northern Hemisphere forest floras of Tertiary age (Martinetto, 1998). This area in Southeast Asia may be the birthplace and cradle of the Holarctic and even Paleotropic flora (Wu & Wu, 1998).

According to available data, *Diplopanax* includes two extant and four extinct species. Distribution of extant species comprises southern China and Vietnam. *Diplopanax stachyanthus* is the type species of the genus. The following dichotomous key is provided for the identification of *Diplopanax* species.

KEY TO THE MODERN SPECIES OF *DIPLOPANAX*

1a. Tree, about 8–12(15) m tall; inflorescence a raceme or panicle branched at the base, 15–30 cm long; rachis of inflorescence glabrous or sparsely pubescent in basal portion; mature flower buds before opening about 3 mm wide; flowers egg-yellow, about 8 mm diam.; disc of the flower without prominent bosses and ± smooth; style glabrous . . . . 1. *D. stachyanthus*

1b. Tree, 15–25 m tall; inflorescence not a branched spike, 5–8 cm long; rachis of inflorescence densely pubescent in basal portion; mature flower buds before opening 4–5 mm wide; flowers yellow-white, about 10–12 mm diam.; disc of the flower with 5 prominent bilobed bosses surrounding the base of the style; style sparsely pubescent . . . . 2. *D. vietnamensis*

1. **Diplopanax stachyanthus** Handel-Mazzetti, Sinensia 3(8): 197–198. 1933. TYPE: China. Guangxi: Kwangsi, N. Luchen, Miu-shan, Binlong, 1200 m, 14 June 1928, *R. C. Ching 5969* (holotype, LU; isotype, NY).

This species is distributed in southern China (Provinces Hunan, Guangdong, Yunnan, and Guangxi Zhuang Autonomous Region) and northern Vietnam (Provinces Cao Bang and Vinh Phuc). *Diplopanax stachyanthus* grows in wet evergreen broad-leaved montane primary and open secondary forests and shrubs, wood sides, at elevations of 900–1600 m on soils developed predominantly on silicate sands, clay, granite, and rhyolites. It flowers in April–June.

Specimens examined. CHINA. **Kwangsi:** Shap Man Taai Shan, near Iu Shan village, SE Shang-sze, Kwangtung Border (Shang-sze District), 23 May 1933, *W. T. Tsang 22361* (LE). VIETNAM. **Cao Bang Prov.:** Le A pass at elevation 1600 m a.s.l., 24 Nov. 1976, *Khoi, Nhan & Ve 71* (LE). **Vinh Phuc Prov.:** Tam Dao 2, 29 May 1977, *T. B. Nguyen 121* (LE).

2. **Diplopanax vietnamensis** Averyanov & T. H. Nguyen, sp. nov. TYPE: Vietnam. Prov. Kontum: cloud evergreen primary forest on N slope of Ngoc Linh mountain system, 2380 m, 9 Mar. 1995, *L. Averyanov, N. T. Hiep VH 596*[1] (holotype, HN; isotypes, AUU, LE, MO, P). Figure 1.

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[1] Index ***VH*** (abbreviation of words ***Vietnamese Highlands***) is used in the numbering of herbarium collections that were made during fieldwork associated with the U.S. National Geographic Society exploration program "Flora of Highlands of South Viet Nam."

Inflorescentia brevis, simplex (eramosa), spiciformis, 5–8 cm; inflorescentiae rhachis crassa, basi dense pilosa; flores albido-flavides, magni, 10–12 mm in diametro, discus florum cum 5 crassis excrescentiis; stylus disperse pilosus—species nova a *D. stachyantho* (sola antea cognita species generis) dignoscor.

Tree 15–25 m tall. *Branchlets* glabrous, apically with numerous spirally arranged leaves appearing verticillate within shortened internodes of the branch. *Leaves* simple, entire, petioled, coriaceous, bright glossy green and shiny, glabrous. *Petioles* 1.5–3 cm long and 2–3 mm thick. *Leaf blade* narrowly obovate, elliptic or oblong-lanceolate, 8–18 cm long, 3–6 cm wide, base narrowly cuneate, apex shortly attenuate and rounded. *Inflorescences* axillary (usually appearing as subterminal or terminal), spike 5–8 cm long, rachis 3–5 mm thick, densely finely pubescent throughout its length with short appressed white hairs. *Flowers* articulated, sessile, actinomorphic, 5-merous, with 5 free petals, 5 calyx teeth, and 10 stamens, 10–12 mm diam., yellow-white, fragrant. *Calyx* broad, with 5-dentate limb about 6 mm diam.; calyx lobes tooth-like, short, with broad base and acute tip. *Petals* rigid to coriaceous, with inflexed tips in bud and in open flowers, ovate with broad base, narrowed toward the acute apex, about 5 mm long, 2.5–3 mm wide, with prominent broad ovate hairy callus at basal half on adaxial surface. *Stamens* shorter than petals, with thick filaments; anthers with 2 longitudinally dehiscent cells. *Ovary* inferior, 1-celled, broadly obovate, about 4 mm long, densely pubescent outside with fine appressed white hairs. *Style* 1, undivided, conical, with broad pubescent base, narrowing toward punctiform stigma, surrounded at the base with 5 thick bilobed glabrous bosses. *Fruits* drupe-like, about 3–4 cm long, 1.6–2 cm wide, with very hard, durable, woody endocarp of pyrene.

The new species differs from *D. stachyanthus* by its short, simple, spike-like inflorescence 5–8 cm long, a densely pubescent basal portion of the inflorescence rachis, large yellow-white flowers about 10–12 mm in diameter, the presence of 5 prominent bosses on the flower disc, and a sparsely pubescent style. *Diplopanax vietnamensis* is known from the mountainous regions of Kon Tum Province in southern Vietnam, where it grows in wet evergreen broad-leaved montane closed primary forests along ridges and on mountain summits at elevations of 1000–2500 m on soils developed predominantly on silicate sandstones, granite, and gneiss. Sometimes this species was observed as a significant component of the secondary forest stratum. This tree flowers in March–May.

Paratypes. VIETNAM. **Prov. Kontum:** cloud evergreen primary forest on N slope of Ngoc Linh mountain system at 2400–2450 m, 6 Mar. 1995, *L. Averyanov & N. T. Hiep VH 561* (AUU, HN, LE, MO, P); Kon Plong Distr., Hieu Municipality, Mang La forest enterprise (14°39′N, 108°25′E), 15 Apr. 2000, *L. Averyanov, P. K. Loc, P. H. Hoang, D. X. Du & N. T. Vinh VH 5111* (AUU, HN, LE, MO).

Acknowledgments. Field studies in Vietnam, the results of which are presented in this paper, were funded by grants from the U.S. National Geographic Society (grants 5094-93, 5803-96, 6383-98 "Flora of Highlands of South Viet Nam"). We thank D. K. Harder for comments and kind help in improving the English.

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Packera lyallii, a Corrected Name for *Packera contermina* (Asteraceae: Senecioneae)

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ABSTRACT. The new combination *Packera lyallii* (Klatt) J. F. Bain is proposed, based on *Senecio lyallii* Klatt.

Key words: Asteraceae, nomenclature, *Packera*, *Senecio*, Senecioneae.

The segregate genus *Packera* Á. Löve & D. Löve (= the aureoid *Senecio* complex) will be recognized in the upcoming treatment of the Asteraceae for the *Flora of North America* (North of Mexico). This change in treatment has necessitated a number of recent nomenclatural transfers (e.g., Bain, 1999; Trock & Barkley, 1998, 1999). The name change proposed herein is necessitated by a recent change in the rules of nomenclature contained in the *International Code of Botanical Nomenclature (St. Louis Code)* (ICBN) (Greuter et al., 2000).

The publication of the latest ICBN (2000), the St. Louis Code, introduced a new rule (Article 53.6 Note 3, Ex. 20) that states that a rejected homonym "remains legitimate and takes precedence over a later synonym of the same rank should a transfer to another genus (or species) be effected." This change has rendered *Packera contermina*, the recent new combination proposed by Bain (1999), superfluous. The basionym, *Senecio lyallii*, is legitimate in *Packera* according to the new aforementioned rule. Therefore, the following new combination is proposed:

Packera lyallii (Klatt) J. F. Bain, comb. nov. Basionym: *Senecio lyallii* Klatt, Ann. K. K. Naturhist. Hofmus. 9: 365. 1894, not *Senecio lyallii* Hooker f. *Senecio conterminus* Greenman, Ann. Missouri Bot. Gard. 3: 101. 1916. TYPE: Canada. Summit of the Rocky Mountains, 1861, *Dr. Lyall s.n.* (holotype, B? not seen; isotype, GH).

Following the same rule, the taxon commonly treated as *Packera streptanthifolia* (Greene) Weber & Löve (based on *Senecio streptanthifolius* Greene, a name replacing the later homonym *Senecio cymbalarioides* Nuttall) should hereafter be treated as *Packera cymbalarioides* (Nuttall) Weber & Löve, a combination published in 1981.

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Additional Notes on Chinese *Listera* (Orchidaceae)

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ABSTRACT. Two new species from China, *Listera microphylla* S. C. Chen & Y. B. Luo and *L. fangii* Tang & Wang ex S. C. Chen & G. Zhu, are described and illustrated. *Listera megalochila* (S. C. Chen) S. C. Chen & G. Zhu is elevated in status from varietal to species level based on characters of the floral lip. Their affinities with other related species of *Listera* are briefly discussed.

Key words: China, *Listera*, Orchidaceae.

Listera R. Brown is a genus of ca. 35 species, mainly distributed in boreal and temperate regions of the Northern Hemisphere, with a few species extending to Taiwan and Vietnam to the south. The genus is easily distinguishable by the single pair of simple, opposite, leaves with secondary venation reticulate near the middle of the plant and a flower with a bilobed lip that is commonly much larger than the sepals and petals. Twenty-one species and four varieties have been previously reported from China (Chen & Luo, 1999).

In preparing a revised manuscript of this genus for the *Flora of China* (English edition), the specimens preserved in PE have been carefully re-examined, and the following additions and changes are made:

1. **Listera microphylla** S. C. Chen & Y. B. Luo, sp. nov. TYPE: China. NW Yunnan: Gong Shan Co., 2500 m, Oct. 1935, *C. W. Wang 67264* (holotype, PE). Figure 1A, B.

Species nova insignis, *L. mucronatae* subsimilis, a qua bene differt planta parvula 5–11 cm alta, caule aerio brevissimo (6–20 mm longo), foliis multo minoribus 6–8 × 7–9 mm, floribus minoribus.

Terrestrial herb, 5–11 cm tall; rootstock short, with several ± fleshy roots. Aerial stem 6–20 mm long below the single pair of leaves, glabrous. Leaves 2, opposite, sessile, orbicular-ovate, 6–8 × 7–9 mm, obtuse-acute at apex, slightly fleshy, secondary venation densely reticulate, covered with minutely glandular hairs on both sides, the margin nearly entire or slightly undulate. Peduncle 2.6–6 cm long, glabrous, sometimes with a sterile bract in upper part; raceme 1.6–3 cm long, glabrescent or loosely glandular-hairy on rachis, 3- or 4-flowered; bracts subovate or ovate-lanceolate, 3–4 × 2 mm; pedicel 1.5–2 mm long, slender, glabrous; ovary almost as long as the pedicel, glabrous. Flowers greenish white, glabrous; dorsal sepal oblong-ovate, ca. 3.5 × 1.5 mm, 1-nerved, obtuse at apex; lateral sepals lanceolate-ovate, slightly oblique, similar in size to dorsal one, carinate distally; petals similar to dorsal sepal, but a little shorter and narrower; lip obovate-cuneate in outline, ca. 5.2 mm long, 3.5 mm wide in upper part, 1 mm wide near the base, bilobed at apex, with an indistinct keel from the base terminating in a short mucro in the sinus; lobes broadly oblong, ca. 1.4 × 1.6 mm, 3-nerved, the margin nearly entire; column suberect, 1.5–2 mm long; anther ca. 1 mm long. Capsules ellipsoid, erect, ca. 3 mm long, 2.5 mm thick.

Distribution. This species is known only from the type collection at an altitude of 2500 m on a grassy slope.

This species is similar to *Listera mucronata* Panigrahi & J. J. Wood, but differs in having a much shorter stem and much smaller leaves. It is close to *L. brevicaulis* King & Pantling, but differs in having a slightly pubescent scape and small auricles at the base of the lip. *Listera micrantha* may also be close to the newly described species but has a short, trilobed lip and pubescent scape.

2. **Listera fangii** Tang & Wang ex S. C. Chen & G. Zhu, sp. nov. TYPE: China. Sichuan: Guang Xiang [Dujiangyan], 800–1000 m, 14 July 1928, *W. P. Fang 2204* (holotype, PE). Figure 1C, D.

Species *L. nipponicae* affinis, a qua imprimis differt pedunculo et racemo fere usque ad 20 cm longo quam caule multo longiore, labello infra medium unguiculato, auriculis late ovato-deltoideis.

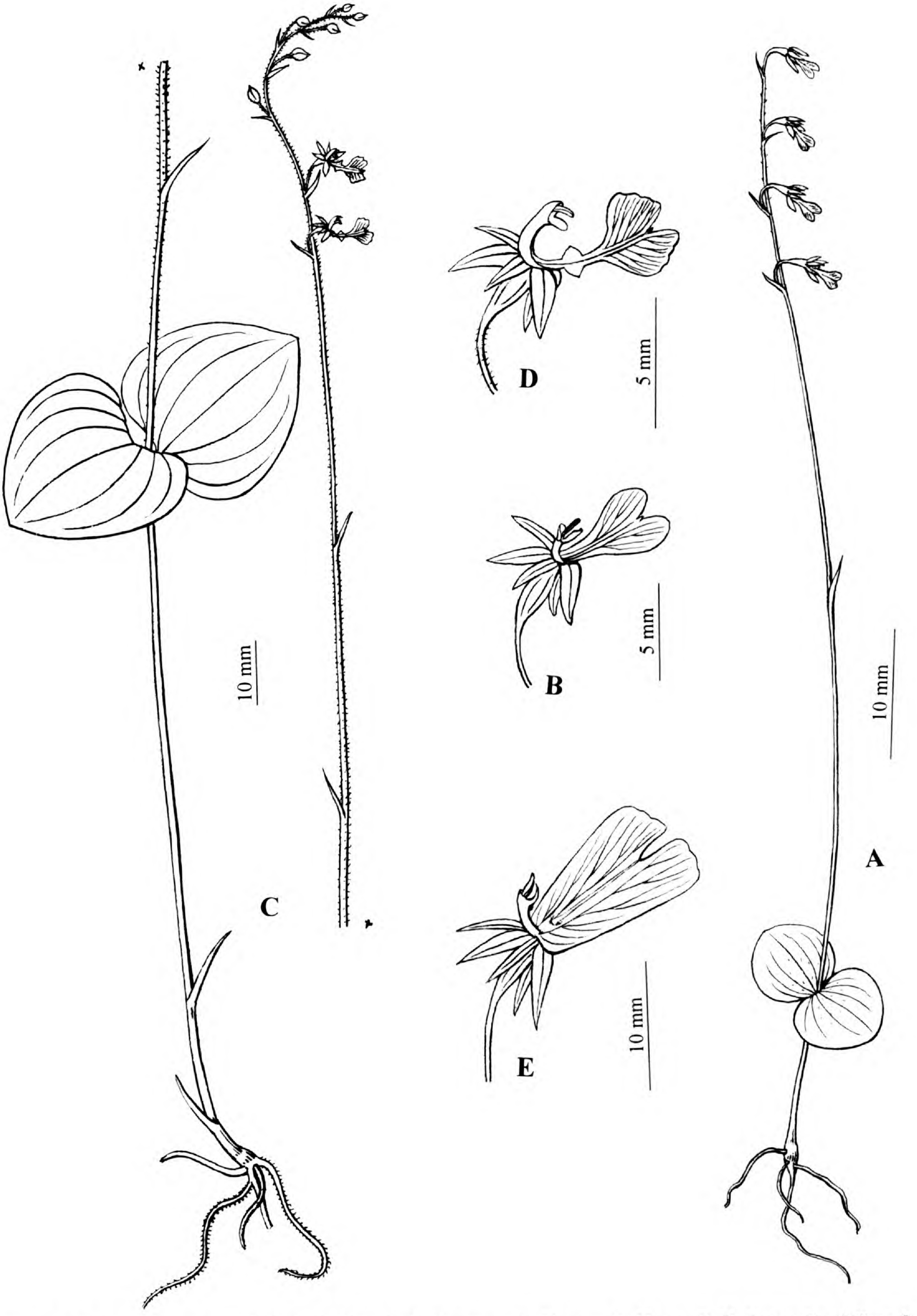

Figure 1. A, B. *Listera microphylla* S. C. Chen & Y. B. Luo. —A. Plant. —B. Flower. C, D. *Listera fangii* Tang & Wang ex S. C. Chen & G. Zhu. —C. Plant. —D. Flower. —E. *Listera megalochila* (S. C. Chen) S. C. Chen & G. Zhu, flower.

Terrestrial herb, ca. 29 cm tall; rootstock short, with several somewhat fleshy roots. Aerial stem 10.5 cm long below the single pair of leaves, glabrous, enclosed in basal part by a tubular sheath over 2 cm long. Leaves 2, opposite, subsessile, ovate-orbicular, 2.4–2.8 × 2.8–3.0 cm, rounded-acute at apex, broadly cuneate-subcordate at base, minutely puberulous on upper surface, entire-margined. Peduncle up to 15.3 cm long, covered with glandular hairs, usually with a sterile bract in lower part; raceme ca. 4.5 cm long (not completely mature), glandular-hairy on rachis, 11-flowered; bracts subovate-oblong, 1.5–2.5 × 0.8 mm, ± glandular-hairy; pedicel 3.5–4.5 mm long, glandular-hairy; ovary ca. 2 mm long, loosely granular-hairy or glabrescent. Flowers glabrous; sepals ovate-oblong, ca. 2 × 0.8 mm, obtuse at apex, 1-nerved, lateral ones slightly oblique; petals similar in outline to dorsal sepal but slightly narrower; lip ca. 5 mm long, below the middle contracted into a claw ca. 2.8 × 0.8 mm, and on either side with a broadly ovate-deltoid auricle ca. 0.8 mm long; the upper part ± fan-shaped, ca. 2 × 3 mm, bilobed deeply to halfway; column suberect, ca. 2 mm long.

Distribution. Known only from the type locality.

This new species is similar to *Listera nipponica* Makino but is easily distinguishable by its unusual floral lip, which is composed of a basal claw and an apical limb, split flower from peduncle, the peduncle elongate and much longer than either aerial stem or raceme, and leaf upper surface minutely puberulous.

3. **Listera megalochila** (S. C. Chen) S. C. Chen & G. Zhu, stat. nov. Basionym: *Listera grandiflora* Rolfe var. *megalochila* S. C. Chen, Acta Phytotax. Sin. 25(6): 473. 1987. TYPE: China. Sichuan: Dajin Xian, 2800 m, 27 June 1958, *X. Li 77925* (holotype, PE). Figure 1E.

Listera megalochila is similar to *L. grandiflora* Rolfe in having large flowers, lips ca. 1.6–1.7 cm long and deeply bifid, sinus entire, and columns 5–7 mm long, and was first published as a variety of the latter species. However, the floral lip obovate-oblong, 5 mm wide at base, more than half of lip width, and presence of a basal V-shaped nectary in *L. megalochila* qualifies its specific status in the genus; in *L. grandiflora* the floral lip is obovate-cuneate, 2–3.5 mm wide at base, less than half of lip width, and without nectar.

Distribution. This species is known from forested slopes in Dajin in Kangding Xian in western Sichuan. It is usually found above 2800 m.

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Miscellaneous Notes on *Sphagnum*—12

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ABSTRACT. Based on unique combinations of characters, five new species, *Sphagnum* [sect. *Sphagnum*] *matogrossense*, *Sphagnum* [sect. *Sphagnum*] *hertelianum*, *Sphagnum* [sect. *Sphagnum*] *trollii*, *Sphagnum* [sect. *Subsecunda*] *uruguayense*, and *Sphagnum* [sect. *Acutifolia*] *amazonense*, are added to the rich *Sphagnum* flora of South America.

Key words: South America, Sphagnaceae, *Sphagnum*.

For many years I have given special attention to the genus *Sphagnum* in South America. I find it frustrating that the genus is so abundantly represented there, particularly in Brazil, and so poorly known. I have taken a cautious approach to the genus in North America, where the flora and its ecological relationships are so well known. The species are not very numerous, and most of them can, in fact, be recognized in the field by aspect and ecological niche. But I have found it necessary to describe many new species from South America, partly because collections are relatively few and partly because I do not know the multiplicity of habitats available to the genus or phytogeographic relationships between the floras. Even in the case of common species, every specimen has to be studied in minute detail before deciding whether it has been described before, and it is not possible to determine the range of variability from the relatively few collections available. The species differ mainly in microscopic structures that may indeed vary with the habitat, but the kind of information given on the labels is virtually meaningless. Even though I consider these five new species (and the many other novelties that I have offered in description) fully justified, further collection and study will be necessary to evaluate them.

Sphagnum [sect. *Sphagnum*] **matogrossense** Crum, sp. nov. TYPE: Brazil. Ponte da Pedra: Matto Grosso, June 1909, *F. C. Hoehne 2147* (holotype, M). Figures 1–6.

Epidermis caulina stratis 3, subtiliter fibrosis vel efibrosis, parietes exteriores cellularum superficialium foramine uno vel duo (raro tres); cylindrus lignosus atro-rufus. Folia caulina ad 1.4 mm longa, ad apicem fibrosa; cellulae hyalinae superficie exteriore lacunis rotundis vel oblongis, interiore lacunis nullis sed aliquando poris parvis in cellularum angulis. Rami duo; cellulae epidermidis subtiliter fibrosae vel efibrosae, poris unis. Folia ramulina ad 3 mm longa; cellulae hyalinae superficie exteriore 1–3 poris in cellularum angulis conjunctis, interiore poris nullis; cellulae chlorophylliferae sectione transversali ellipticae vel fusiformae, utroque latere foliorum liberae.

Pale, tawny plants up to about 6 cm high. Stem cortex 3-layered, the epidermal cells short, delicately fibrillose or not at all, 1–2(–3)-porose; wood cylinder very dark, blackish brown. Stem leaves pale brown, ca. 1.4 mm long, lingulate and rounded at a fringed apex but shortly concave-pointed; hyaline cells undivided, fibrillose on both surfaces toward the apex, sometimes as much as ¼–½ the leaf length, on the outer surface with 3–5 large, rounded, oblong, or irregular gaps, on the inner surface without gaps but occasionally with a small, ringed corner pore. Branches in fascicles of 2 (1 spreading); cells of cortex delicately or not at all fibrillose, with 1 large pore. Branch leaves somewhat spreading, 2.8–3 mm long, broadly ovate-acute, deeply concave; hyaline cells fibrillose on both surfaces, on the outer surface with 1–3 end and corner pores, grouped in threes at adjacent corners, commonly with membrane pleats, on the inner surface with pores none; green cells central and elliptic, exposed on both surfaces but with thickened cell ends.

The plants resemble *Sphagnum ouropretense* C. Müller & Warnstorf in having stems with a very dark, blackish brown wood cylinder, but the stem leaves have hyaline cells fibrillose only toward the apex, branches in fascicles of two, and hyaline cells of branch leaves commonly membrane-pleated.

Sphagnum [sect. *Sphagnum*] **hertelianum** Crum, sp. nov. TYPE: Venezuela. Estado Bolívar: Kweikin-ima Tepuy (= Cerro Guaiquinima), 05°47′N, 63°51′W, 1500–1550 m, blanket bog with scattered rock outcrops and mossy dwarf forest, submerged, 13–15 Feb. 1990, *H. Hertel 36,606* (holotype, M; isotype, MICH). Figures 7–11.

[†] Deceased 30 April 2002. Dr. Crum had essentially completed the manuscript for this article. With help from Steven P. Churchill (MO), Crum's manuscript was lightly edited in June 2002 by Marshall R. Crosby (MO).

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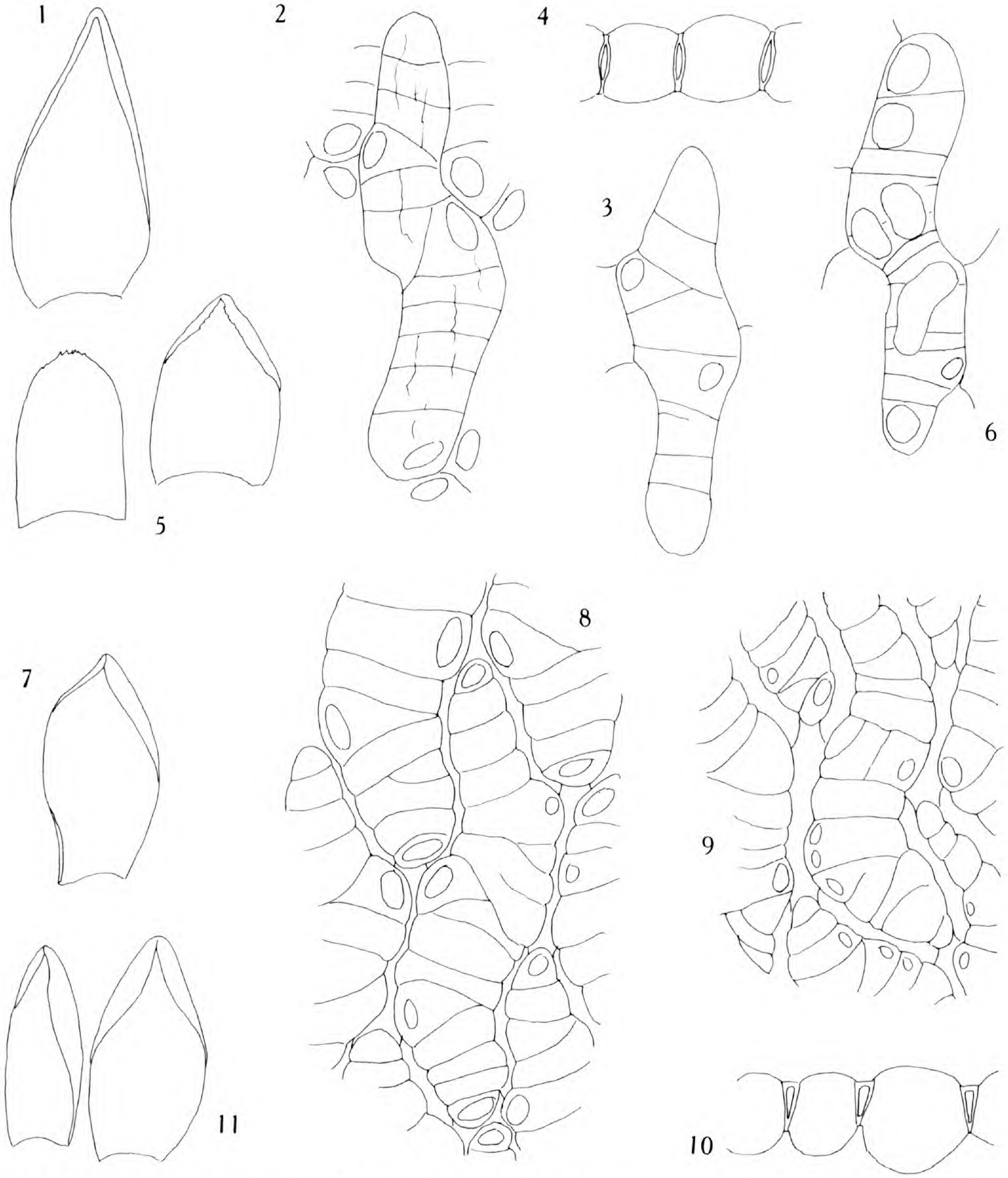


Figures 1–11. *Sphagnum matogrossense* and *S. hirtellianum*. 1–6. *S. matogrossense*. —1. Branch leaf, ×30. —2. Upper cell of branch leaf, outer surface, ×320. —3. Upper cell of branch leaf, inner surface, ×320. —4. Portion of branch leaf in section, ×320. —5. Stem leaves, ×30. —6. Upper cell of stem leaf, outer surface. ×320. 7–11. *Sphagnum hirtellianum*. —7. Branch leaf, ×30. —8. Upper cells of branch leaf, outer surface, ×320. —9. Upper cells of branch leaf, inner surface, ×320. —10. Portion of branch leaf in section, ×320. —11. Stem leaves, ×30.

Plantae parvae, columniformes, pallide incarnato-fuscae. Epidermis caulina et ramulina subtiliter vel haud fibrillosa. Folia caulina et ramulina similia; cellulae hyalinae superficie exteriore poris magnis ternis in angulis conjunctis instructa, interiore poris et pseudoporis parvis commissuralibus numerosis. Rami 2-fasciculati, subaequales. Folia ramulina cellulis chlorophylliferis sectione transversali ± triangulis, superficie interiore expositis.

Small, columnar, pale pinkish brown plants, up to 4 cm high. Stems dark red-brown; cortical cells in 2 layers, short, uniporose, delicately fibrillose or non-fibrillose; wood cylinder blackish brown. Stem leaves 2.5 mm long, oblong-lingulate, concave, broad at the apex but concave-pointed, bordered by a resorption furrow; hyaline cells non-septate, fibrillose throughout, on the outer surface with large, ringed pores in threes at adjacent angles and also singly at side corners, on the inner surface with ringed elliptic pores at corners and numerous smaller pores and pseudopores at commissures, often in series of 2–5. Branches paired, subequal, about 5 mm long, both directed upward and crowded; epidermal cells uniporose, delicately fibrillose. Branch leaves 2.5–3 mm long, oblong-ovate, tapered to the apex, concave, bordered by a resorption furrow; hyaline cells similar to those of stem leaves; green cells triangular, exposed on the inner surface (and sometimes narrowly exposed on the outer), the hyaline cells convex on the inner surface, bulging on the outer.

The plants have an interesting columnar form owing to short branches crowded together and directed upward. The branches are in fascicles of two and similar in size and form (neither pendent). The cortical cells of stems and branches are weakly fibrillose, if at all. The stem and branch leaves are similar. They have, on the outer surface, large, ringed, elliptic pores conspicuously in threes at adjacent angles and, on the inner surface, a few rather large corner pores in addition to numerous small pores and pseudopores at the commissures, often in series of 2 to 5.

Sphagnum [sect. *Sphagnum*] **trollii** Crum, sp. nov. TYPE: Colombia. Páramo de Boquerón bei Bogotá, 3900 m, *C. Troll* (holotype, M). Figures 12–16.

Plantae ca. 4 cm altitudine, fulvae. Caules subfusci; cellulae epidermidis caulinae fibrillosae, 1–3-porosae; cylindrus lignosus obscure rufo-brunneus. Folia caulina eis ramulinis similia sed plus lingulata, 1.5–1.8 mm longa; cellulae hyalinae fibrillosae, non septatae, superficie exteriore poris commissuralibus ellipticis (sursum ca. 5, deorsum 8–9), sub apicibus lacunis magnis, interiore plerumque poris nullis. Folia ramulina 2–2.2 mm longa, ovata; cellulae chlorophylliferae orciformes, superficie utroque anguste expositae.

Plants tawny, up to 4 cm high. Stems brown; cortex 3-layered, the epidermal cells fibrillose, 1–3-porose; wood cylinder dark red-brown. Stem leaves much like branch leaves in structure, though smaller, 1.5 mm long and more nearly lingulate, bordered by a resorption furrow; hyaline cells fibrillose, undivided, on the outer surface with elliptic commissural pores, about 5 toward the apex and 8 or 9 below, near the apex with large gaps, on the inner surface with scarcely any pores. Branches in fascicles of 3 (2 short and spreading); cells of the epidermis uniporose, efibrillose or some few cells fibrillose. Branch leaves 2–2.2 mm long, ovate; hyaline cells with fewer pores but otherwise similar to stem leaves; green cells orciform, narrowly exposed on both surfaces, more so on the outer.

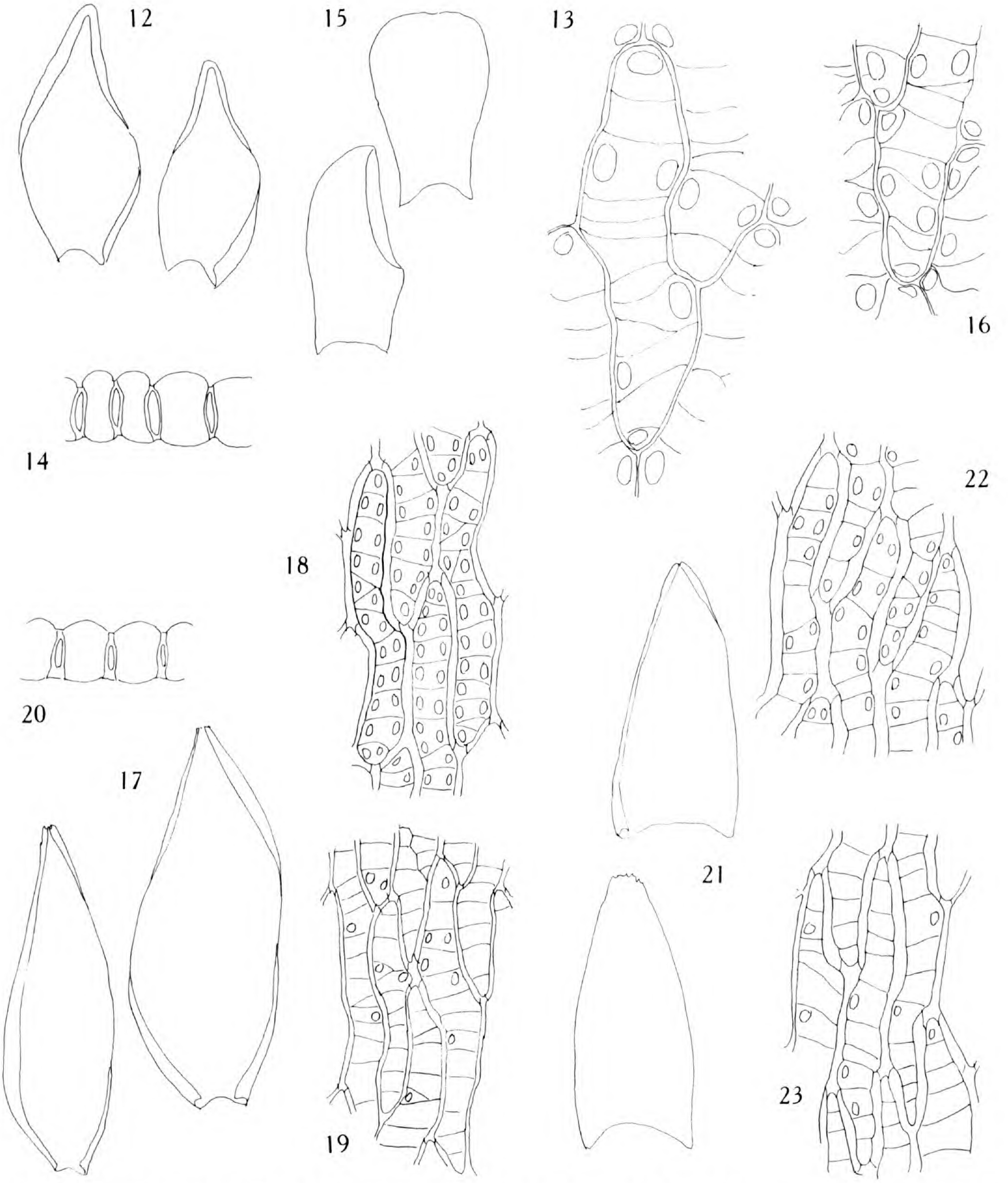
The dark wood cylinder of stems and similar stem and branch leaves are especially interesting. *Sphagnum lapazense* Crum also has a dark wood cylinder and similar stem and branch leaves, but the stem cortex is only 1-layered and lacks pores and fibrils, and the leaves have only a few pseudopores on the outer surface but numerous true pores on the inner.

Sphagnum [sect. *Subsecunda*] **uruguayense** Crum, sp. nov. TYPE: Uruguay. Depto. Montevideo, Carrasco, in ripariis aren.-arg., 25 Oct. 1934, *W. G. Herter 1432a* (holotype, M). Figures 17–24.

Hyalodermis caulis strato uno, cellulis parvis, indistincte diversis; cylindrus lignosus brunneus. Folia caulina 1.5–1.8 mm longa, oblongo-ovata, rotundo-obtusa; cellulae hyalinae superficie exteriore numerosae, interiore paucae. Fasciculus ramorum ramis 3 (2 patentibus). Folia ramulina 2 mm longa, oblongo-ovata vel oblongo-lanceolata, concavo-acuminata; cellulae hyalinae superficie exteriore poris commissuralibus numerosis, interiore poris paucis; cellulae chlorophylliferae anguste triangulo-trapezoideae, sectione transversali superficie exteriore anguste expositae.

Plants rather small, yellowish green. Cortical cells of stem small and inconspicuous, in 1 layer; wood cylinder brown. Stem leaves 1.5–1.8 mm long, oblong-ovate, rounded-obtuse, somewhat concave above, narrowly bordered; hyaline cells fibrillose in the upper ½–⅔, occasionally once- or even twice-divided, on the outer surface with as many as 8 commissural pores, on the inner surface with pores few, small, and rounded. Branches in fascicles of 3 (2 spreading). Branch leaves not at all secund, 2–2.1 mm long, oblong-ovate or oblong-lanceolate, concave; hyaline cells not or rarely divided, on the outer surface with numerous small, rounded-elliptic commissural pores in nearly continuous rows, on the inner surface with few small, rounded pores; green cells in section narrowly triangular-trapezoidal, narrowly exposed on both surfaces, more so on the outer.

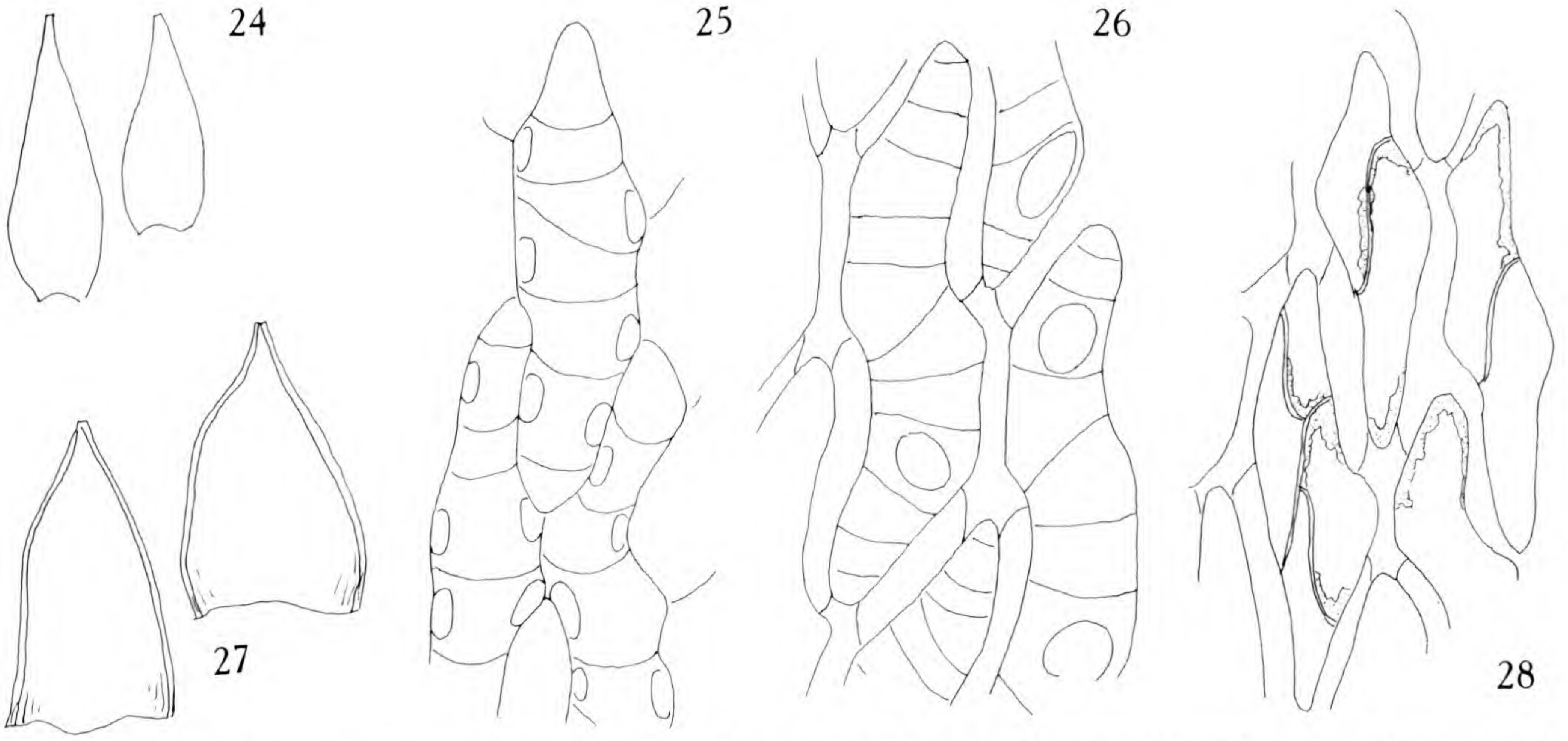
Herter distributed this material as *S. medium* Limpricht var. *affine*, nom. inval., and in aspect it indeed resembles the section *Sphagnum* to which that species belongs. However, it has none of the diagnostic features of that section, and the small pores of both stem and branch leaves are commissural in arrangement and numerous, as in most of section *Subsecunda*. Notable features include the unusually small cortical cells of the stem as well as the relatively few small, rounded pores on the inner surface of both stem and branch leaves and more numerous, small, rounded-elliptic pores on the outer surface, those of the branch leaves in nearly continuous commissural rows.



Figures 12–23. *Sphagnum trollii* and *S. uruguayense*. 12–16. *S. trollii*. —12. Branch leaves, ×30. —13. Upper cells of branch leaf, outer surface, ×320. —14. Portion of branch leaf in section, ×320. —15. Stem leaves, ×30. —16. Upper cells of stem leaf, outer surface, ×320. 17–23. *Sphagnum uruguayense*. —17. Branch leaves, ×30. —18. Upper cells of branch leaf, outer surface, ×320. —19. Upper cells of branch leaf, inner surface, ×320. —20. Portion of branch leaf in section, ×320. —21. Stem leaves, ×30. —22. Upper cells of stem leaf, outer surface, ×320. —23. Upper cells of stem leaf, inner surface, ×320.

Sphagnum [sect. *Acutifolia*] **amazonense** Crum, sp. nov. TYPE: Peru. Amazonas: Chachapoyas District, Las Palmas zw. Balsas u. Leimemba, 06°45′S, 77°49′W, 3000 m, 31 Aug. 1973, *P. & E. Hegewald 6996* (holotype, MO). Figures 24–28.

Plantae fulvellae, ca. 6 cm altae. Cellulae epidermidis caulinae sine poris; cylindrus lignosus rutilus. Folia caulina 1.2 mm longa, subtriangularia, parce concava, valde limbata, deorsum ± dilatata; cellulae hyalinae efibrillosae, plerumque 1(–2)-septatae, utroque superficie lacuna magna perforata. Folia ramulina 1.1–1.2 mm longa, anguste ovata, concava, ca. 3 seriebus cellularum elongatar-



Figures 24–28. *Sphagnum amazonense.* —24. Branch leaves, ×30. —25. Upper cells of branch leaf, outer surface, ×320. —26. Upper cells of branch leaf, inner surface, ×320. —27. Stem leaves, ×30. —28. Upper cells of stem leaf, inner surface, ×320.

um limbata; cellulae hyalinae superficie exteriore poris annulatis ellipticis numerosis ad commissuras, interiore poris 1–3, rotundis, non annulatis; cellulae chlorophyliferae sectione transversali triangulae, dorso foliorum expositae; cellulae hyalinae utroque superficie valde convexae.

Plants tawny, about 5 or 6 cm high. Stem cortex without pores; wood cylinder red-yellow. Stem leaves 1.2 mm long, ovate-triangular, acute, slightly concave, heavily bordered by 4–5 rows of cells, the border somewhat expanded toward the base; hyaline cells 1–2-divided, efibrillose, with a large gap on both surfaces. Branches in fascicles of 3 (1 pendent). Branch leaves 1.1–1.2 mm long, narrowly ovate, concave, bordered by about 3 rows of linear cells; hyaline cells on the outer surface with numerous (up to 9) ringed, elliptic commissural pores, on the inner surface with 1–3 rounded, unringed pores; green cells triangular, exposed on the inner surface, the hyaline cells bulging on both surfaces.

The plants have stem leaves that are more or less triangular, acutely pointed, and very slightly concave; the hyaline cells are efibrillose and once or twice divided and have large membrane gaps on both surfaces. The branch leaves have rather numerous elliptic commissural pores on the outer surface and as many as three, rather large, rounded, thin-margined pores (or gaps) on the inner surface; the green cells are exposed on the inner surface, and the hyaline cells are bulging on both surfaces.

Two New Species of *Oxypetalum* (Asclepiadoideae, Apocynaceae) from Brazil

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ABSTRACT. *Oxypetalum habrogynum* and *O. helios*, two new species of Asclepiadoideae, Apocynaceae, are described and illustrated. *Oxypetalum habrogynum* has the membrane of the caudicles of the pollinarium concave and not convex or plane as in other species. *Oxypetalum helios* has the segment of the corona 3-lobed, lacking an adaxial appendage, and the gynostegium apex is filiform and bifid at its distal third. These species are endemic to the National Park of the Serra da Canastra in the state of Minas Gerais, Brazil.

Key words: Apocynaceae, Asclepiadoideae, Brazil, *Oxypetalum*.

Oxypetalum R. Brown (Asclepiadoideae, Apocynaceae) is a Neotropical genus comprising about 100 species, occurring in a variety of habitats, principally in open areas like savannah, grassland, and forest edges. Brazil is the center of diversity for the genus, with a majority of species found within the state of Minas Gerais. During the preparation of the treatment for the flora of Serra da Canastra National Park, Minas Gerais, in southeastern Brazil (Fig. 1), two new species of *Oxypetalum*, *O. habrogynum* and *O. helios*, were recognized and are here described and illustrated.

Oxypetalum habrogynum Farinaccio, sp. nov. TYPE: Brazil. Minas Gerais: São Roque de Minas, Parque Nacional da Serra da Canastra, estrada Sacramento–São Roque de Minas, capões após cerradão, 21 Mar. 1998 (fl), *M. A. Farinaccio, P. T. Sano, A. C. Araújo, D. V. Arce & P. Fiaschi 143* (holotype, SPF; isotypes, F, MO). Figure 2.

Ab omnibus speciebus generis membrana pollinarii concava optime distinctum. Species quam maxime affinis *O. pachygyno*, quae tamem characteribus inflorescentiae florumque differt.

Vines, stems tomentose. *Leaves* opposite, patent; petiole 1–2.2 cm long, somewhat sulcate, tomentose; blades 3.5–8(–11) × 2–3.2(–6) cm, oblong to ovate-oblong, discolorous, puberulous to pubescent, chartaceous, brochidodromous, apex rounded to acute, mucronate, base cordate, with 2 to 5 colleters at base of adaxial side. *Partial inflorescence* extra-axillary, alternate, 6- to 11-flowered, erect; peduncles 0.5–1.7 cm long, tomentose, bracts 1.5 × 0.5 mm, lanceolate, adaxial surface hirsute, abaxial surface glabrous, with colleters at the base; pedicels 2–6 mm long, pubescent to tomentose. *Calyx* green to brown, divided almost to base, lobes 3–4.3 × 1–1.5 mm, lanceolate, apex acute, abaxial surface pubescent to tomentose, adaxial glabrous, 1 or 2 colleters below each sinus. *Corolla* abaxial surface dark purple to green, pubescent, adaxial white, cream or lightly pink, glabrous to puberulous, tube campanulate, 2–2.5 mm long, lobes 3.6–5.5 × 2–2.1 mm, lanceolate, reflexed, margins hyaline, apex acute. *Corona* white, lobes 2.4–3.2 × 1–1.7 mm, oblong to obovate, imbricate, the adaxial surface with carunculate excrescences and a central tooth-like appendage, apex subtruncate to truncate, crenate. *Gynostegium* rostrate, white to lightly pink, 1.5 mm long, 1.1 mm diam., sessile, apex 2.5–4.3 mm long, conical, bifid from the distal third. *Anthers* 0.7–1.5 × 0.6–1 mm, rectangular to subquadrangular, terminal appendage 0.8–1 × 0.8–0.9 mm, obscured by corona, ovate, apex acute, wings longer than or equal to dorsum, straight. *Corpusculum* 0.43–0.53 mm long, 0.11–0.13 mm wide, lanceolate, thick-gibbous, apex acute, caudicles 0.13–0.19 mm long, flattened, broad, translucent, with horny teeth 0.21–0.29 mm, pollinia 0.38–0.42 × 0.11–0.14 mm, oblong. *Follicle* black when senescent, 6 × 0.5 cm. *Seeds* unknown.

Oxypetalum habrogynum is distinct from the other species in the genus by the membrane of the caudicles of the pollinarium, which is concave and not convex or plane as in other species. It is very closely related to *O. pachygynum* Decaisne, mainly by vegetative characteristics, but may be distinguished by characteristics of the partial inflorescence and of the flowers (Table 1).

This species is endemic to the Serra da Canastra National Park. It occurs in humid soil of grasslands, around the borders of small forest tracts ("capões") and gallery forests. It has been collected in flower

Figure 1. Map showing the Serra da Canastra National Park, Minas Gerais State, Brazil.

in March, July, and October, and with senescent fruits in July. The specific epithet is an allusion to its gynostegium, more delicate in comparison to the gynostegium of *O. pachygynum.*

Paratypes. BRAZIL. **Minas Gerais:** São Roque de Minas, Parque Nacional da Serra da Canastra, estrada para Sacramento, próximo ao Córrego dos Passageiros, 20 Mar. 1995 (fl), *J. N. Nakajima et al. 892* (HUFU); Córrego do Bárbaro, 19 Oct. 1997 (fl), *J. N. Nakajima et al. 2972* (HUFU); estrada Sacramento–São Roque de Minas, Três Matinhas, 8 July 1999 (fl, fr), *M. A. Farinaccio et al. 352* (SPF).

Oxypetalum helios Farinaccio, sp. nov. TYPE: Brazil. Minas Gerais: São Roque de Minas, Parque Nacional da Serra da Canastra, Córrego do Quilombo, Três Matinhas, 8 July 1999 (fl, fr), *M. A. Farinaccio, A. A. Araújo & F. P. Gomes 351* (holotype, SPF; isotypes, HRCB, K, MBM, MO, NY, RB). Figure 3.

Inter affines segmentis coronae 3-lobatis adaxiale exappendiculatis et apice gynostegii filiformi bifidoque diagnoscitur.

Vines, stems pubescent. *Leaves* opposite, patent; petiole 0.7–1.3 cm, smooth, pubescent; blades 4.5–8.5 × 1.7–3 cm, elliptic to lanceolate, sometimes ovate, discolorous, subglabrate, minutely hairy along the midvein and margins, chartaceous, with brochidodromous venation, apex acute to obtuse, mucronate to apiculate, base cordate with 2 colleters at base of adaxial side. *Partial inflorescence* extra-axillary, alternate, 2- to 9- (frequently 3)-flowered, erect; peduncle 1.6–2.2 mm long, pubescent, bracts 2–3.3 × 0.5–0.7 mm, linear or oblong, puberulous; pedicels 1–1.8 cm long, pubescent. *Calyx* yellow to green, dark purple in the proximal region, divided almost to base, lobes 2.5–6 × 0.5–1 mm, lanceolate, apex acute, puberulous, 2 or 3 colleters below each sinus. *Corolla* cream to yellow, campanulate, tube 2.5–3 cm long, puberulous, lobes 1–1.3 × 0.1–0.2 cm, linear to narrowly oblong, patent to reflexed, twisted, abaxial surface subglabrate, adaxial surface pubescent, margins hyaline, apex acute. *Corona* light green to cream, lobes 2–3 × 1.5–1.8 mm, oblong, 3-lobed, apex truncate, curved. *Gynostegium* cream, 2.5 mm long, 0.8–1 mm diam., sessile, apex cream to lightly pink, 3–4 mm long, filiform, bifid from distal third. *Anthers* 0.72–1 × 0.5–0.72 mm, rectangular, terminal appendage 1.1–1.5 × 0.5–0.72 mm, oblong, apex acute, emarginate, wings straight, longer than the dorsum. *Corpusculum* 0.96–1.12 × 0.14–0.18 mm, oblong, laminar, apex truncate, caudicles 0.11–0.16 mm long, flattened, broad, translucent, with horny teeth 0.19–0.24 mm long, pollinia 0.27–0.32 × 0.11–0.13 mm, oblong. *Follicle* green to brown, 5.5–8.5 × 1.5–2.5 cm, ovate, striate, puberulous. *Seeds* 6–7 × 3–3.5 mm, ovate, verrucose.

Oxypetalum helios may be included in the *O. insigne* (Decaisne) Malme complex, principally on the characteristics of habit (climbing plants) and morphology of the pollinarium, which has the laminar corpusculum longer than pollinia. It is very closely related to *O. glabrum* (Decaisne) Malme. Both plants are sparsely pubescent, and they share a similar leaf morphology and flower size. However, *O. helios* is immediately distinguished from all species of that complex by the segment of the corona 3-lobed, lacking an adaxial appendage, and principally by the gynostegium apex, which is filiform and bifid at its distal third.

This species is endemic to the Serra da Canastra National Park. It occurs in humid soil around the borders of small forest tracts ("capões"). It has been collected in flower and fruit in July, September, and

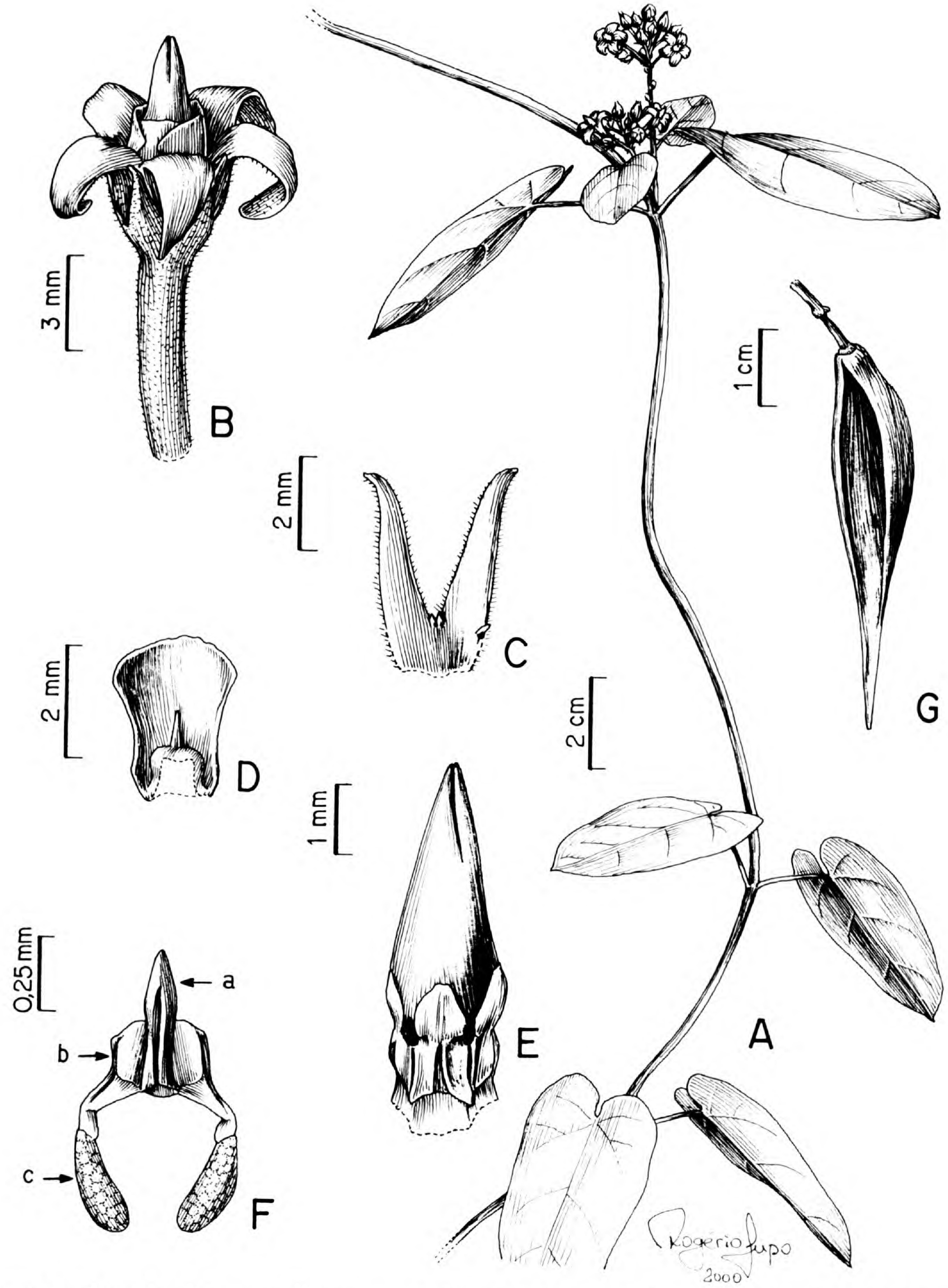

Figure 2. *Oxypetalum habrogynum* Farinaccio. —A. Flowering branch. —B. Flower. —C. Adaxial surface of part of the calyx showing colleters. —D. Adaxial surface of corona lobe. —E. Gynostegium. —F. Pollinarium: (a) corpusculum, (b) caudicles, (c) pollinium; (a) + (b) = translator. —G. Senescent fruit. (A–F from the holotype, *Farinaccio et al. 143*; G from *Farinaccio et al. 352*.)

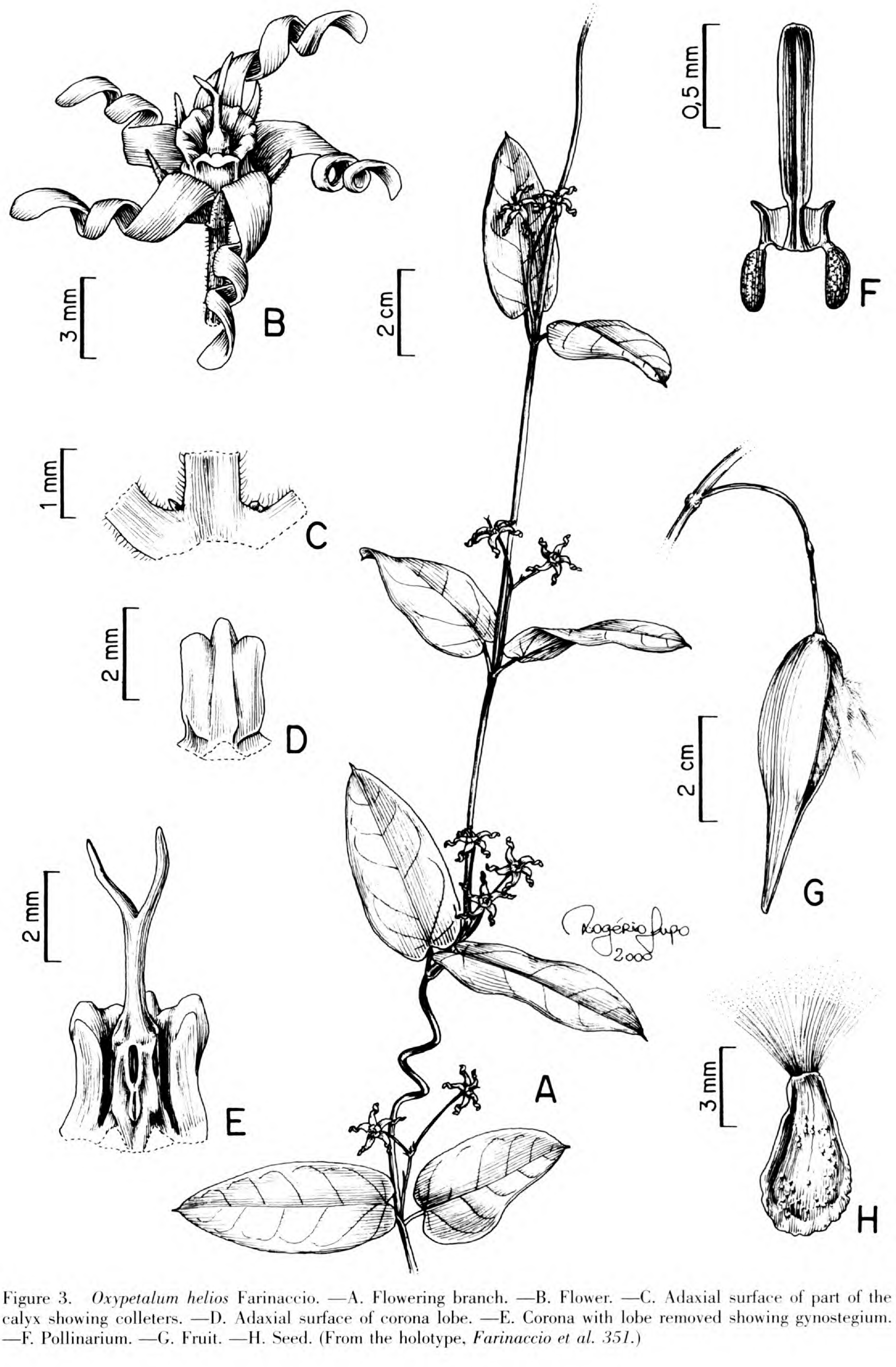

Figure 3. *Oxypetalum helios* Farinaccio. —A. Flowering branch. —B. Flower. —C. Adaxial surface of part of the calyx showing colleters. —D. Adaxial surface of corona lobe. —E. Corona with lobe removed showing gynostegium. —F. Pollinarium. —G. Fruit. —H. Seed. (From the holotype, *Farinaccio et al. 351*.)

Table 1. Differential characters between *O. habrogynum* and *O. pachygynum.*

Characters	Species *O. habrogynum*	 *O. pachygynum*
Flower number in the partial inflorescence	6–11	2–5
Number of colleters in the calyx sinus	1–2	4
Color of the corolla	white, cream, or slightly pink	green to dark purple
Tube length	2–2.5 mm	2.5–4 mm
Corolla lobe length	3.6–5.5 mm	6.5–10.2 mm
Abaxial face of the corolla lobes	glabrous to puberulous	gray-sericeous
Corona color	white	green cream
Gynostegium color	white to slightly pink	dark purple
Gynostegium size	1.5 × 1.1 mm	2–3 × 1.7–2 mm
Gynostegium apical apex length	2.5–4.3 mm	4–6 mm
Anther wings	entire	dentate
Terminal anther appendage	0.8–1 mm, shorter than the corona	2.2 mm, exceeding the corona

October. The specific epithet is an allusion to its yellow flowers, which with their very conspicuous, extremely narrow twisted lobes resemble the sun.

Paratypes. BRAZIL. **Minas Gerais:** São Roque de Minas, Parque Nacional da Serra da Canastra, Córrego do Quilombo, 26 Sep. 1995 (fl, fr), *R. Romero et al. 2803* (HUFU, SPF); 20°10′17″S, 46°39′52″W, 14 July 1997 (fl, fr), *J. A. Lombardi 1862* (BHCB); Córrego do Quilombo, Três Matinhas, 15 Oct. 1997 (fl, fr), *J. N. Nakajima et al. 2869* (HUFU, SPF).

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Two New Species of *Ainsliaea* (Asteraceae, Mutisieae) from China and Vietnam

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ABSTRACT. Two new species, *Ainsliaea pentaflora* from Tonkin, Vietnam, and *Ainsliaea qianiana* from Yunnan, China, are described and illustrated. *Ainsliaea pentaflora* is distinguished by its 5-flowered capitula, rounded anther appendages, and rosulate leaves with practically wingless petioles. *Ainsliaea qianiana* is distinguished by its apiculate anther appendages, rosulate leaves with petioles winged, and 3-flowered capitula. These species are compared with closely related species. Included are keys to those *Ainsliaea* with apiculate anther appendages and 5-flowered capitula.

Key words: *Ainsliaea*, Asteraceae, China, Compositae, Mutisieae, Vietnam.

The genus *Ainsliaea* DC. (including *Diaspananthus* Miquel) contains about 50 species distributed in southeast Asia. All are perennial herbs with rosulate leaves or leaves arranged at the median part of the stem, few-flowered capitula in spikes or panicles, slightly zygomorphic, deeply 5-lobed corollas with unilateral lobes, and plumose pappus bristles. The most closely related genera, *Macroclinidium* Maximowicz, *Myripnois* Bunge, and *Pertya* Schultz Bipontinus, usually differ by their scabrid, non-plumose pappus bristles (Bremer, 1994).

During the course of a taxonomic revision of the genus *Ainsliaea* by the author, the following two species were recognized as undescribed.

Ainsliaea pentaflora S. E. Freire, sp. nov. TYPE: Vietnam. Tonkin: Massif du Tom Dav, 900 m, Dec. 1921, *A. Petelot s.n.* (holotype, C). Figure 1.

Herba perennis, scaposa. Folia rosulata, longipetiolata; lamina ovata, basi rotundata, leviter decurrentis, apice acuta, in margine mucronato-denticulata, membranacea, supra scabridula parce villosa vel glaberrima, subtus villosa, pinnativenia; petioli non alati, villosi. Folia inter inflorescentiam pauca, elliptica. Capitula pentaflora, sessilia, solitaria vel 2-fasciculata in panicula disposita. Involucrum cylindrici-campanulatum. Phyllaria 6–7-seriata, coriacea, apice villosa. Flores isomorphi, omnes hermaphroditi; corollae tubuliformes, 5-lobatae, cum lobis unilateralibus; antherae apice rotundatae, basi sagittatae, breviter laciniatae; styli rami obtusi. Achaenia villosa; pappi setae uniseriatae, plumosae.

Plants perennial, herbaceous, ca. 0.35 m tall. Stems erect, unbranched, villous. Leaves basally clustered, rosulate, long-petiolate; petioles wingless, 6.5–9 cm long, villous; leaf blades chartaceous, ovate, 7.5–8.5 × 3.5–4 cm, apex acute, base rounded, then cuneately narrowed into the petiole, margins denticulate-mucronate; adaxial surface slightly scabrous, sparsely villous to glabrous, trichomes multicellular-unbranched (consisting of uniseriate pedestal and long apical cells oblique septate), ca. 0.7–1.25 mm long, abaxial surface villous, veins somewhat more densely pubescent than rest of abaxial surface; venation pinnate, secondary veins 2 or 3 on each side of midrib, arcuate, the secondary veins and midrib prominent. Cauline leaves few, much reduced, ovate-elliptic. Capitula sessile, solitary or 2, disposed in panicles, nodding in maturity. Involucre 6- or 7-seriate, narrowly campanulate, 13–15 × 12–14 mm; phyllaries coriaceous, apically villous; outer phyllaries oblong-ovate, 3–4 × 1.5 mm, the apices acute; inner phyllaries linear-elliptic, 10–10.5 × 1.5–1.7 mm, the apices acute. Florets 5, hermaphroditic, corollas glabrous, apically papillose, tubular, 4.5–5.5 mm long, 5-lobed, lobes ca. 1 mm long, with one deeper slit ca. 1.5 mm, the corolla then pseudoligulate but without an expanded limb, tube ca. 3.5 mm long. Anthers 5, ca. 3 mm long, apical appendages rounded, ca. 0.4 mm long, sagittate; tails 0.8–1 mm long, shortly pilose. Style branches short, obtuse, ca. 1.2 mm long. Achenes oblong, 7.5–8 mm long, pilose. Pappus bristles uniseriate, ca. 39, plumose, 7.5–8 mm long, white.

The new species is known only from the type collection from Tonkin, Vietnam, at approximately 900 m.

Ainsliaea pentaflora most closely resembles *A. latifolia* (D. Don) Schultz Bipontinus. Both have ovate leaves arranged at the base of the stem and rounded apical anther appendages. However, *A. pentaflora* differs from *A. latifolia* by its 5(vs. 3)-

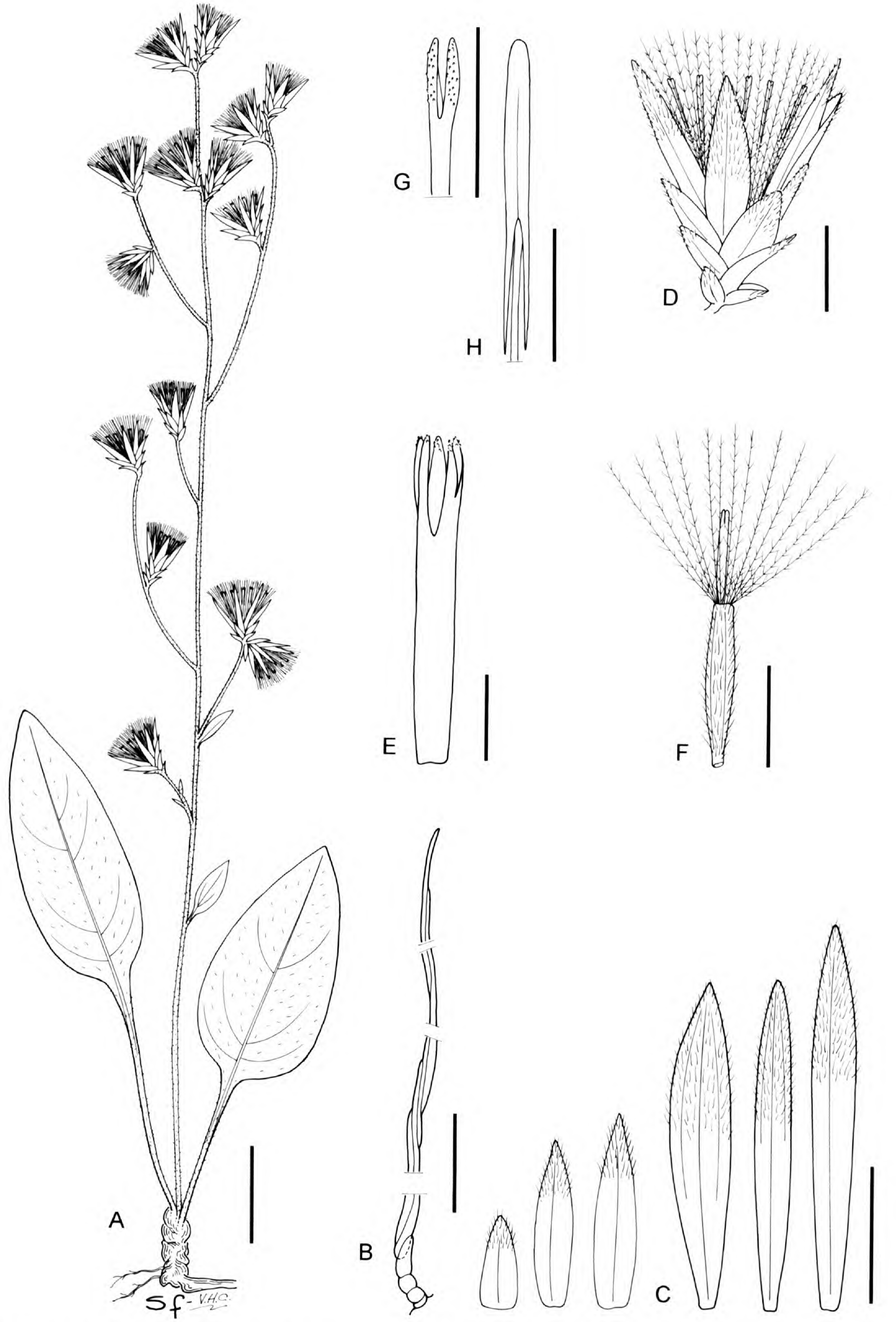

Figure 1. *Ainsliaea pentaflora* S. E. Freire. —A. Habit. —B. Foliar trichome. —C. Phyllaries. —D. Capitula. —E. Corolla. —F. Floret. —G. Style branches. —H. Stamen. Scale bars: A = 3 cm; B = 0.2 mm; C = 3.5 mm; D & F = 5 mm; E = 1.5 mm; G = 2.5 mm; H = 1 mm. Drawn from the holotype: *Petelot s.n.* (C).

flowered capitula, and its practically wingless (vs. winged) petioles.

The new species epithet *pentaflora* refers to the 5-flowered capitula. Two other species of the genus are also 5-flowered: *A. brandisiana* Kurz from Myanmar (= Burma) and *A. spanocephala* Y. C. Tseng from Thailand.

KEY TO THE *AINSLIAEA* SPECIES WITH 5-FLOWERED CAPITULA

1a. Leaf bases cuneate; anther appendages apically rounded . . . . *A. pentaflora* S. E. Freire
1b. Leaf bases rounded or cordate; anther appendages apically acuminate.
2a. Leaf bases rounded . . . . . *A. brandisiana* Kurz
2b. Leaf bases cordate . . . . *A. spanocephala* Y. C. Tseng

Ainsliaea qianiana S. E. Freire, sp. nov. TYPE: China. NE Yunnan: Colline de Kin-tchong-chan, 2990 m, *E. E. Maire 2529* (holotype, W; isotypes, NY, UC). Figure 2.

Herba perennis, scaposa. Folia rosulata, longipetiolata, cum petiolo late alato; lamina elliptica vel ovata, in petiolo subito angustata, apice acuta, in margine mucronato-denticulata et villosa, crasse, utrinque glabra, subtus albida, pinnativenia. Folia inter inflorescentiam pauca, lineari-elliptica. Capitula triflora, numerossisima, sessilia, 3–5-fasciculato-spicata, horizontalia vel pendula, unilateralia, spica simplex vel breviter ramosa. Involucrum cylindricum. Phyllaria 6–7-seriata, papyracea, omnes glabra. Flores isomorphi, omnes hermaphroditi; corollae rubescentes, 5-lobatae, cum lobis unilateralibus, linearibus, partitis subaeque; antherae apice apiculatae, basi sagittatae, breviter laciniatae; styli rami breves, rotundati. Achaenia villosa; pappi setae uniseriatae, plumosae.

Plants perennial, herbaceous, 0.50–0.60 m tall. Stems erect, unbranched, moderately villous. Leaves basally clustered, rosulate, long-petiolate; petioles winged, 10–11 cm long; leaf blades subcarnose, elliptic to elliptic-ovate, 7.5–8.5 × 3.5–3.8 cm, apex acute to obtuse, base abruptly rounded and decurrent into the petiole, margins denticulate-mucronate and villous, trichomes multicellular-unbranched (consisting of a uniseriate pedestal and long apical cells obliquely septate), ca. 0.6–1 mm long; upper and lower surfaces glabrous, the surface whitish below; venation pinnate, secondary veins 2 or 3 on each side of midrib, arcuate, secondary veins and midrib prominent. Cauline leaves few, much reduced, linear-elliptic. Capitula sessile, 3- to 5-fasciculate, rarely 1 or 2, spicately disposed, nodding in anthesis, spike unilateral, single- or few-branched. Involucre 6- or 7-seriate, cylindrical, 12–14.5 × 3–4 mm in anthesis; phyllaries papyraceous, glabrous; outer phyllaries linear-ovate, 2.8–3 × 0.8–1 mm, the apices acuminate; inner phyllaries linear-ovate to linear-elliptic, 11–13 × 1.2–2 mm, the apices acuminate to acute. Florets 3, hermaphroditic, corollas light pink, glabrous, apically papillose, 5-lobed, lobes unilateral, oblong, ca. 3.5 mm long, with one deeper slit ca. 5.5 mm long, the corolla then slightly ligulate, tube ca. 4.5 mm long. Anthers 5, ca. 6 mm long, apical appendages shortly apiculate, 1–1.5 mm long (apiculum ca. 0.2 mm long), sagittate; tails ca. 1.3 mm long, shortly pilose. Style branches shortly bilobed, apically rounded, ca. 0.25 mm long. Achenes oblong, 3–4 mm long, densely pilose. Pappus bristles uniseriate, ca. 39, plumose, 6–7 mm long, white.

Ainsliaea qianiana at present is known only from the type collection from northeastern Yunnan, China, at approximately 2990 m.

The species is named to honor Qian Yi-yong, a dedicated botanist and collector of the Chinese flora.

The new species is characterized by its apiculate anther appendages, rosulate leaves with petioles winged, and capitula 3-flowered. *Ainsliaea qianiana* exhibits some likeness to *A. macrocephala* in habit and capitulescence. That species is amply distinguished by its apically rounded anther appendages and its pilose phyllaries and leaves. Twelve other species of the genus also have apiculate anther appendages.

KEY TO THE *AINSLIAEA* SPECIES WITH APICULATE ANTHER APPENDAGES

1a. Leaves clustered at the median part of the stem.
2a. Leaves 3-parted . . . . *A. dissecta* Franchet & Savatier
2b. Leaves lobed.
3a. Blades palmately lobed.
4a. Capitula 1-flowered . . . . *A. lancangensis* Y. Y. Qian
4b. Capitula 3-flowered . . . . *A. acerifolia* Schultz Bipontinus
3b. Blades pinnately lobed . . . . *A. cordifolia* Franchet & Savatier
1b. Leaves ± rosulate.
5a. Leaves palmativeined; capitula 1-flowered . . . . *A. uniflora* Schultz Bipontinus
5b. Leaves pinnativeined; capitula 3- or 5-flowered.
6a. Capitula 5-flowered.

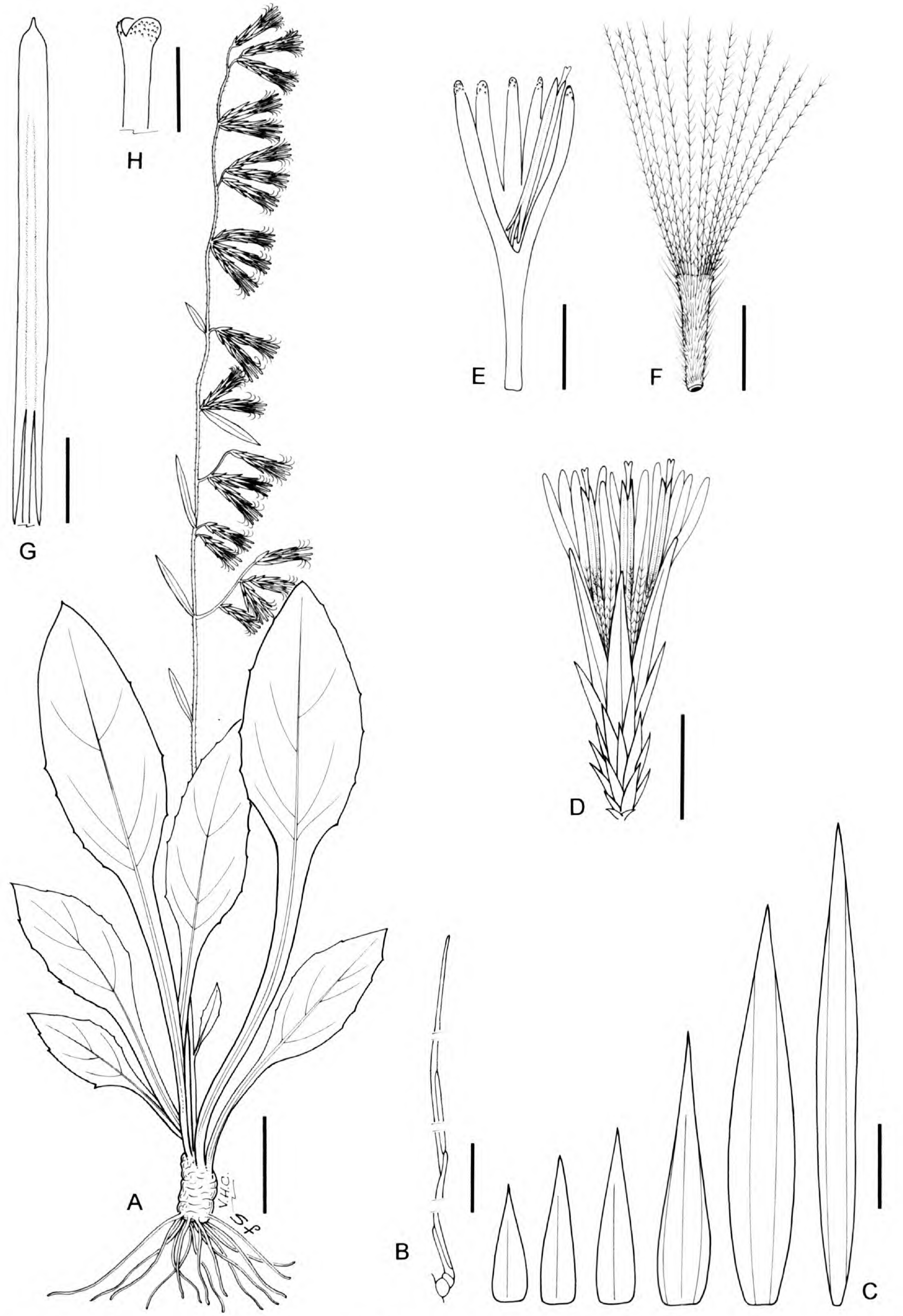

Figure 2. *Ainsliaea qianiana* S. E. Freire. —A. Habit. —B. Foliar trichome. —C. Phyllaries. —D. Capitula. —E. Floret without ovary. —F. Achene with pappus. —G. Stamen. —H. Style branches. Scale bars: A = 3 cm; B = 0.1 mm; C & F = 2 mm; D = 5 mm; E = 2.5 mm; G & H = 1 mm. Drawn from the holotype: *Maire 2529* (W).

- 7a. Leaf bases rounded . . . . *A. spanocephala* Y. C. Tseng
- 7b. Leaf bases cordate . . . . *A. brandisiana* Kurz
- 6b. Capitula 3-flowered.
  - 8a. Petioles winged . . . . *A. qianiana* S. E. Freire
  - 8b. Petioles wingless.
    - 9a. Blades elliptic, rounded at the base.
      - 10a. Blades 8–12 cm long . . . . *A. pingbianensis* Y. C. Tseng
      - 10b. Blades 4.5–5 cm long . . . . *A. angustata* C. C. Chang
    - 9b. Blades oblong, cordate at the base.
      - 11a. Phyllaries apically pilose . . . . *A. cavaleriei* H. Léveille
      - 11b. Phyllaries glabrous.
        - 12a. Blades slightly concolorous . . . . *A. ramosa* Hemsley
        - 12b. Blades with lower surface whitish, veins reddish . . *A. rubrinervis* C. C. Chang

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Estudios en el Género *Schwartzia* Vellozo (Marcgraviaceae): Una Nueva Especie de la Cordillera Central Andina de Colombia

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RESUMEN. Se describe e ilustra una nueva especie de *Schwartzia*, *S. parrae*. La nueva especie se conoce únicamente de la Cordillera Central Andina de Colombia (Departamento de Antioquia). Se presenta una clave para distinguir las especies colombianas de *Schwartzia*.

ABSTRACT. A new species of *Schwartzia*, *S. parrae*, is described and illustrated. The new species is known only from the Andean Central Cordillera of Colombia (Departamento de Antioquia). A key for the Colombian species of *Schwartzia* is provided.

Key words: Andes, Colombia, Marcgraviaceae, *Schwartzia*.

El género *Schwartzia* Vellozo, constituido por ca. 15 especies, se distribuye desde Costa Rica hasta el sur de Brasil y se caracteriza por presentar inflorescencias racemosas y flores largamente pediceladas con un nectario (bráctea nectarífera) ubicado en la porción medial a proximal del pedicelo (Giraldo-Cañas, 2001a, 2001b, 2001c). Este género fue considerado por mucho tiempo dentro del género *Norantea* Aublet (Wittmack, 1878; Szyszylowicz, 1893; Gilg & Werdermann, 1925; De Roon, 1970; Ferreira, 1995), hasta que fue revalidado recientemente por Bedell (1989).

Ambos géneros presentan inflorescencias racemosas, diferenciándose básicamente por la longitud del pedicelo, siendo en *Schwartzia* las flores largamente pediceladas (pedicelo de 16–80 mm de longitud), mientras que en *Norantea* son cortamente pediceladas (pedicelo de 3–7 mm de longitud). Por otra parte, en *Schwartzia* los nectarios reproductivos, cortamente peciolados (pecíolo de 1–7 mm de longitud), se ubican en la porción medial a proximal del pedicelo y en *Norantea* se localizan en el tercio medio o hacia su porción distal, presentando un pecíolo de 5–20 mm de longitud. *Norantea* s.l. ha sido dividido en 4 géneros: *Norantea* s. str., *Schwartzia*, *Sarcopera* Bedell y *Marcgraviastrum* (Wittmack ex Szyszylowicz) De Roon & S. Dressler (De Roon & Dressler, 1997).

Como resultado del estudio del género *Schwartzia* y de la familia Marcgraviaceae (Giraldo-Cañas, 1999, 2001a, 2001b, 2001c; Giraldo-Cañas & Picca, 1999; Picca & Giraldo-Cañas, 1999) se propone una nueva especie, la que se describe e ilustra a continuación:

Schwartzia parrae Giraldo-Cañas, sp. nov. TIPO: Colombia. Antioquia: Mun. Yolombó, vereda El Bote, sitio Alto del Bote, 8.1 km SO de Yolombó, bosque perturbado, 75°01′O, 6°32′N, 1550 m, 1 jul. 1989, *R. Callejas J. Betancur & O. Escobar 7957* (holótipo, HUA; isótipos, MO, NY). Figura 1.

Frutex foliis spiraliter alternantibus, petiolis 2–7 mm longis, laminis (5–)9–22 cm longis et (1.3–)2–5.2 cm latis, 28–56 hidatodiis donatis. Racemus multiflorus. Flores 20–32, pedicellis 4–8 cm longis; stamina ca. 48, antheris basi subcordatis, filamentis applanatis, verruculosis; ovario conico; stigma mammiforme; bractea floralis cymbiformis, (7–)9–18 mm longa et (3–)4–8 mm lata.

Arbustos escandentes, tallos cilíndricos a irregularmente aplanados, fuertemente estriados; corteza castaño, ferrugínea a cobriza. Hojas espiraladas, subsésiles a cortamente pecioladas; pecíolo ligeramente estriado, recurvado, canaliculado (el canal muy angosto, ca. 1 mm de ancho), castaño claro a negruzco, de 2–7 mm de longitud; láminas oblongas a obovadas, de (5–)9–22 × (1.3–)2–5.2 cm, de base redondeada a ligeramente cordata, acuminadas, el ápice prolongándose en un apículo negruzco de 1–1.5 mm de longitud, enteras, con márgenes ligeramente revolutos o involutos y engrosados, coriáceas, glabras; nervio medial conspicuo en ambas caras, levemente hundido en la haz y ligeramente abultado en el envés, liso, de 1–3 mm de ancho en la porción proximal de la lámina foliar, desvaneciéndose hacia la porción distal de la lámina foliar; venación secundaria suprimida o apenas perceptible en la haz, débil en el envés, entonces ésta broquidódroma; 14–28 pares de glándulas laminales en la superficie abaxial, localizadas a 1.5–11 mm del margen, elípticas, de 1 × 0.5

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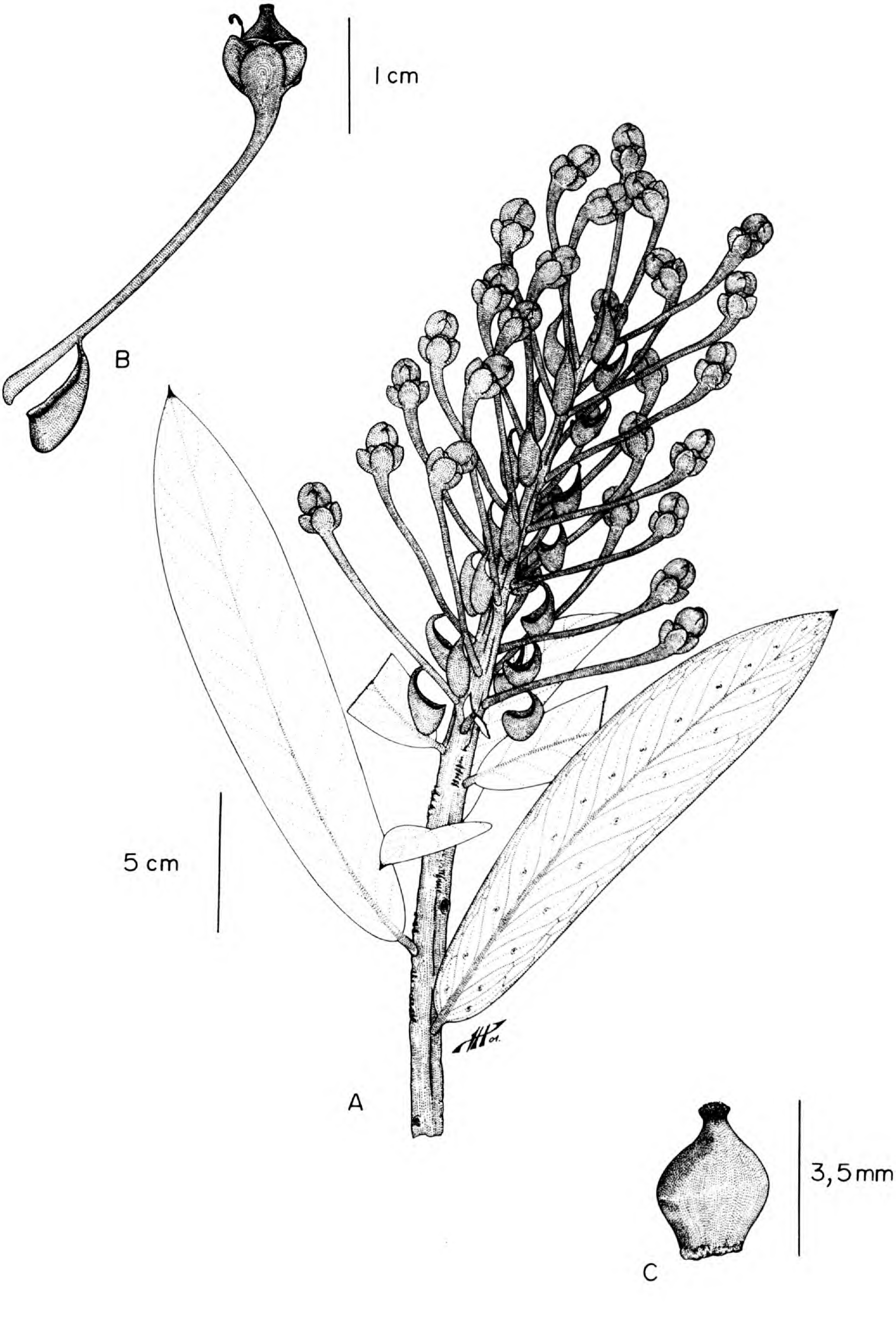

Figura 1. *Schwartzia parrae* Giraldo-Cañas. —A. Rama florífera. —B. Flor, pedicelo y bráctea nectarífera. —C. Ovario. (De *Callejas et al. 7957*, holótipo, HUA.)

mm, con su orificio negruzco de 0.2 × 0.15 mm, distanciadas entre si 1–5 cm. Inflorescencia terminal, racemosa, multiflora (20–32 flores), densa; pedúnculo de 12–19 cm de longitud; pedicelos de 4–8 cm de longitud, cilíndricos a moderadamente aplanados, rectos a levemente flexuosos, lisos a ligeramente estriados, un poco más gruesos en su porción distal, cobrizos, cada uno con una bráctea nectarífera (nectario). Nectarios (brácteas nectaríferas) cimbiformes, levemente rostrados, péndulos, verdes a purpúreos, ligeramente estriados longitudinalmente, pecíolos de los nectarios 1.5–3 mm de longitud, urnas de (7–)9–18 × (3–)4–8 mm, los orificios dispuestos hacia el eje de la inflorescencia y ocupando una posición transversal respecto a su eje, los nectarios insertados por debajo del ⅓–⅙ proximal del pedicelo. Flores dispuestas en forma espiralada, inserción pedicelo-flor horizontal a moderadamente oblícua; bractéolas 2, sepaloides, opuestas, orbiculares, verruculosas, carnosas, 5–7 mm de longitud, márgenes translúcidos; sépalos 5, imbricados en dos series, orbiculares, verruculosos, carnosos, 7–8 mm de longitud, márgenes translúcidos; pétalos 5, connatos basalmente (antes de la antesis) por ca. ⅔ de su longitud, obovado-elípticos, de 8.5–11 × ca. 3 mm, carnosos, verruculosos; estambres ca. 48, filamentos ca. 1.5 mm de longitud (antes de la antesis), aplanados, verruculosos, adnatos a la base de los pétalos, anteras introrsas, elíptico-oblongas, subcordatas basalmente, de 3–4 mm de longitud; ovario súpero, cónico, ligeramente estriado, ca. 3.5 × ca. 3 mm; estigma mamiforme. Fruto desconocido.

Schwartzia parrae está dedicada a mi amigo y colega Carlos Parra (COL), estudioso de las familias Brassicaceae, Myricaceae y Myrtaceae, quien a pesar de su juventud ha contribuido significativamente al conocimiento de la *Flora de Colombia*. Esta especie sólo es conocida de la Cordillera Central Andina (Departamento de Antioquia) y crece entre los 1100 y 2000 m. Dado que sólo se conocen de esta especie cuatro ejemplares colombianos, se infiere que ésta se encuentra en vías de extinción, dada la acelerada fragmentación y/o destrucción de los bosques en donde ella vive (observaciones personales).

Schwartzia parrae es fácilmente distinguible de las demás especies colombianas por sus nectarios reproductivos pedicelares, los cuales son cimbiformes, mientras que en las demás especies éstos son sacciformes, tubulares o globosos. Las cuatro especies colombianas descritas pueden diferenciarse fácilmente por la siguiente clave:

CLAVE PARA DISTINGUIR LAS ESPECIES DE *SCHWARTZIA* PRESENTES EN COLOMBIA

1a. Nectarios reproductivos pedicelares cimbiformes; 14–28 pares de glándulas laminales por hoja; bractéolas de 5–7 mm de long.; sépalos de 7–8 mm de long . . . . *S. parrae* Giraldo-Cañas
1b. Nectarios reproductivos pedicelares sacciformes, tubulares a globosos; 0–6 pares de glándulas laminales por hoja; bractéolas de 1.8–4.7 mm de long.; sépalos de 2–7 mm de long.
  2a. Nectarios reproductivos pedicelares naciendo por debajo de la articulación de los pedicelos al eje de la inflorescencia; estambres < 18; glándulas laminales ubicadas a 6–10 mm del margen . . . . *S. diaz-piedrahitae* Giraldo-Cañas
  2b. Nectarios reproductivos pedicelares naciendo en el tercio proximal del pedicelo; estambres 22–50; glándulas laminales ubicadas a 0.5–4.5 mm del margen.
    3a. Estambres 22–26; bractéolas ca. 2 mm de long.; sépalos de 2.2–2.8 mm de long.; ovario ca. 2.5 mm de long.; urnas de los nectarios reproductivos pedicelares de 9–17 mm de long . . . . *S. lozaniana* Giraldo-Cañas
    3b. Estambres 50; bractéolas de 2.5–5 mm de long.; sépalos de 5–7 mm de long.; ovario de 3–8 mm de long.; urnas de los nectarios reproductivos pedicelares de 15–33 mm de long . . . . *S. chocoensis* Giraldo-Cañas

Parátipos. COLOMBIA. **Antioquia:** Mun. Amalfi, 8–27 km NE de Amalfi, en la vía Vetilla-Fraguas, sitios Salazar y Marengo, 1150–1450 m, 7 dic. 1989, *Callejas et al. 9102* (HUA); Mun. Guatapé, sector Santa Rita, zonas aledañas a la carretera, 75°05′O, 6°10′N, 1800–2000 m, 22 jun. 1997, *Alzate et al. 247* (HUA); Mun. San Luis, vereda Manizales, finca de Ramón Jaramillo, 1460–1760 m, 11 oct. 1981, *Orozco et al. 549* (COL).

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Rediscovered after 200 Years, *Moraea ovata* Thunberg Is a Rare *Ferraria* (Iridaceae: Iridoideae) from Namaqualand, South Africa

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ABSTRACT. Rediscovery in the late 1990s of the mysterious *Moraea ovata* Thunberg, described in 1800 and first collected in 1793 in early fruit, shows that the species belongs to the related genus *Ferraria*. Flowers, only found in June 2001, show that it has parallel anther locules and a spindle-shaped ovary without a sterile beak, features consistent with section *Ferraria* of the genus. The new combination *F. ovata* is provided for the species, which we speculate is most closely related to *F. densepunctulata*, native to the west coast of Western Cape Province, South Africa. The range of *F. ovata* is restricted to low to middle elevations in central Namaqualand in Northern Cape Province, South Africa.

Key words: *Ferraria*, Iridaceae, *Moraea*, phytogeography, southern Africa.

The southern African *Moraea ovata* Thunberg has been a puzzling plant to botanists ever since it was described just 200 years ago. It was named by Carl Peter Thunberg in 1800 in his preliminary account of the Cape flora, *Prodromus plantarum capensium*. This work included plants from all of southern Africa, but effectively only dealt with the winter-rainfall belt of the subcontinent, which extends north and west of Cape Town along the coast and near interior. Summer-rainfall southern Africa had barely been explored botanically at the time. *Moraea ovata* was only known to Thunberg from three fruiting specimens, all of which lacked a corm, the underground storage organ of most Iridaceae, and often a feature of taxonomic importance. In fact, the reason the species was placed in *Moraea* was most likely because it clearly had an inferior ovary. Thunberg's account is succinct, but accurately describes the short stem, round in section, bearing broadly ovate leaves. Later, in his *Flora capensis* published in 1820, Thunberg mentioned that he received his specimens from the English plant collector Francis Masson, and that they grew "in Namaquas juxta koks fontein" (in Namaqualand near Koksfontein), the locality confirmed by the annotation on the type sheet of *M. ovata*, "Cocksfonteyn."

So confusing was *Moraea ovata* that the English botanist J. G. Baker, in his account of the Iridaceae in *Flora capensis* (1897), treated the species as a synonym of the western southern African *Lapeirousia pyramidalis* (Lamarck) Goldblatt (which Baker called *L. fissifolia* (Jacquin) Ker Gawler). The assignment was made because *L. pyramidalis* has an inflorescence with unusually broad bracts that resemble in a crude way the leaves of *M. ovata*. The leaves of the latter are, however, true leaves, i.e., they do not subtend a flower nor are they associated with a smaller inner bract as they would be in *Lapeirousia* if they were floral bracts surrounding a flower. In 1928 a second English botanist, N. E. Brown (1928), critically examined the specimens in the Thunberg Herbarium housed at Uppsala, Sweden, and concluded that the specimens were not a *Lapeirousia*, but he made no further comment. In a revision of the Cape species of *Lapeirousia*, Goldblatt (1972) was not so certain, and *M. ovata* was provisionally regarded as a somewhat divergent form of *L. pyramidalis*.

From the sparse literature relating to Masson's travels during his second visit to the Cape (1786–1795), we assume it was on his 1793 visit to Namaqualand that Masson collected these plants (Gunn & Codd, 1981). It has been established that Masson traveled as far as the Kamiesberg in that year, since he collected certain species that only occur there (Forbes, 1965), but his exact itinerary is not known. There is no Koksfontein recorded in the place names in the Kamiesberg, but Kookfontein is the name given to the original farm on which the present-day settlement of Soebatsfontein lies.

Could Masson have passed though the area that lies to the west of the Kamiesberg on his trip to or from the mountains? This seemed likely, for in 1995 the conservation biologist Anelise le Roux collected a sterile specimen that exactly matched Masson's type collection on the farm Doornfontein, which lies on the eastern boundary of Kookfontein. We returned there in 1997 but failed to locate more plants.

In 1999, during a multidisciplinary expedition to Namaqualand, the biologists Nick Helme and Philip Desmet discovered a handful of plants that closely matched Masson's specimens in the Knersvlakte south of Kliprand on the farm Steenbokskraal (not at all close to Soebatsfontein). Although the plants were in bud, they did not look as if they would flower, so three specimens were carefully dug up, later to be replanted. These plants differed slightly from those collected previously by Masson and le Roux in having short, narrow basal leaves that were unifacial in the upper half as are those of *Ferraria*, a genus of 10 species of semi-arid habitats in southern and south tropical Africa (de Vos, 1979). The corms were also exactly like those of a *Ferraria* in their compressed, discoid shape, multiple internodes, and lack of long-lived, fibrous tunics. The habitat was not especially distinctive, for plants were found growing on a gentle, sandy slope in veld dominated by dwarf succulents. In August 2000 we discovered yet another population of the species, again in sterile condition, west of Kliprand.

In early June 2001, this botanical mystery was finally solved when the population that we found the previous year was revisited. Several plants in full bloom were found and the identity of *Moraea ovata* could finally be established. The flowers, like the corm, match exactly those of *Ferraria* (de Vos, 1979), having subequal, clawed, lanceolate tepals, with crisped margins. Like other species of *Ferraria*, the filaments are united in a slender column for most of their length, and the style divides at the apex of the filament column to form three flattened, somewhat petaloid style branches that are deeply forked, with an abaxial stigmatic surface, and with fringed distal margins that extend over the stigma lobes.

Ferraria ovata (Thunberg) Goldblatt & J. C. Manning, comb. nov. Basionym: *Moraea ovata* Thunberg, Prod. pl. cap. 186. 1800. TYPE: South Africa. Northern Cape (Namaqualand near Koksfontein), without date, *Masson in herb. Thunberg 1225* (holotype, UPS). Figure 1.

Plants 4–20 cm high, mostly unbranched. Corm discoid, ca. 2 cm diam., the old corms persisting beneath the current one. Stem erect, terete. Basal leaves linear, channeled below, to 4.5 cm long, the upper half unifacial, ca. 2 mm wide, upper leaves amplexicaul, broadly ovate and concave with narrow reddish membranous margins, 1.5–1.8 cm long and up to 1.5 cm wide, with a short, unifacial tip; leaves of immature plants unifacial, linear, up to 15 cm long, ca. 2 mm wide. Inflorescence a rhipidium of 1 or 2 flowers, spathes green, leathery, ovate with narrow reddish membranous margins, the outer 10–12 mm long, the inner 12–15 mm long. Flowers actinomorphic, lightly acrid-scented, lasting 1 day, cream streaked with maroon, the tepal limbs spreading or lightly reflexed, yellow marked with a few brown spots and with undulate and minutely crisped chocolate brown margins; tepals free, lanceolate, subequal, the inner slightly smaller than the outer, the claws ascending, forming a cup ca. 7 mm deep and ca. 8 mm diam. at the rim, the inner 15–18 × 5–6 mm with claws 6–7 mm long, the outer 15–20 × 7–9 mm with claws 6–7 mm long; nectaries bipartite with two concave hollows, 2 × 2 mm, situated between the lower third and middle of the tepal claws. Filaments united in a smooth column, 7–8 mm long; anthers diverging, appressed to the style branches, 2 mm long, the anther lobes parallel. Ovary included in the spathes, ovoid, 6 mm long; style dividing at the apex of the filament column, the branches diverging, deeply divided, terminating in feathery crests, the stigma lobes abaxial, below the crests. Mature capsules and seeds unknown.

Flowering time. June and possibly July.

Distribution. *Ferraria ovata* is apparently restricted to south-central Namaqualand, where it occurs on stony, granite-derived soil at middle elevations. Despite the few collections known, it may be more common than the record indicates. Plants are inconspicuous except in flower, and flowering occurs early in the season when little plant exploration is undertaken to Namaqualand, where the main flowering occurs in August and September.

Relationships. In her account of *Ferraria*, de Vos (1979) recognized two main clusters of species plus the monotypic section *Glutinosae* for the south tropical African *F. glutinosa* (Baker) Rendle. Sections *Ferraria* and *Glutinosae* comprise *Ferraria* species with the apparently plesiomorphic feature of parallel anther lobes. While section *Glutinosae* has flowers with a plesiomorphic ovoid-truncate ovary and capsule, species of section *Ferraria* have an elongate, spindle-shaped ovary lacking a sterile beak (rostrum) except in *F. schaeferi*. Species of

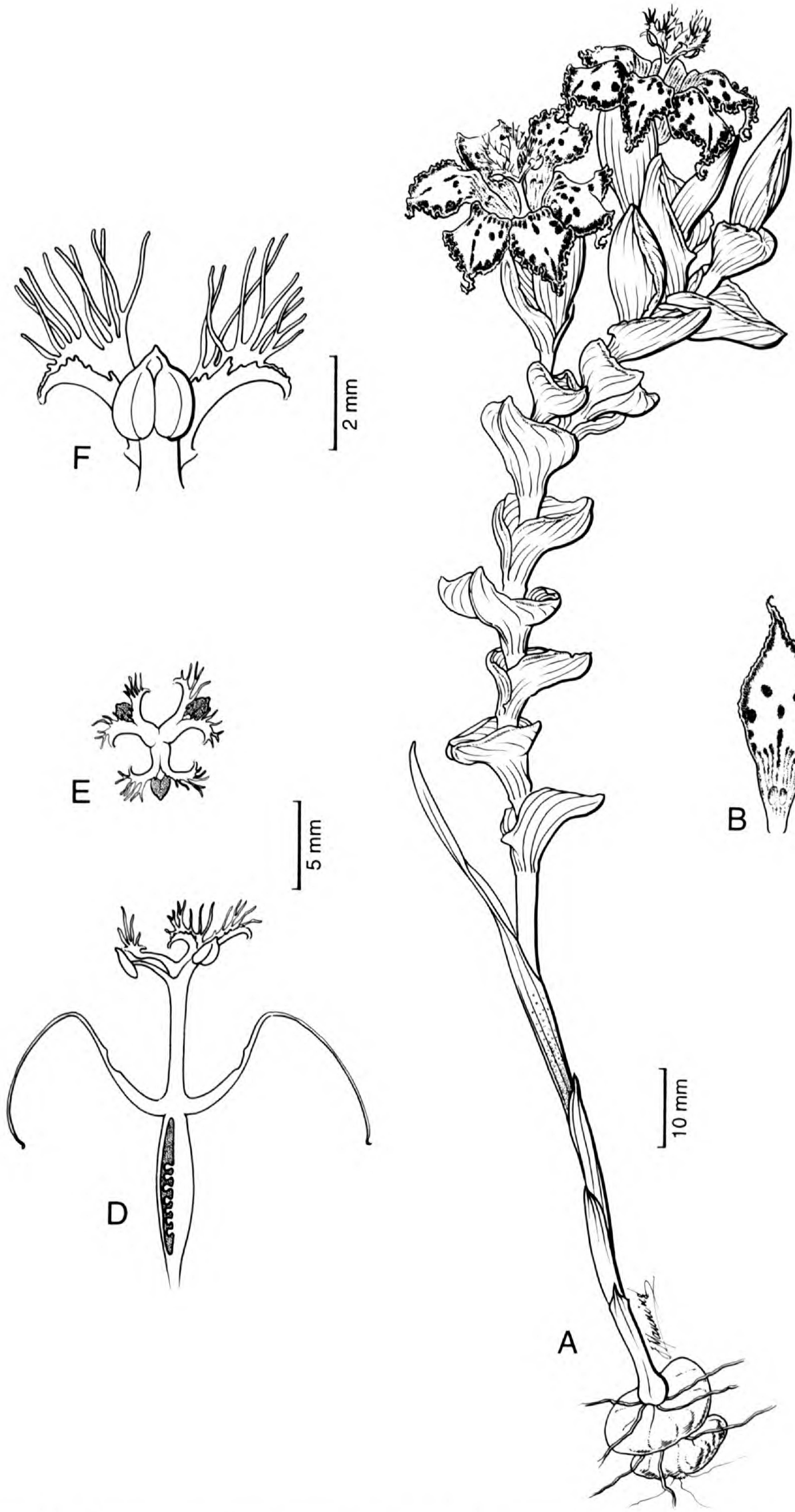

Figure 1. *Ferraria ovata* (Thunberg) Goldblatt & J. C. Manning. —A. Entire plant with corm. —B. Inner tepal. —C. Outer tepal. —D. Diagrammatic section of flower showing spindle-shaped ovary, filament column, and orientation of the style branches and anthers. —E. Top view of style branches showing divided style branches with fringed margins and position of the anthers (shaded). —F. Detail of the tip of one style branch and anther with parallel lobes. Drawn by J. C. Manning from *Manning 2350* (NBG).

Ferraria sect. *Macroscyphae* have an apomorphic rostrate ovary with a sterile, somewhat tubular beak at least 8 mm long, and anther lobes that either diverge from the apex or are initially parallel but later diverge toward the base (only *F. ferrariola* (Jacquin) Willdenow, which thus seems somewhat ambiguously placed in the section).

Ferraria ovata is clearly a member of section *Ferraria* and resembles *F. densepunctulata* M. P. de Vos of the Cape west coast in several aspects, particularly its marked heterophylly, with the blades of the lower leaves linear and up to 5 mm wide, small stature, and especially significantly in the position of the nectaries. In all other species of *Ferraria* the nectaries are situated at the base of the tepals, but in *F. densepunctulata* and *F. ovata* they are situated near the middle of the tepal claws. The two species resemble one another also in their early flowering, in May and June. They differ most significantly in the shape of the cauline leaves and in the color and longevity of the flowers. In *F. densepunctulata* the cauline leaves are lanceolate, unlike the ovate, cucullate cauline leaves of *F. ovata*, and the pale gray or greenish flowers are finely marked with maroon or purple spots, bear conspicuous yellow-green nectaries, and remain open for two days, unlike the yellow, boldly marked flowers of *F. ovata* that last just one day and have inconspicuous cream nectaries streaked with maroon.

Species of section *Ferraria* are confined to the west coast and near interior of South Africa and southwestern Namibia, an area that lies entirely within the southern African winter-rainfall zone.

Biology. The slightly fetid-smelling, dull-colored, brown-speckled flowers are typical of *Ferraria*, most species of which are visited by muscid and calliphorid flies (unpublished data), and which we assume are fly-pollinated, as did Vogel (1954). *Ferraria ovata* may likewise be considered to share this pollination strategy, for we observed several muscid flies crawling on the flowers and carrying loads of the orange-colored pollen of the species. Flies were not captured for identification. Flies visit the flowers to feed on nectar produced from the nectaries located on the tepals.

A Revised Key to Section *Ferraria*

DISCUSSION

We include *Ferrariola ferrariola* in the key below, for although it was included in section *Macroscyphae* by de Vos, its sectional position is ambiguous. It shares with section *Ferraria* the nearly parallel anther lobes (they diverge from the base with age), but it has the rostrate ovary characteristic of section *Macroscyphae*, also, however, present in *F. schaeferi* Dinter of section *Ferraria*. In particular, *F. ferrariola* shares the heterophyllous condition with *F. densepunctulata* and *F. ovata*. Whatever its correct sectional position, it seems helpful to include *F. ferrariola* in the key to section *Ferraria*.

1a. Stem slender with internodes partly exposed; lower leaves linear to falcate, with blades usually less than 5 mm wide; nectaries situated at the base or near the middle of the tepals.
2a. Basal leaf sheaths conspicuously reddish or red-spotted; nectaries situated at the base of the tepal claws; ovary rostrate; stigmas large and flap-like, partially obscuring the anthers . . . . *F. ferrariola*
2b. Basal leaf sheaths at most faintly flushed reddish; nectaries situated near the middle of the tepal claws; ovary rostrate; stigmas minute, at the tip of curving, horn-like branches.
3a. Cauline leaves ovate-cucullate; flowers yellow with brown margins and a few conspicuous spots; nectaries cream streaked maroon . . . . *F. ovata*
3b. Cauline leaves lanceolate-attenuate; flowers gray or greenish with minute brown or maroon speckling; nectaries yellowish green . . . . *F. densepunctulata*
1b. Stem stout, mostly covered by leaf bases; leaves sword-shaped to falcate, with blades more than 5 mm wide; nectaries situated at the base of the tepals.
4a. Ovary with a short tapering rostrum ca. 8 mm long; tepals 22–25(–30) mm long, yellow with dark brown margins and blotches, often coalescing in the outer quarter; flowers sweetly scented . . . . *F. schaeferi*
4b. Ovary without a tapering rostrum; tepals 25–35 mm long, flowers variously colored, usually dark maroon or purple with paler margins or cream to pale yellow and variously striped and blotched; flowers with an unpleasant fetid scent.
5a. Leaves with a thickened zone in the middle and a strong pseudomidrib, 2-ranked . . . *F. crispa* Burman
5b. Leaves with numerous veins of equal size and without a pseudomidrib, often spirally 2-ranked . . . . *F. foliosa* G. J. Lewis

Additional specimens (cited according to the geographical quarter-degree square system for indicating latitude and longitude in use in southern Africa). SOUTH AFRICA. **Northern Cape:** 30.17 (Hondeklipbaai) Farm Doornfontein, Steenkamp Kraal (BA), 2 Sep. 1995 (sterile), *Le Roux 4658* (JONK). **Western Cape:** 30.18 (Kamiesberg) Farm Gannabos on road from Bitterfontein to Kliprand (CD), 10 Aug. 2000 (sterile), *Goldblatt & Manning 11373* (MO, NBG), 6 June 2001, *Manning 2350* (NBG); Knersvlakte, Farm Steenbokskraal, 20 Aug. 1999, *National Geographic-IPC Expedition 115* (NBG).

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One New Combination and One New Species in *Leiomitra* (Trichocoleaceae, Hepatophyta) from Southern South America

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ABSTRACT. *Trichocolea elegans* Lehmann is transferred to the genus *Leiomitra* Lindberg, because gynoecia have been found in several specimens with a coelocaule, perianth, and thin calyptra. *Leiomitra smaragdina* Hässel sp. nov. also belongs to this genus as confirmed through female specimens. Both species, present in Chile and in Argentina, are described and illustrated, with the distinguishing characters emphasized.

RESUMEN. *Trichocolea elegans* Lehmann se transfiere al género *Leiomitra* Lindberg porque se encontraron ginoecios en varios especímenes con celocaule, periantio y una delgada caliptra. *Leiomitra smaragdina* Hässel sp. nov. pertenece también a este género como fue confirmado a través de especímenes femeninos. Se describen e ilustran ambas especies, presentes en Chile y en Argentina, con énfasis en sus caracteres distintivos.

Key words: Argentina, Chile, Hepatophyta, *Leiomitra*, Trichocoleaceae.

The characters or circumscribing concepts for the genera *Trichocolea* Dumortier corr. Nees 1838, nom. conserv., and *Leiomitra* Lindberg 1875 were discussed by Hatcher (1957, 1959), Engel (1999), and Schuster (1980, 1984, 2000). *Trichocolea* is considered to be distinguished by a pinnate growth form, the female organs terminal on main shoots, and sporophytes surrounded by a hirsute calyptra, covered with paraphyllia (see Hatcher, 1959). *Leiomitra* does not present a regular pinnate growth form, female organs are developed on short lateral branches, and the calyptra is smooth and free, included in a coelocaule that ends in a perianth (see Hatcher, 1959), corresponding to *Trichocolea tomentosa* (Swartz) Gottsche in *Trichocolea* sect. *Laeviflora* Gottsche (see Schuster, 1984, fig. 52).

Only *Trichocolea* was reported from southern South America, with two species: *T. elegans* Lehmann, by Hatcher (1957), Fulford (1963), Engel (1978), and Schuster (2000), present along the southwest humid side of the continent; and *T. elliottii* Stephani, a Caribbean species, disjunct and restricted to the Juan Fernández Islands by Hatcher (1957) and Fulford (1963). Schuster (2000) concluded that some species in his tentative key of *Trichocolea* (which includes *T. elegans* and *T. elliottii*) may prove to belong to the genus *Leiomitra*, as the specimens he had seen were sterile.

The discovery of a third species, in a recent excursion, induced me to check all my putative collections of *Trichocolea* sensu R. Hatcher as well as those of some other institutions in the hope of revealing additional specimens. Instead I found some female "*Trichocolea elegans*" plants and several male plants. Androecia, gynoecia, and sporophytes were unknown to Hatcher (1957) and to Fulford (1963). Engel (1978: 78) cited a fertile specimen from Chile, Brunswick Peninsula, B. Fortescue "*c. sporo.*," but gave no further details.

Close observation of the gynoecia found on what was known as "*Trichocolea elegans*" has shown that all these specimens belong to *Leiomitra*. Therefore, a nomenclatural change is necessary, along with the description of the characters that support these changes.

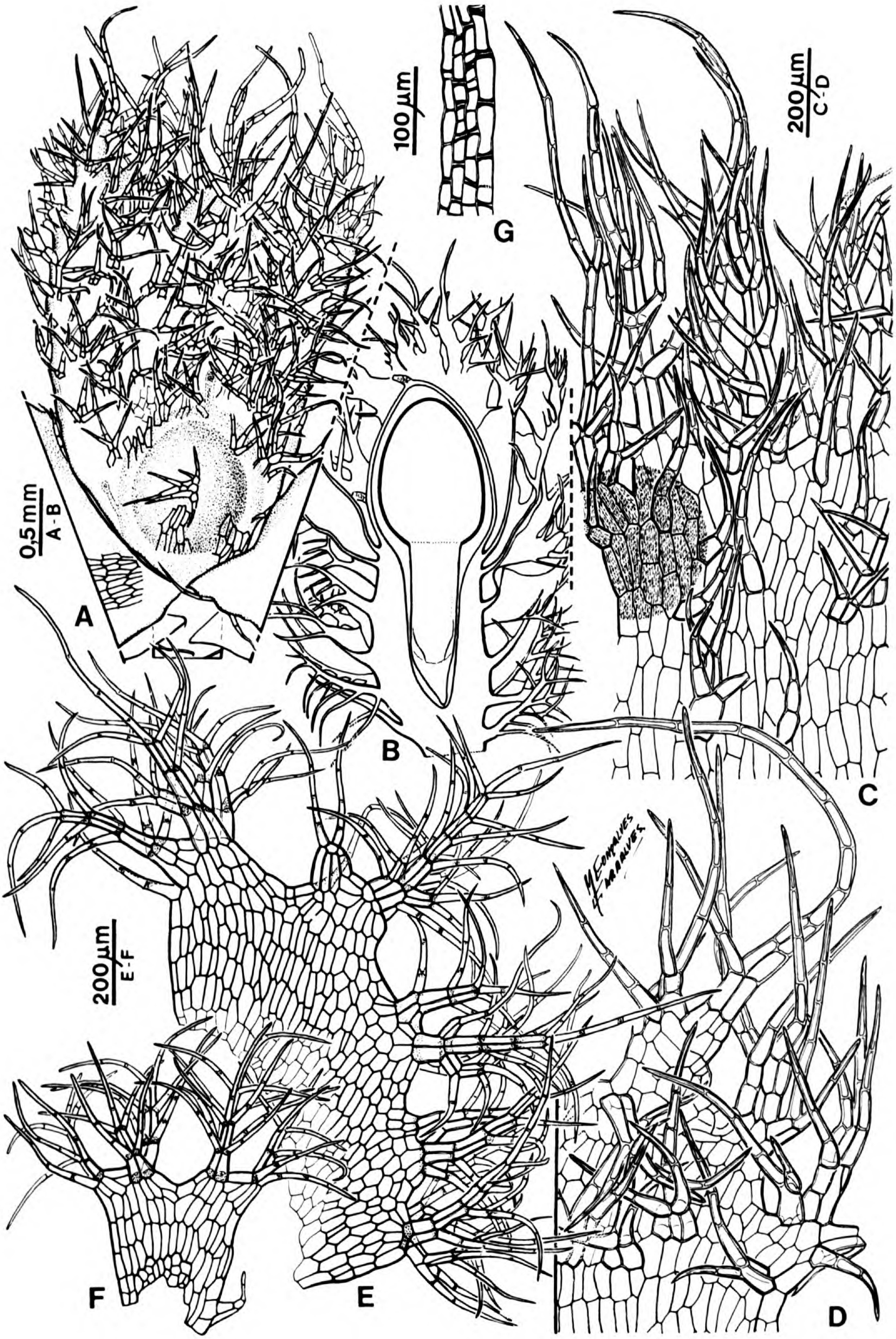
Leiomitra elegans (Lehmann) Hässel, comb. nov. Basionym: *Trichocolea elegans* Lehmann, Nov. Minus Cog. Stirp. Pug. 10: 8. 1857. TYPE: Chile. Valdivia, *Lechler s.n.* (holotype, not seen; isotype, NY). Figure 1.

Trichocolea verticillata Stephani, Bih. Kongl. Svenska Vetensk.-Akad. Handl. 26 (III, 6): 57, 1900. TYPE: Chile. "Valdivia," 1887. *Dr. Hahn s.n. hb. Jack* (♀ cum capsula) (lectotype, designated here, M); syntypes: "Ensenada," *P. Dusén s.n.* (G); "Aysen," *P. Dusén s.n.* (G); "Pto. Bueno," *P. Dusén s.n.* (G); "Chiloé," *P. Dusén s.n.* (G).

Trichocolea decrescens Stephani, Bih. Kongl. Svenska Vetensk.-Akad. Handl. 46(9): 77, fig. 30b–c, 1911. TYPE: Chile. "Caleta Rayo," *C. Skottsberg 557* (lectotype, designated by Engel (1978), G); "Juan Fernández Islands. El Yunque," *C. Skottsberg s.n.* (syntype).

Detailed descriptions. R. Hatcher (1957: 16, figs. 98–110), Fulford (1963: 48, fig. 6a–e).

Description of additional characters. Branching sometimes 1(or 2)-pinnate, frequently irregular, the


0,5 mm
A-B
A
B
100 µm
G
200 µm
C-D
C
200 µm
E-F
F
E
D

main shoot not distinguishable; the distance of leaf insertion quite variable. Oil bodies ovoid to fusiform, refringent pale yellowish, (6)8 to 11 per leaf cell, 5–7 × 2.5–3.5 μm. Male plants irregularly 1-pinnate. Androecia inconspicuous with 3 to 4 pairs of bracts on main shoot or branches, successive but intercalary between long sets of normal leaf cycles. Bracts of the same size and armature as vegetative leaves, dorsal portion of lamina enlarged, covering antheridia. Antheridia globose, 150–200 μm diam., 1 (or 2) per bract, with biseriate stalk. Gynoecia inconspicuous, terminal on main stem or enlarged branches, but through development of adjacent terminal branch becoming delayed as short lateral branches. Archegonia covered by bracts and bracteole similar to the leaves and amphigastria, although with an enlarged lamina, 0.4–1.5 mm high (including segments), the segments at their base 12 to 15 cells wide, the dorsal ones being larger. Mature gynoecium 2.5–3 mm long, coelocaule wall 8 to 9 cells thick, covered with 3 to 4 cycles of leaves that are identical to the vegetative leaves. The unistratose perianth, not surpassing the bracts, smooth at its base, covered above with isolated but crowded short, curved, simple, or furcate to opposed ciliate structures, reminiscent of leaf cilia; mouth laciniate-ciliate, each lacinia similar to bract segments, 8 to 10 cells wide at their base, with several opposed pairs of cilia, final uniseriate filament rather straight, 4 to 6 cells long. Calyptra free, thin, with sterile archegonia on its base. Foot as deep as the 3 or 4 pairs of leaves. Seta 2.5–3.5 mm long. Capsule brown, ellipsoid. Capsule wall 4-stratose, outer cells prismatic with thin walls and occasional brown thickenings, inner cells fusiform, irregularly arranged with semiannular brown thickenings. Spores red-brown, hispid, 23 μm diam. Elaters nearly straight, 205–250 μm long, 5–11 μm wide, with 2 (to 3) helicoidal brown thickenings.

The distinguishing characters of *Leiomitra elegans* (Lehmann) Hässel are: the pale grayish green color; the spongy consistency; shoots ca. 1.2 mm wide; leaves with 5 opposite ciliate arching segments trifid at their bases.

The completely developed gynoecia of this taxon, here described and illustrated for the first time and verified from several samples, confirm that it belongs to *Leiomitra*. The general aspect of the gynoecium of *Leiomitra elegans* is also reminiscent of that of *Leiomitra hirticaulis* R. M. Schuster, (see Schuster, 1984, fig. 52).

Examination of approximately 200 samples of *Leiomitra elegans* reveals that its growth form is usually pendulous, loosely or compactly interwoven with other hepatics. It occurs in dripping carpets, not only on old trunks in the temperate forests, but also on fallen logs, on humid rock walls, on crevices above waterfalls, wet banks by streams, and the floor of *Nothofagus* forests. Its presence has been confirmed in Chile and Argentina, from Villarica in Chile to Isla de los Estados (Staten I.) at the tip of Tierra del Fuego in Argentina, as well as in the islands that surround Chiloé and the Channel Islands, like Piazzi Island, Rennel Island, Vidal Gormaz Island, Virtudes Island, and Diego de Almagro Island.

Selected specimens. CHILE. Corral, (♂), *R. A. Pérez Moreau s.n.* (BA 2427). **Región X:** cerca de Termas El Amarillo, (♂), *G. Hässel de Menéndez (G.H.M.*) 11241* (BA). **Región XI:** 20 km W of La Tapera, Mina Sta. Teresa, (♂, ♀), *Hyvönen 5156* (BA); Parque Nacional Queulat, *G.H.M. & M. Rubies 12661* (BA); Clarence Island, (♂, ♀), *Hyvönen 2951* (BA); Seno Ultima Esperanza, Ancón Sin Salida, Seno Unión, (♀), *S. W. Greene, Transecta Botánica de la Patagonia Austral-Bryophytes (TBPA-B**) 878 b* (BA); Piazzi Island, Caleta Ocasión, (♀), *G.H.M., TBPA-B 899* (BA); Rennel Island, (♀), *G.H.M., TBPA-B 1331* (BA); Vidal Gormaz Island, Caleta Nantuel, (♀), *G.H.M., TBPA-B 1412j* (BA), *G.H.M., TBPA-B 1449* (BA); Virtudes Island, Pto. Virtudes, (♀), *G.H.M. TBPA-B 1913* (BA). ARGENTINA. **Neuquén:** Brazo Blest, Arroyo Bravo, *O. Kühnemann* (♀, cum capsula) (BA 2161b). **Río Negro:** Pto. Blest, camino a Los Cántaros, *G.H.M. 8921* (♂) (BA), *G.H.M. 9785* (♂, ♀) (BA); Río Negro, Lago Frías, cerca de la casa del guardaparque, *G.H.M. 177* (♂, ♀ cum capsula) (BA, MO), *R. A. Pérez Moreau* (♂) (BA 4612a), camino al límite con Chile, *G.H.M. 364* (♀ c. caps) (BA). **Chubut:** Lago Menéndez, circuito Río Cisnes, *G.H.M. 6475* (♀ juv.) (BA). **Tierra del Fuego:** Isla de los Estados, B. Hoppner, *G.H.M. 4681* (♀ juv.) (BA).

*G.H.M. = *G. Hässel de Menéndez*; **TBPA-B = *Transecta Botánica de la Patagonia Austral-Bryophytes.*

Leiomitra smaragdina Hässel, sp. nov. TYPE: Chile. Parque Nacional Queulat, sendero de la cascada, cuesta 615 msm, (♂, ♀, cum capsula) 22 Mar. 1999, *G. Hässel de Menéndez & M. Rubies 12642* (holotype, BA; isotype, MO). Figure 2.

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Figure 1. *Leiomitra elegans* (Lehmann) Hässel. —A. Bracts, perianth (light shading), and capsule (darker shading). —B. Longitudinal section of gynoecium. —C. Apical portion of perianth with superficial cilia and cuticle shaded on left. —D. Apical portion of bract. —E. Leaf. —F. Amphigastrium. —G. Transverse section of capsule wall. (A, B, D from *G. Hässel de Menéndez, Transecta Botánica de la Patagonia Austral-Bryophytes 1913* [BA]; C, G from *G.H.M. 177* [BA]; E, F from *G.H.M. & M. Rubies 12661* [BA].)


A
B
C
D
E
F
G
H
I
J
K
L
1mm
A-B
0,5mm
C-D-H
200µm
E-J-K
100µm
200µm
F-G-I
H.GONÇALVES CARRALVES.

Plantae smaragdinae minutae, facie hirsuta. Folia lamina deminuta 5-segmentata. Amphigastria 4-segmentata. Segmenta attenuata ciliata; cilia rigida paribus oppositis, 0–2 furcata. Dioica. Gynoecium coelocaule bracteis tecto ad apicem perianthio segmentato ciliato.

Plants minute, solitary or in groups, flat and tightly adherent to other small plants, emerald green, appearing hirsute, shoots including stem and leaves 0.49–0.65 mm wide, regularly to irregularly 1- or 2-pinnate; branches alternate, most of them lateral terminal of the *Frullania* type, of variable length, very occasionally ventral intercalary branches present. Stem cylindric, 97–146 μm diam., 5 to 7 (to 10) cells diam., with 14 to 26 peripheral cells, medullar cells 15–30 μm diam., epidermal cells 12–15 μm diam.; cortex undifferentiated, cuticle coarsely striolate. The main stem with uniseriate Y- or I-shaped paraphyllia, 2 or 3 (to 5) cells long. Leaves spreading, with oblique insertion, asymmetric, divided into 5 ciliate segments. Leaves including segments 0.40–0.60 mm long. Lamina (1)2 to 4 cells high (cells 35–47 μm high, 12–23 μm wide, and 12–14 μm thick), sometimes with small lateral teeth. Segments at base (2)4 cells wide, distally 2 cells wide, these cells 35–47 μm long, segment apex tapered, 1-seriate 3 to 4 cells long, the tip cell 75–130 μm long, central segments with 4 to 5 pairs of opposite cilia, lateral segments with 3 to 4 pairs of cilia; proximal cilia 1 or 2 furcate; cilia consisting of rather stiff and straight cells, borne on the abaxial side of the segments, with furcate branching and swept toward the tip of the shoot; whole surface of leaves coarsely striolate. Amphigastria up to 0.99 mm long including segments. Undivided portion of the lamina 1 to 2 cells high; segments 4, the central sinus deepest; cilia opposite as in leaves. Rhizoids, when present, at base of amphigastria. Dioicous. Androecia fusiform, conspicuous, on stem and branches with 5 to 6 or more (?) pairs of saccate perigonial bracts, the dorsally convex lamina 5 to 6 cells high, with segments and cilia similar to the leaves; 1 or 2 antheridia per bract; globose, 160 μm diam., stalk biseriate. Gynoecia inconspicuous, terminal on stem, becoming displaced when unfertilized. Bracts and bracteoles in 2 series surrounding the coelocaule; bracts up to 2 mm long (including segments and cilia), lamina higher than in leaves, with superficial branched cilia; the 5 segments ciliate as in leaves; bracteole similar to amphigastria but more shallowly segmented. All tips of segments and cilia swept toward shoot tip. Perianth not emerging, 2–2.5 mm high, ending in segments and cilia similar to those of the leaves but with more delicate cell walls. Calyptra thin; sterile archegonia at bottom in contact with perianth base. Capsule dark brown, spherical 3- or 4-stratose. Spores brown, hispid, 18–23 μm diam. Elaters brown, 190–260 μm long, 9–12 μm diam. in the middle, attenuate tips 5 μm diam., with 2 to 3 helicoidal thickenings.

Distinguishing characters of *Leiomitra smaragdina*, a species from southern South America, are: the emerald green color when alive (hence the specific epithet), the small size relative to other *Leiomitra* species, the reduced foliar lamina with the stiff segments and cilia spreading and directed toward tip of shoot, which give it a hirsute effect.

Other paraphyllose species of *Leiomitra* are present in tropical South America, as indicated by Schuster (2000: 147) in a key: *L. paraphyllina* Spruce, *L. hirticaulis* R. M. Schuster, and *L. robusta* (Stephani) R. M. Schuster. In these taxa the leaf lamina is higher than in *L. smaragdina*, more than 4 cells, and the perianth is absent, low, or vestigial.

Leiomitra smaragdina grows on bark of different tree species, in the same habitat as *Leiomitra elegans*, but the smaller plants are less exuberant than this species, and the individuals are often attached to other hepatics, like *Porella subsquarrosa* (Nees & Montagne) Trevisan, *Chiloscyphus striatellus* C. Massalongo, *C. ctenophyllus* (Schiffner) Hässel, *C. inflexispinus* (Hooker f. & Taylor) J. J. Engel & R. M. Schuster, or grow with *Riccardia spinulifera* C. Massalongo, *Plagiochila lophocoleoides* Montagne, *P. bispinosa* Lindenberg ex Gottsche, *Acrobolbus ochrophyllus* (Hooker f. & Taylor) R. M. Schuster, *Pigafettoa crenulata* C. Massalongo, *Leiomitra elegans* (Lehmann) Hässel, *Tylimanthus limbatus* Stephani, *Jamesoniella colorata* (Lehmann) Spruce ex Schiffner, and *Apometzgeria frontipilis* (Lindberg) Kuwahara & J. J. Engel. Thus far, the new species has been found only in the XI Chilean Region, where areas of the temperate rain forest of *Nothofagus* species still exist. In Argentina *Leiomitra smaragdina* has been found on trunks of *Nothofa-*

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Figure 2. *Leiomitra smaragdina* Hässel. —A. Female plant. —B. Male plant. —C. Perianth with capsule (shading). —D. Longitudinal section of gynoecium. —E. Apical portion of perianth with superficial cilia, cuticle indicated by shading below. —F. Leaf. —G. Amphigastrium. —H, I. Perigonial bracts. —J. Apical portion of bract. —K. Transverse section of capsule wall. —L. Transverse section of stem with paraphyllia. (A–L from holotype, *G.H.M. & M. Rubies 12642* [BA].) Note: C, D, E, J have a different magnification from similar details in Figure 1 for *L. elegans*.

gus dombeyii, together with other bryophytes like *Plagiochila bispinosa* Lindenberg ex Gottsche, *P. heterodonta* (Hooker f. & Taylor) Gottsche et al., and *Leiomitra elegans* in the Nahuel Huapi and Los Alerces National Parks, located in the provinces Neuquén, Río Negro, and Chubut. Only one specimen, the type, has been found with a single capsule.

Specimens examined. CHILE. **XI Región:** Lago Risso Patrón, 115 msm, *G.H.M. & M. Rubies 12894* (BA); Carretera Austral, Quebradita, *G.H.M. & M. Rubies 13094* (BA). ARGENTINA. **Neuquén:** Parque Nacional Nahuel Huapi, Villa Angostura, camino al límite con Chile, a 500 m de la Aduana, sobre vara de *Chusquea G.H.M. 8299* (♀ juvenile sterilis) (BA). **Río Negro:** Parque Nacional Nahuel Huapi, Lago Frías, camino al Tronador, *G.H.M. 162* (♀ juv. ster.) (BA 22913); Lago Nahuel Huapi, Pto. Blest, *G.H.M. 87* (♀ juv. ster.) (BA 9471), *G.H.M. 102* (♀ juv. ster.) (BA 9486). **Chubut:** Parque Nacional Los Alerces, Lago Menéndez, *O. Kühnemann* (BA 4946 a).

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Two New Species of *Pectis* (Asteraceae: Tageteae) from South America

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ABSTRACT. *Pectis hassleri* and *P. pumila* are new species, the former from the Gran Chaco area of Paraguay and the latter from southwestern Ecuador and northwestern Peru. *Pectis hassleri* differs from *P. odorata* by leaves that are glandular-punctate on the adaxial as well as the abaxial surfaces, by longer and wider ligules of the ray florets, and by ray pappi of awns and shorter bristles. *Pectis pumila* differs from the closely related *P. arida* by its wider leaves and by its sessile or subsessile capitula with campanulate involucres and obovate phyllaries. A hexaploid chromosome count of $2n = 36_{II}$ is newly reported for *P. pumila*.

Key words: Asteraceae, Compositae, Ecuador, Paraguay, *Pectis*, Peru, South America, Tageteae.

As part of monographic studies of *Pectis* L. (Asteraceae: Tageteae), I have discovered two previously undescribed South American species.

Pectis hassleri Keil, sp. nov. TYPE: Paraguay. Gran Chaco: Loma Clavel, 23°20′S, Nov. 1903, *E. Hassler 2491* (holotype, G; isotypes, BM, F, GH, K, LIL, MICH, MO, NY, P, S, UC, US).

P. odoratae affinis sed glandibus pellucidis numerosis in lamina adaxiali, ligulis flosculorum radiorum longioribus (5.5–6.5 mm vs. 3–4 mm) et latioribus, et pappis acheniorum radiorum 2–3 aristarum 2.5–4 mm longum et ca. 10 setarum breviorum versus 30–40 setarum usque ad 7 mm longum diversa.

Annual or sometimes apparently perennial; herbage probably scented, but nature of odor unknown. Stems spreading to erect or ascending, 10–35 cm long, several-branched from near the base, few-branched above, moderately to densely leafy, purple-brown, glabrous or sparsely to densely puberulent. Leaves opposite, lance-linear, often falcate, 2–5 cm long, 2–4 mm wide, acute, mucronate to bristle-tipped, proximally ciliate with 2 to 5 pairs of bristles 2–3 mm long, glabrous or sparsely distally scaberulous on the margins, densely dotted on both surfaces with round, pellucid glands 0.1–0.2 mm diam., the glands of the adaxial surface smaller and more numerous than those of the abaxial surface, minutely ciliolate near the base, otherwise glabrous. Capitula long-peduncled, solitary or in open, few-headed cymes, ca. 38- to 75-flowered; peduncles 3–11 cm long, slightly clavate, bearing 3 to 7 linear-acuminate scale-like bractlets 3–6 mm long or the proximal bract larger and leaflike. Involucres campanulate; phyllaries 8 (to 10), oblanceolate to obovate, 6–8.5 × 2–3.5 mm, broadly overlapping, subacute, weakly convex, proximally rounded and gibbous, indurate-keeled in the proximal ½–⅔, narrowly hyaline- or purple-margined in the proximal ⅔, densely dotted or streaked with elliptical to linear glands, distally ciliolate. Ray florets 8 (to 10); corolla yellow or reddening abaxially, 9–10 mm long, the tube 3–3.5 mm long, the ligule narrowly ovate, 5.5–6.5 mm long, glabrous. Disk florets 30 to 65; corolla yellow, 4–6 mm long, weakly 2-lipped, slightly exceeding the pappus, the tube and throat about equal, the abaxial lip ca. 1 mm long, 2–3× as long as the 4 lobes of the adaxial lip; anthers ca. 2 mm long; style exserted. Achenes 3.5–4 mm long, sparsely appressed-puberulent with trichomes 0.2–0.4 mm long; ray pappus of 2 or 3 stiff awns 2.5–4 mm long and ca. 10 shorter bristles 1–2 mm long; disk pappus of 20 to 30 slender bristles 2–5 mm long. Chromosome number unknown.

Distribution. Endemic to the Gran Chaco area of Paraguay, this species is represented by only a handful of collections with rather sparse data. I have not been able to determine a precise location for any of the collections examined. Elevation data are unavailable. Essentially nothing is known about the ecology of the species. Known flowering dates range from November to June.

Relationships. *Pectis hassleri* is one of the very few species of *Pectis* with glands on the adaxial leaf surface. In most other species the glands are confined to the abaxial surface of the leaf or to the margins. The significance, if any, of these extra glands is unknown. The glands are similar in size and shape to those of the related *P. odorata* A. H. R. Grisebach and *P. substriata* H. H. Rusby, both

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of which are strongly scented. Presumably *P. hassleri* is scented as well.

I have named the species in honor of Erich Hassler, a pioneer in botanical studies of Paraguay. Hassler recognized the type collection of *P. hassleri* as a distinct taxon and considered it to be a variety of *P. odorata*. He assigned it an unpublished varietal epithet alluding to broad ligules.

Paratypes. PARAGUAY. Chaco septentrionalis, Puerto Tolancera, 1907, *K. Fiebrig 1330* (G); Chaco, 21°S lat., 1906, *K. Fiebrig 1459* (G, Z); Gran Chaco, s.d., *A. Pride s.n.* (K); in region crossed by the lower portion of the River Pilcomayo, June 1906, *T. Rojas 257* (BAF, BM, G, K, P).

Pectis pumila D. J. Keil, sp. nov. TYPE: Peru. Lambayeque: along Pan American Hwy. ca. 30 km NNW of Piura, 7 km S of Puente Sullana (over Río Chira), 30 Mar. 1987, *D. J. Keil et al. 19917* (holotype, F; isotypes, ASU, BM, CPUN, F, G, GH, HUT, K, MEXU, MO, NY, OBI, OS, RSA, S, TEX, UC, US, USM).

P. aridae D. J. Keil affinis sed foliis saepe latioribus, capitulis sessilibus vel subsessilibus, involucris campanulatis, et phyllariis obovatis diversa.

Erect or diffusely branched, often strongly scented, tap-rooted annuals. Stems 1 to several from the base, erect or diffusely spreading, 3–50 cm long, cymosely branched distally, straw-colored to dark purple-brown, puberulent throughout or in lines extending from the connate flange and midribs of the leaf bases with soft, multicellular trichomes 0.1–0.2 mm long. Leaves opposite, linear-oblanceolate or lanceolate, 2–4 cm long, 2–6 mm wide, obtuse to subacute, mucronate or bristle-tipped, with the base narrowed or more often conspicuously expanded, entire and ciliate to beyond the middle with slender bristles 2–4 mm long or serrate with bristle-tipped teeth, punctate abaxially with scattered, round, pellucid glands 0.2–0.3 mm diam., scaberulous along the margins, sparsely hirtellous proximally along the margin and midrib with trichomes 0.1–0.2 mm long, otherwise glabrous. Capitula solitary, sessile or subsessile in the forks of the stems, subtended by 1 or 2 scarious, lance-acuminate bractlets, 24- to 31-flowered. Involucres campanulate; phyllaries 5 or 6, obovate, broadly overlapping, 5–7 × 2.5–4 mm, obtuse to subacute, mucronulate, broadly scarious-margined, broadly convex and inconspicuously round-keeled, distally sparsely punctate with 1 to several elliptic glands 0.2–0.3 mm long, sometimes streaked proximally with linear glands or occasionally glandless, erose-ciliolate at the apex, otherwise glabrous. Ray florets 5 or 6; corolla yellow or becoming pink, 4–5 mm long, the tube 1.5–2 mm long, the ligule slender, 2.5–3 mm long, glabrous. Disk florets 19 to 25; corolla yellow, weakly 2-lipped, glabrous or glandular-puberulent, 2.5–3.5 mm long, the tube 0.8–1 mm long, the throat 0.6–1.2 mm long, the abaxial lip 1–1.3 mm long, 2–3× as long as the 4 lobes of the adaxial lip; anthers ca. 1 mm long; style about as long as the corolla, included. Achenes 2.7–3.8 mm long, strigillose with 2-celled hairs 0.2–0.3 mm long. Ray pappus of 1 or 2 paleaceous-based, antrorsely barbed bristles 2–2.5 mm long or sometimes reduced to scales 0.5 mm long or shorter, sometimes with 1 or 2 additional scales between the bristles. Disk pappus of 15 to 25 unequal paleaceous-based, antrorsely barbed bristles 1.5–4 mm long. Chromosome number: $2n = 36_{\mathrm{II}}$.

Distribution. *Pectis pumila* occurs only in the coastal lowlands of southern Ecuador and northern Peru at 0–250 m. Habitats include arid scrublands, roadsides, and beaches. It often occurs in mixed populations with the closely related *Pectis arida* and with *P. linifolia* L. var. *linifolia*. Some herbarium specimens have mixed gatherings of *P. arida* and *P. pumila*. In beach habitats *P. pumila* grows in proximity to *P. multiflosculosa* (DC.) C. H. Schultz Bipontinus.

Relationships. *Pectis pumila* is apparently most closely related to *P. arida*. Both are much-branched annuals with leaves densely gland-dotted abaxially. The sessile or subsessile campanulate capitula with broad phyllaries differentiate *P. pumila* from *P. arida*, which has peduncled capitula with cylindrical involucres and narrower phyllaries.

This species has been collected for many years, but it either has gone undetermined in herbaria or has been misidentified. Until recently, I believed it to be the taxon described by H. Cassini (1819) as *Cryptopetalon ciliare* (*Pectis cryptopetala* C. H. Schultz Bipontinus). I now know that the type (P) for that name is conspecific with the type of *Pectis sessiliflora* (Lessing) C. H. Schultz Bipontinus. Because the specific epithet used by Cassini when he described the taxon as a member of the genus *Cryptopetalon* is the same as that of a Linnaean species of *Pectis*, many botanists have misidentified *P. pumila* as *Pectis ciliaris* L., a very different taxon not known from western South America.

Chromosome number. A meiotic chromosome number of $2n = 36_{\mathrm{II}}$ (diakinesis) was determined from *Keil et al. 19917-D* (OBI) and is herein newly reported. The well-established base number for *Pectis* is $x = 12$ (Keil, 1977; Keil et al., 1988). *Pectis pumila* is therefore a hexaploid taxon.

Paratypes. ECUADOR. **Guayas:** Salinas, 7 Apr. 1939, *E. Asplund 5620* (S); Salinas, Puntilla, 1 May 1956, *E. Asplund 20369* (S); along Pacific Ocean betw. Santa Elena & San Pablo, 17 Mar. 1973, *L. Holm-Nielsen et al. 2082* (S); Chanduy, 18 Mar. 1973, *L. Holm-Nielsen et al. 2118* (COL, F, NY, S); Punta de Santa Elena, 21 Mar. 1973, *L. Holm-Nielsen et al. 2306* (F, MO, NY, S, U), *2309* (MO, NY, S), *2337* (NY, S), *2356* (F, MO, NY, S, U); Ancón Distr., Santa Elena Peninsula, 7 June 1932, *Sheppard s.n.* (K); Chanduy, *R. Spruce 6476* (BM, E, G, K, LE, OXF), *6477* (BM, G, OXF, P); Salinas, Puntilla, 1–2 Mar. 1941, *H. K. Svenson 11078* (US), *11096* (GH, US); Salinas, Puntilla, 21 Feb. 1941, *H. K. Svenson 11124 p.p.* [mixed with *P. arida*] (US); Salinas, 15 Mar. 1941, *H. K. Svenson 11208* (GH, NY, US); Punta Centinela, 6 Apr. 1941, *H. K. Svenson 11267* (NY); Punta Carnero, Peninsula de Santa Elena, May 1978, *F. M. Valverde 2569* (MO). PERU. **Lambayeque:** near Motupe, 18 Apr. 1953, *R. Ferreyra 9084* (MO, OBI, USM); 24 km S of Motupe, 29 Mar. 1987, *D. J. Keil et al. 19911* (F, MO, OBI, UC). **Piura:** El Alto, 14 May 1957, *H. Ellenberg 1388* (U); Piura, betw. Amotape & Talara, 19 Apr. 1949, *R. Ferreyra 5935 p.p.* [mixed with *P. arida*] (US); Quebrada Mogollon, Amotape hills, 29 Mar. 1941, *O. Haught & H. K. Svenson 11520 p.p.* [mixed with *P. arida*] (NY); E of La Brea, 25 km SE of Talara, 3 Mar. 1939, *O. B. Horton 11581* (G, GH, UC); 39 km NW of Marca Vellica, 30 Mar. 1987, *D. J. Keil et al. 19920* (CPUN, F, HUT, MO, NY, OBI, OS, TEX, UC, USM); betw. Talara & Los Organos, 30 Mar. 1987, *D. J. Keil et al. 19923* (OBI); Talara, s.d., *E. Smith 15* (MO, USM, OBI); Huancabamba, Serrán, 2 Apr. 1939, *H. E. Stork 11368 p.p.* [mixed with *P. arida*] (GH). **Tumbes:** N of Tumbes, 7 May 1957, *H. Ellenberg 1276* (U); Caleta Cruz betw. Zorritos & Tumbes, 27 May 1957, *R. Ferreyra 12220* (MO); Caleta Cruz, 25 Apr. 1955, *R. Ferreyra et al. 10694 p.p.* [mixed with *P. arida*] (OBI, USM); beach just S of Cancas, 30 Mar. 1987, *D. J. Keil et al. 19925* (ASU, BM, CPUN, F, G, GH, HUT, K, MO, NY, OBI, RSA, S, UC, US, USM); beach 2 km N of Cancas, 30 Mar. 1987, *D. J. Keil et al. 19929* (CPUN, F, HUT, MO, OBI, USM).

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A New Species of *Anthurium* (Araceae) from Southern Ecuador and a Revision of the *Anthurium oxybelium* Schott Complex

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ABSTRACT. *Anthurium obpyriforme* from Loja province in southern Ecuador is described as new. This species has been confused with *A. oxybelium* Schott but shows considerable morphological and ecological differences. *Anthurium oxybelium* is introduced as the oldest name of a widespread upland species, and its relevant synonymy is included. A key is provided to distinguish *Anthurium obpyriforme* from the latter and other related high-altitude species of *Anthurium* sect. *Belolonchium* in Ecuador.

Key words: Andes, *Anthurium*, Araceae, Ecuador.

The exclusively Neotropical *Anthurium*, with approximately 1000 species, is the largest genus in Araceae (Croat, 1999b). At least 227 named species of *Anthurium* are known from Ecuador (Croat, 1999a), and many Andean species remain undescribed, especially those with large cordate leaves (Croat, 1999b). High-altitude Andean habitats are well collected and have relatively few *Anthurium* species compared to forests at lower elevations. Nevertheless, during fieldwork in the Cajanuma area in the Podocarpus National Park in southern Ecuador, it was recognized that besides *Anthurium oxybelium*, which is the dominant *Anthurium* above 2500 m, another species was exceedingly abundant at this altitude. Older collections showed that this new species had formerly been misidentified and confused with the widespread *A. oxybelium*. However, there were no difficulties in discriminating between the two species in the field, and field observations on more than 1000 individuals of both species and subsequent herbarium studies left no doubt that the material represents a separate species.

Like *Anthurium oxybelium*, many other high Andean species of *Anthurium* are widely distributed. Due to the large amount of variability in any species of Araceae in these montane habitats, some of them have been described several times, especially those from mesic upland sites that were the most readily available habitats to the early collectors (e.g., André, Holton, Lehmann, Purdie). In this manner *A. oxybelium* has proven to have many synonyms, most of which were published by Louis Sodiro, who worked in Ecuador around the turn of the last century. *Anthurium oxybelium* is the oldest name in this complex, and it is related to *Anthurium obpyriforme*, the newly described species. Owing to this relatedness, the taxonomic complexity of this common widespread species, the inadequacy of the original description, the marked change in its status, and the extensive new synonymy, *A. oxybelium* is redescribed later in this paper.

Anthurium obpyriforme Leimbeck, sp. nov. TYPE: Ecuador. Loja: Podocarpus National Park, along trail from Cajanuma Visitors Center to Mirador, wet montane forest, 04°05′S, 79°10′W, 2750–3000 m, 29 Oct. 2000, *R. Leimbeck, J. Madsen & B. Windeballe 319* (holotype, AAU; isotypes, LOJA, MO-5309365-67, QCNA). Figure 1.

Planta epiphytica; internodia brevia, 1.5–3 cm crassa; caudex ad 5–30 cm longus; cataphylla mox in fibras resoluta, 9–17 cm longa; petiolus 25–96 cm longus, 4–9 mm crassus cum geniculo 1.5–2.5 cm longo; lamina obpyriforma, basi cordata, coriacea, 25–77 cm longa, 17–46 cm lata; pedunculus quam petiolus duplo brevior, 14–43 cm longus, 2–5 mm crassus; spatha erecta, lanceolata vel ovata, subviridis vel albida; spadix stipite 5–8 mm longo suffultus, 7–22 cm longus, 6–14 cm crassus, viridi-griseus vel rubineus.

Epiphytic, rarely terrestrial; internodes short, 1.5–3 cm diam.; stem short, generally 5–30(–85) cm long; cataphylls 9–17 cm long, drying light brown to red-brown, usually weathering to a dense mass of light yellow fibers; leaves erect-spreading;

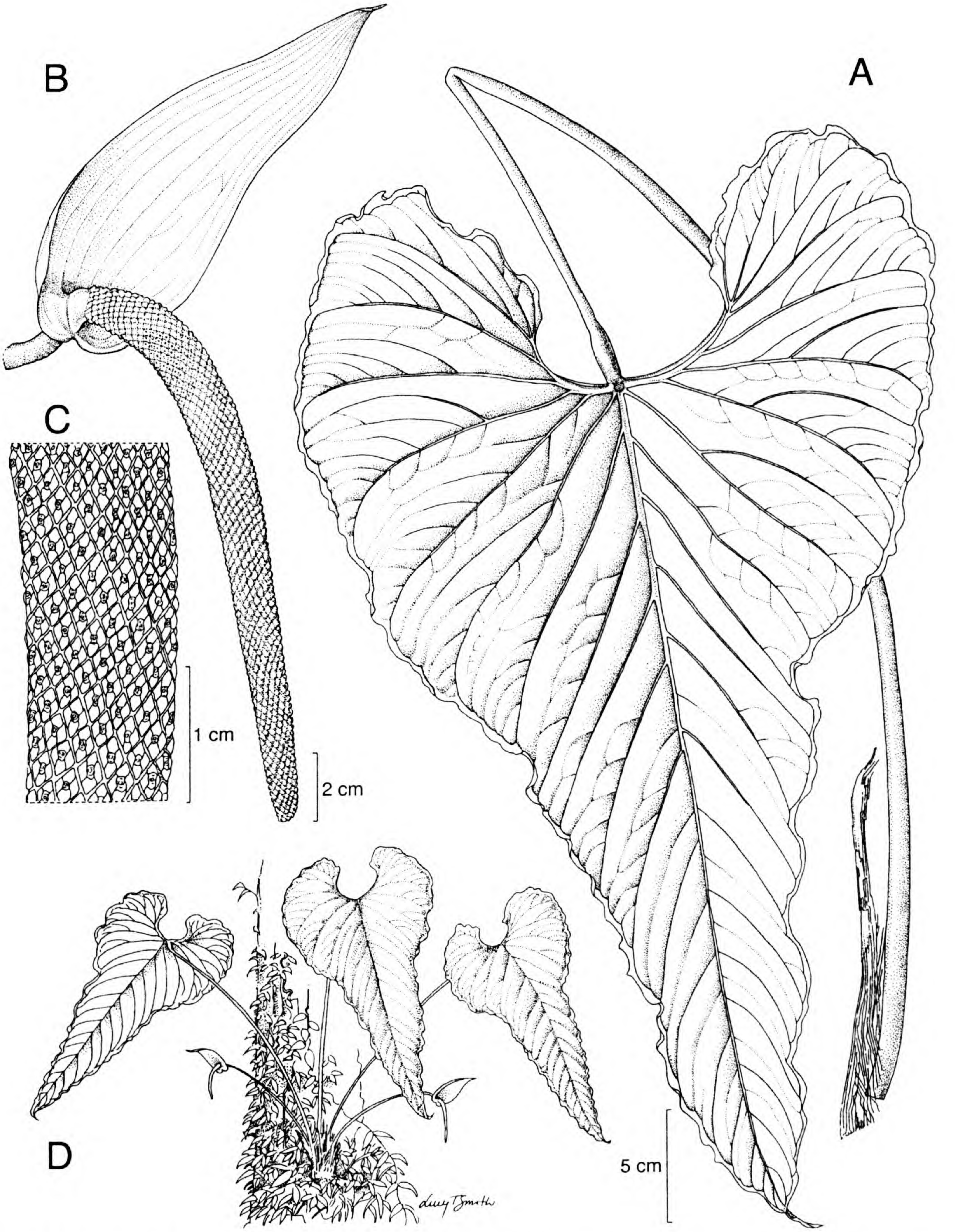

Figure 1. *Anthurium obpyriforme* Leimbeck. —A. Leaf with cataphyll enclosing the petiole base. —B. Spathe and spadix. —C. Spadix details. —D. Habit. (A from *Leimbeck & Windeballe 339*; B, C from the holotype, *Leimbeck, Madsen & Windeballe 319*.)

petioles 25–96 cm long, 4–9 mm diam., rigid, terete, esulcate to obtusely sulcate adaxially, matte, light green, drying brown to red-brown; sheath to 5 cm long; geniculum 1.5–2.5 cm long, slightly thicker than petiole, often red; blade obpyriform, deeply cordate at base, acute to acuminate at apex, (16–) 25–77 cm long, (6–)17–46 cm wide, ca. 1.6 times longer than wide, broadest at petiole insertion, coriaceous, matte to semiglossy on both surfaces, epunctate, deep green on upper surface, paler below, drying green to grayish green, margin undulate; anterior lobe constricted at middle of blade, with concave lateral margins, ca. 3 times longer than posterior lobes; posterior lobes curved inward; midrib convexly raised above, ± sharply V-shaped below, light green, drying brown; primary lateral veins 8 to 13 per side, departing midrib at 35–45° angle, usually only lowermost primary lateral veins prominent and raised in valleys (like a ridge rising up longitudinally in the center of a groove) on upper surface, the remainder sunken above, all primary lateral veins narrowly raised on lower surface, moderately straight or weakly curved to the margin, light green, usually drying brown; interprimary veins usually present, sometimes only near apex; secondary veins sunken above, raised below, lesser veins distinct in dry condition; collective vein usually arising from the first basal vein, higher order basal veins also collecting, but ultimately merging with the margin, 1–3 mm from margin, sunken above, raised below; basal veins 6 to 10 per side, the first pair usually free to base, the 5th and higher order basal veins coalesced to 5–9 cm, convexly raised above, moderately acute below, light green; posterior rib naked for most of its length along the sinus, to 6 mm wide, ± flat, light green, at petiole insertion often red; sinus parabolic to hippocrepiform with rounded to truncate apex; inflorescence erect-spreading; peduncle 14–43 cm long, ca. half as long as petiole, 2–5 mm diam., slender, terete, matte, light green; spathe erect, directed at ca. 180° angle with the peduncle, 6–22 cm long, 1.5–8.5 cm wide, lanceolate to ovate, sometimes naviculiform, coriaceous, light green to white at anthesis, plurinerved, ± acuminate at apex, cordate at base, inserted at ca. 45° angle on peduncle; stipe stout with small bulge at base and apex, 5–8(–15) mm long, same color as spathe; spadix spreading to arcuate-pendent, curved at ca. 90° angle to peduncle, rigid, tapered, 7–22 cm long, 6–14 mm diam., green-gray, turning dark ruby; flowers rhombic, 2.5–3.3 mm long, 2.2–2.5 mm wide (dry), 5 to 10 flowers in principal spiral, 6 to 15 flowers in alternate spiral; stamens yellow-white, exserted ca. 1 mm above tepals when dry; pollen yellow-white. Infructescence not seen.

Anthurium obpyriforme is so far known only from the western slopes of the Nudo de Sabanilla in Loja province, at an altitude of 2700–3050 m, which is near the tree line. The habitat is covered by upper montane rain forest with ca. 3000 mm precipitation per year, an annual mean temperature of 11°C, and an exceptionally high tree species richness (Madsen & Øllgaard, 1994) and epiphyte richness (Bøgh, 1992). Due to low canopy height (± 10 m) and frequent treefalls the forest is quite open locally. However, dense bamboo thickets of *Chusquea* sometimes form an almost impenetrable lower understory. The dominant tree species is *Weinmannia glabra* L. f. (Cunoniaceae), and the majority of trees belong to Melastomataceae (Madsen & Øllgaard, 1994). *Anthurium obpyriforme* grows mostly epiphytically on the lower parts of the phorophyte, 0–3 m above the ground. Among all encountered individuals, only 14% were terrestrial, but most of the terrestrial individuals were small and none of them were fertile. With more than 750 individuals/ha *A. obpyriforme* is very common, and after *A. oxybelium* it is the second most abundant *Anthurium* in the area. Only three other Araceae species occur in the same habitat: *A. nigrescens* Engler, *A. longegeniculatum* Engler, and a third, yet undetermined *Anthurium*.

Anthurium obpyriforme has been confused with *A. oxybelium*. Both species belong to *Anthurium* sect. *Belolonchium* Schott emend. Engler, which is characterized by coriaceous, cordate leaves with conspicuous minor veins and cataphylls that usually weather into a mass of fibers (Croat & Sheffer, 1983). However, *A. obpyriforme* differs in being epiphytic with short internodes, while *A. oxybelium* is primarily a scandent terrestrial with longer internodes. Furthermore, *A. obpyriforme* has generally larger leaf blades (25–77 cm long vs. rarely longer than 30 cm) with strongly constricted anterior lobes (vs. anterior lobes with ± straight margins), esulcate to obtusely sulcate petioles (vs. sharply sulcate), cataphylls always weathering into fibers (vs. cataphylls at upper nodes remaining ± intact), shorter peduncles (half as long as petioles vs. about equal), and a shorter stipe (5–8 mm vs. 10–30 mm long).

Anthurium obpyriforme is also similar to "A. melampyi Croat ined.," a yet unpublished species from Colombia and Carchí province in northern Ecuador. That species differs in having long, ribbed petioles (100–140 cm long), large blades that often are more than 1 m long, many primary lateral veins (25 to 30 per side), and the collective vein arising near the base, from one of the lowermost basal veins.

Several other related cordate-leaved *Anthurium* occur at high elevations in the Ecuadorian Andes, most of which were placed in section *Belolonchium* by Engler (1905). However, the section is poorly defined and may represent an assemblage of species that could not be assigned to any of the other sections with cordate leaves (Croat & Sheffer, 1983). Species of *Anthurium* sect. *Belolonchium* sensu Engler (1905) occurring above 2500 m (Croat, 1999a) are presented in a key at the end of this paper, to distinguish them from *Anthurium obpyriforme.* The key is based on herbarium material at AAU and species descriptions in Engler (1905), Sodiro (1903b), and Croat and Rodríguez de Salvador (1995).

Paratypes. ECUADOR. **Loja:** Podocarpus National Park, 1-ha sample plot N of Cajanuma Visitors Center, wet montane forest, 04°05′S, 79°10′W, 2800 m, 1 Nov. 2000, *R. Leimbeck & B. Windeballe 325* (AAU, LOJA, QCNA), 4 Nov. 2000, *R. Leimbeck & B. Windeballe 339* (AAU); E of Nudo de Cajanuma, N of Centro de Información, 04°05′S, 79°10′W, 2900 m, 20 Sep. 1989, *A. Bøgh 47838* (AAU, MO), *A. Bøgh 47840* (AAU), 26 Oct. 1988, *J. Madsen 75508* (AAU); above Cajanuma, trail from Centro de Información towards Lagunas de Compadre, just below forest limit, wet montane forest, 04°05′S, 79°10′W, 2900–3050 m, 16 Jan. 1989, *J. Madsen 85523* (AAU).

Anthurium oxybelium Schott, Oesterr. Bot. Wochenbl. 7(39): 310. 1857. TYPE: Colombia. Nueva Granada: Río Hacha, exact location unknown, *Purdie s.n.* (holotype, K).

Anthurium lividispica Sodiro, Anales Univ. Centr. Ecuador 15(108): 14. 1901. Syn. nov. TYPE: Ecuador. Pichincha: El Corazón, 2800 m, Mar. 1900, *Sodiro s.n.* (specimen lost). Ecuador. Cotopaxi: El Corazón, Jan. 1901. *Sodiro s.n.* (holoneotype, designated here, G; isoneotype, QPLS).

Anthurium luteolum Sodiro, Anales Univ. Centr. Ecuador 15(108): 13. 1901. Syn. nov. TYPE: Ecuador. Pichincha: Oyacachi, ca. 2800 m, *Sodiro s.n.* (holotype, Q).

Anthurium patulum Sodiro, Anales Univ. Centr. Ecuador 15(108): 14. 1901. Syn. nov. TYPE: Ecuador. Napo: Oyacachi, Jan. 1900, *Sodiro s.n.* (holotype, B; isotypes, G, QPLS).

Anthurium psilurum Sodiro, Anales Univ. Centr. Ecuador 15(108): 14. 1901. Syn. nov. TYPE: Ecuador. Pichincha: Oyacachi, ca. 2800 m, *Sodiro s.n.* (holotype, B; isotypes, G, QPLS).

Anthurium puelanum Sodiro, Anales Univ. Centr. Ecuador. 15(108): 17. 1901. Syn. nov. TYPE: Ecuador. Chimborazo: Volcán Tungurahua, Puela, *Sodiro s.n.* (holotype, B; isotype, G).

Anthurium sclerophyllum Sodiro, Anales Univ. Centr. Ecuador 15(108): 14. 1901. Syn. nov. TYPE: Ecuador. Napo: Papallacta–Cuyujua, Feb. 1901, *Sodiro s.n.* (holotype, QPLS; isotypes, G, Q).

Anthurium stans Sodiro, Anales Univ. Centr. Ecuador 15(108): 17. 1901. Syn. nov. TYPE: Ecuador. Pichincha: Volcán Pasochoa, 3000–4200 m, *Sodiro s.n.* (holotype, B).

Anthurium albaretii J. F. Macbride, Candollea 5: 348. 1934. Syn. nov. TYPE: Ecuador. Pichincha: Volcán Pasochoa, *Sodiro s.n.* [28] (holotype, B).

Terrestrial or sometimes epiphytic, 0.3–1(–1.5) m tall; internodes mostly 4–6 cm long, 1.5–2 cm diam., except much shorter, usually about 1 cm long near apex, sometimes much longer on older stems, to 16 cm long; cataphylls 8–13 cm long, persisting red-brown, intact to semi-intact toward apex, becoming red-fibrous, eventually deciduous at lower nodes; petioles subterete, sharply sulcate, 19–64 cm long, 4–5 mm diam., often red near apex; blades narrowly ovate to triangular or weakly panduriform, (12–)20–30 cm long, (4–)10–26 cm wide, (1.3–)2.3–4 times longer than wide, usually deeply cordate at base, moderately coriaceous, semiglossy, slightly bicolorous, usually drying red-brown on both surfaces, sometimes gray-green; posterior lobes (2–)4.5–15(–20) cm long, 2.7–8(–13) cm wide, directed toward the base or slightly outward, sometimes markedly curved inward and overlapping; margins of the anterior lobes convex to straight or concave; midrib ± concolorous, narrowly raised in valley above, convex and paler below; primary lateral veins (5)8 to 11 pairs, etched-sunken above, convex below, spreading at 50–75° angle; tertiary veins etched above, slightly darker than lower surface; collective veins arising from 3rd basal veins, sometimes from the first basal veins, 3–4 mm from margin; basal veins (3)4 to 9 pairs, the 1st and sometimes 2nd free to the base, the 3rd and 4th coalesced to (0.5–)2–4 cm; posterior rib naked for 1–3.5 cm along the sinus; sinus oblong to closed to hippocrepiform, rarely parabolic; inflorescence erect to erect-spreading, held at about the level of the leaves; peduncle 10–50 cm long; spathe usually held horizontally and hooding spadix, 6–16 cm long, 1–3.5 cm wide, green, sometimes tinged with red to greenish purple, rarely reddish or red, long-acuminate to acicular (the acicular portion to 1.5 cm long); stipe 1–3 cm long; spadix (4–)8–17 cm long, 7–15 mm diam., (5.7–)9–17 times longer than wide, often curved downward, green, olive-green, greenish purple, dark purple, purplish green, greenish brown, brown in age; pistils early; tepals 3.5–4 mm long (diameter in longitudinal direction); stamens are exserted at anthesis.

Anthurium oxybelium ranges from Colombia (and probably Venezuela) to Ecuador (Sucumbios, Napo, Morona–Santiago, Zamora–Chinchipe, Carchi, Imbabura, Pichincha, Cotopaxi, Tungurahua, Cañar, Azuay, Loja) and Peru (Amazonas, Cajamarca, Pasco, Cuzco) at 1400–4300 m elevation. It is highly variable, even within a single population, as is indicated by the fact that Sodiro described so many species from a single locality at Oyacachi. Despite high variability, these plants share certain things in common. Typically the internodes are longer than broad, though larger or older plants appear to have thicker stems with shorter internodes. Most cataphylls are persistent, and at least the upper ones are usually intact, but they are mainly fibrous at the base. Petioles are subterete and obtusely and narrowly sulcate. The moderately coriaceous blades vary greatly in shape, being primarily narrowly triangular to narrowly ovate with a usually obovate or rarely hippocrepiform sinus and an acuminate apex. The margins of the anterior lobe are variable, most commonly straight or broadly convex, though sometimes concave. Basal vein numbers are mostly 4 to 6 per side, the first or sometimes the second pair is free to the base, and several of the remainder are coalesced to 4 cm. The posterior rib is naked along much of its length. The inflorescences are long-pedunculate, and while the peduncles average about as long as the petioles, they may be shorter, as long as, or longer than the petioles. Spathes are variable, usually lanceolate to narrowly elliptic, sometimes elliptic, usually green or green tinged with purple, sometimes purple with green veins. The spadix is usually green, but sometimes purple or red tinged, typically short and weakly tapered to the apex, generally about as long as the spathe or shorter. The spadix is commonly 10–17 times longer than wide, but on the stubbier forms it may range up to little more than 5 times longer than wide. Flowers are large for the genus, usually 3.5–4 mm diam. with the stamens exserted at anthesis.

For many years this species has been called *Anthurium pulchrum* Engler, an illegitimate name since that name was already published by N. E. Brown for another species. That illegitimate name was published by Engler (1898: 449) based on a Sodiro (*Sodiro s.n.* [28]) collection from Volcán Pasochoa in Pichincha province. Synonymized here under *A. oxybelium*, *A. albaretii* was intended as a new name for *A. pulchrum* by Macbride (1934).

As is the case of many Sodiro collections, no specimens for *A. luteolum* were listed in the original description, which consisted only of a key. His first mention of any collection is in his first 1903 publication (Sodiro, 1903a: 281), where he stated that *A. luteolum* was collected between Papallacta and Cuyujua. Only a single collection exists with this information, a collection at the Universidad Central in Quito (Q).

A neotype was necessary for *A. lividispica* Sodiro because no specimens exist from El Corazón dated March 1900, as was listed by Sodiro. Instead, a collection from the same locality but collected in January 1901 has been designated here as the neotype.

Anthurium macrourum was treated as a synonym of *A. patulum* (now *A. oxybelium*) in the *Catalogue of the Vascular Plants of Ecuador* (Croat, 1999a), but owing to the lack of a type it appears best to continue to assume that the species is distinct. Most existing material of that species, which was determined by Sodiro, have spadices longer and proportionately more slender than those of *A. oxybelium*.

Most of the taxa synonymized in this treatment were described from a few areas in Ecuador, all very similar in life zone characteristics. Many species were described from a narrow region on the eastern flanks of the Andes east of Quito, between Papallacta, Cuyujua, and Oyacachi in Pichincha province, along the road between Quito and Baeza. The remaining species were described from Volcán Pasochoa or at Puela on Volcán Tungurahua. Considering the variability in this species complex, none of the types listed above represent anything out of the ordinary. Sodiro separated *A. luteolum* by its having a yellow, rather than green spathe as in *A. oxybelium*. *Anthurium oxybelium* is apparently further distinguished in having the blades sagittate-hastate and somewhat constricted above the petiole attachment.

Anthurium lividispica and *A. psilurum* are distinquished by having the posterior lobes retrorse with an ovate sinus. Furthermore, *A. lividispica* has convex anterior lobes and a thick spadix, 1.3 times as long as the spathe (vs. straight blade margins and a slender spadix, twice as long as the spathe in *A. psilurum*). All the characters used by Sodiro are either variable ones or characters that change with age, so that all the material easily fits into the complex as it is known today. Throughout its range and even on a local populational level, *A. oxybelium* is one of the most variable species in the genus. Species like *A. oxybelium*, *A. dombeyanum* Brongniart, and *A. nigrescens* that range throughout much of the Andes at high elevations occur in relatively isolated populations on the tops of mountains, which may account for the high variability from population to population.

KEY TO HIGH ANDEAN SPECIES OF *ANTHURIUM* SECT. *BELOLONCHIUM* (SENSU ENGLER, 1905) FROM ECUADOR

1a. Peduncle clearly shorter than petiole; internodes short, rarely 3 cm long.

2a. Flowering spadix sessile or short-stipitate (stipe 0–3 mm long); petioles to 173 cm long.

3a. Epiphyte; petioles many-ribbed; leaf blades prominently constricted above base; spathe white to light green (northern Ecuador) . . . . *A. jimenae* Croat

3b. Terrestrial; petioles sulcate; leaf blades ovate-cordate, not constricted above base; spathe red-tinged, naviculiform (Colombia, Ecuador) . . . . *A. cupulispathum* Croat & Rodriguez

2b. Flowering spadix long-stipitate (stipe 5–20 mm long); petioles to 100 cm long.

4a. Spathe broadly ovate, enclosing the spadix at base, but narrowly open at front; internodes 7–8 cm diam.; geniculum 5–7 cm long; leaves 45–90 cm wide (northern Ecuador) . . . . *A. gualeanum* Engler

4b. Spathe lanceolate to ovate, not enclosing the spadix; internodes to 3 cm diam.; geniculum to 3 cm long; leaves less than 50 cm wide.

5a. Cataphylls usually less than 9 cm long; leaves subelliptic to oblong-sagittate, less than 15 cm wide; spathe purple on both sides with green-yellow linear nerves, longer than spadix (eastern Andean slopes, Ecuador and Peru) . . . . *A. variegatum* Sodiro

5b. Cataphylls more than 9 cm long; leaves ovate to obpyriform, more than 17 cm wide; spathe solid green, purple, roseate or white, not purple with green-yellow nerves; shorter than spadix.

6a. Cataphylls 25–30 cm long; petioles muriculate; leaf blades 60–120 cm long; major veins with scaly, wing-like appendages on lower surface; spathe purple; stipe 15–20 mm long (Ecuador) . . . . *A. scabrinerve* Sodiro

6b. Cataphylls 9–20 cm long; petioles glabrous; leaf blades 40–77 cm long; veins without appendages; spathe green to white or roseate; stipe less than 15 mm long.

7a. Leaves obpyriform, constricted above base, coriaceous; stipe ca. 5–8 mm long with basal and apical bulge; spathe light green to white (southern Ecuador) . . . . *A. obpyriforme* Leimbeck

7b. Leaves ovate, subcoriaceous; stipe 12–15 mm long without bulge; spathe roseate (Colombia to Bolivia) . . . . *A. incurvatum* Engler

1b. Peduncle about equal to or longer than petiole; internodes more than 2 cm long.

8a. Leaf blades 40–70 cm long, 20–35 cm wide; spadix 12–50 cm long.

9a. Stipe 15–30 mm long; petioles plurisulcate; lamina thick, anterior lobe ca. 3 times as long as posterior lobes; spathe wide lanceolate, ca. 11 cm long, 3.5 cm wide (Ecuador) . . . . *A. rigidifolium* Engler

9b. Stipe 5–10 mm long; petioles unisulcate; lamina herbaceous to cartilaginous, anterior lobe ca. 4 times as long as posterior lobes; spathe linear to lanceolate, 15–23 cm long, 1–3.5 cm wide.

10a. Lamina cartilaginous; spathe linear, 1–1.5 cm wide, purple; spadix 18–20 cm long (northern Ecuador) . . . . *A. tremulum* Sodiro

10b. Lamina herbaceous; spathe lanceolate, 1.5–3.5 cm wide, green-yellow; spadix 25–50 cm long (northeastern Andean slope, only known from the type) . . . . *A. vomeriforme* Sodiro

8b. Leaf blades 12–35 cm long, 8–26 cm wide; spadix 4–17 cm long.

11a. Peduncle and petioles usually more than 25 cm long; cataphylls 8–13 cm long (Colombia to Peru) . . . . *A. oxybelium* Schott

11b. Peduncle and petioles usually less than 25 cm long; cataphylls less than 8 cm long.

12a. Lamina triangular-sagittate, 12–14 cm long, 8–10 cm wide, anterior lobe ca. 4 times as long as posterior lobes, sinus between basal lobes arcuate to parabolic (southern Ecuador, only known from the type) . . . . *A. coerulescens* Engler

12b. Lamina ovate-sagittate, ca. 25 cm long, 13–15 cm wide, anterior lobe 2–3 times as long as posterior lobes; sinus between basal lobes hippocrepiform (Venezuela to Bolivia) . . . . *A. nigrescens* Engler

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A New *Microgramma* Subgenus *Solanopteris* (Polypodiaceae) from Peru and a New Combination in the Subgenus

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Abstract. Based on a collection from north-central Peru, a new tuberous species of Polypodiaceae is recognized and described as *Microgramma fosteri*. It differs from other coenosoric species by the presence of laminar scales intermixed among the sori and slender paraphyses with elongate apical cells possessing clear lumina and thin walls. A key for species identification in subgenus *Solanopteris*, to which the new species belongs, is provided. In addition, a new combination is made for a species previously recognized in the genus *Solanopteris*.

Key words: *Microgramma* subg. *Solanopteris*, Neotropics, Peru, Polypodiaceae.

In the Neotropics, modified stems resembling tubers generally inhabitated by ants are known only in the genus *Microgramma* subg. *Solanopteris* (Copeland) Lellinger (Wagner, 1972; Rauh, 1973; Gómez, 1974; Lellinger, 1977; Moran, 1992). This subgenus currently includes four species: *M. bifrons* (Hooker) Lellinger, *M. bismarckii* (Rauh) B. León, comb. nov., *M. brunei* (Wercklé ex Christ) Lellinger, and *M. tuberosa* (Maxon) Lellinger, all with dimorphic fronds. In Peru, two species have been reported: *M. bifrons* from the Departments of Amazonas, Cusco, Loreto, Madre de Dios, Pasco, San Martín, and Ucayali, growing below 1000 m elevation; and *M. bismarckii* from Cusco, Pasco, and San Martín from altitudes above 1000 m (Tryon & Stolze, 1993). Based on a collection made by the second author in the Department of Ucayali at 1220 m, a new species is recognized and described here.

Microgramma fosteri B. León & H. Beltrán, sp. nov. TYPE: Peru. Ucayali: Cordillera Azul del Biabo, cabeceras del río Pisqui, 8°28′45.6″S, 75°43′5.21″W, 1220 m, 12 Sep. 2000, *H. Beltrán, R. B. Foster & W. Alverson 3643* (holotype, USM). Figures 1, 2A, B.

A *Microgramma bismarckii* et *M. tuberosa* squamis laminaribus inter soros positis et paraphysibus gracilibus, cellulis apicalibus elongatis luminibus hyalinis praeditis recedit.

Epiphyte (Fig. 1A). Rhizomes long-creeping, 1.5–2 mm wide, branched, glaucous to dark brown, apices and young parts covered with broadly elliptic non-clathrate peltate scales 0.5–0.75 mm long, white or brown with white margins (Fig. 1B–E); tuberous rhizome hollow, 1.5–2 cm wide, covered with long acuminate scales from a round peltate base, 1.4–1.5 mm long (Fig. 1F), shiny dark-brown in the center. Phyllopodia short, inconspicuous. Leaves dimorphic, 0.2–0.5 cm apart, subcoriaceous, simple with entire margins, subsessile to short-petiolate, petiole 1–2 mm long. Trophophylls (Fig. 1G) obovate to broadly elliptic, apex obtuse, 1.3–2 × 0.8–1.2 cm, scattered scales on both surfaces; scales linear, 1.1–1.4 mm long (Fig. 1H, I); costa prominent abaxially ⅔ of leaf length, primary veins slightly prominulous. Sporophylls (Fig. 1J, K), oblong, apex retuse, 1.2–2 × 0.7–0.8 cm, adaxially with scattered dark brown scales, persistent along margins, sporangia and paraphyses borne on a 2 mm broad receptacular line completely covering the abaxial surface at maturity, with dark brown laminar scales (Fig. 1L, M) 1 × 0.5 mm, base peltate with 0.1 mm long stalk, intermixed with sporangia and paraphyses. Paraphyses hairlike, 0.8–1 mm in length, 8–10 cells long, 1 cell wide, apical cell hyaline, 40–60 μm long (Fig. 2A, B). Spores 65–75 μm long, with spines 8–13 μm long.

The specific epithet honors Robin B. Foster for his work in Peru and his efforts in neotropical conservation. *Microgramma fosteri* is characterized by its leaves with entire margins, scattered persistent abaxial scales, acrostichoid coenosori, 1 mm long

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laminar scales intermixed with the sporangia, 1 cell-wide paraphyses with elongate apical cells having clear lumina, and spores with long spines 8–13 μm. It differs from *M. bifrons* and *M. brunei* by its trophophylls with entire margins, acrostichoid coenosori, and paraphyses with elongate apical cells. It can be distinguished from *M. bismarckii* and *M. tuberosa*, both of which also have coenosori, by its trophophyll with a retuse apex, completely covered abaxially with sporangia when mature (vs. having a nonsoriferous expanded apex), the presence of shiny dark brown laminar scales among the sporangia (vs. none or inconspicuous), and the paraphyses with elongate cells, clear lumina, and thin apical cell walls (vs. having blunt apical cells with dark lumina). *Microgramma bismarckii* and *M. tuberosa*, which are known from few collections, are poorly understood taxonomically and may represent different phases of a single species.

Wagner (1986) studied soral patterns in pleopeltid ferns and commented on the parallel situation in *Solanopteris* and *Microgramma* with regard to soral series ranging from discrete to confluent sori to coenosori. The soral pattern in this newly described species links coenosoric development with a reduction of the fertile blade. The presumed closest relative, *M. bismarckii*, better represented in herbaria, presents laminar expansions beyond the proximal and distal border of the sori but no concurrent frond reduction. In the overall distribution of *Microgramma* subg. *Solanopteris*, coenosoric species occupy altitudes above 1000 m.

Taxonomic characters used for species recognition in subgenus *Solanopteris* have included leaf morphology, venation patterns, and soral shape. However, with the exception of Wagner (1972), little attention has been paid to other characters such as those found in paraphyses. Paraphyses in *Solanopteris* can be described as one cell wide for most of their length. Differences from species to species appear in the distal portions, where variation occurs in cell number, dimensions, shape, and coloration of the apical cell lumina (Fig. 2A–E). The distinctive acrostichoid coenosori in *M. fosteri* mostly contain thin paraphyses with elongate cells, and the most distal cells have a clear lumina and thin walls (Fig. 2A, B). The paraphyses in this new species do not resemble those found in the discrete-sori species (Fig. 2C, D), where the most distal cells are broader than long and the conformed apex has one or two blunt cells. They differ from those other coenosoric species (Fig. 2E), in which the distal cells are also broader than long, and the terminal cell has the lumina dark yellow-brown filled with tannin at maturity. This is similar to the situation in *Polypodium virginianum* L. (Peterson & Kott, 1974) in which the marginal cells are similarly darkened.

Affinities between subgenus *Solanopteris* and some species of subgenus *Microgramma* are manifest in the paraphyses (e.g., Sota, 1986). For *M. baldwinii* Brade and *M. ulei* (Ule) Stolze, both also found in Peru, paraphyses are one cell wide. In *M. baldwinii*, the three to four of the most distal cells are broader than long. In some cases, the third row is bicellular, as in *M. bifrons* and *M. brunei*, and the apical cell is hooked, with the lumina filled with tannin. In *M. ulei*, the apical cell is blunt and dark, more like those seen in *M. bismarckii*. Further research on paraphyses development and characteristics for these and other species of *Microgramma* may contribute to a better understanding of these affinities.

NEW COMBINATION

Microgramma bismarckii (Rauh) B. León, comb. nov. Basionym: *Solanopteris bismarckii* Rauh, Abh. Akad. Wiss. Abh. Lit. Mainz, Math.-Naturwiss. Kl. 5: 232. 1973. TYPE: Peru. Pasco: Oxapampa, 1800–2000 m, Ceja de la Montaña, July 1971, *Werner Rauh 25790* (holotype, HEID).

The following key distinguishes all currently recognized species of *Microgramma* subg. *Solanopteris*.

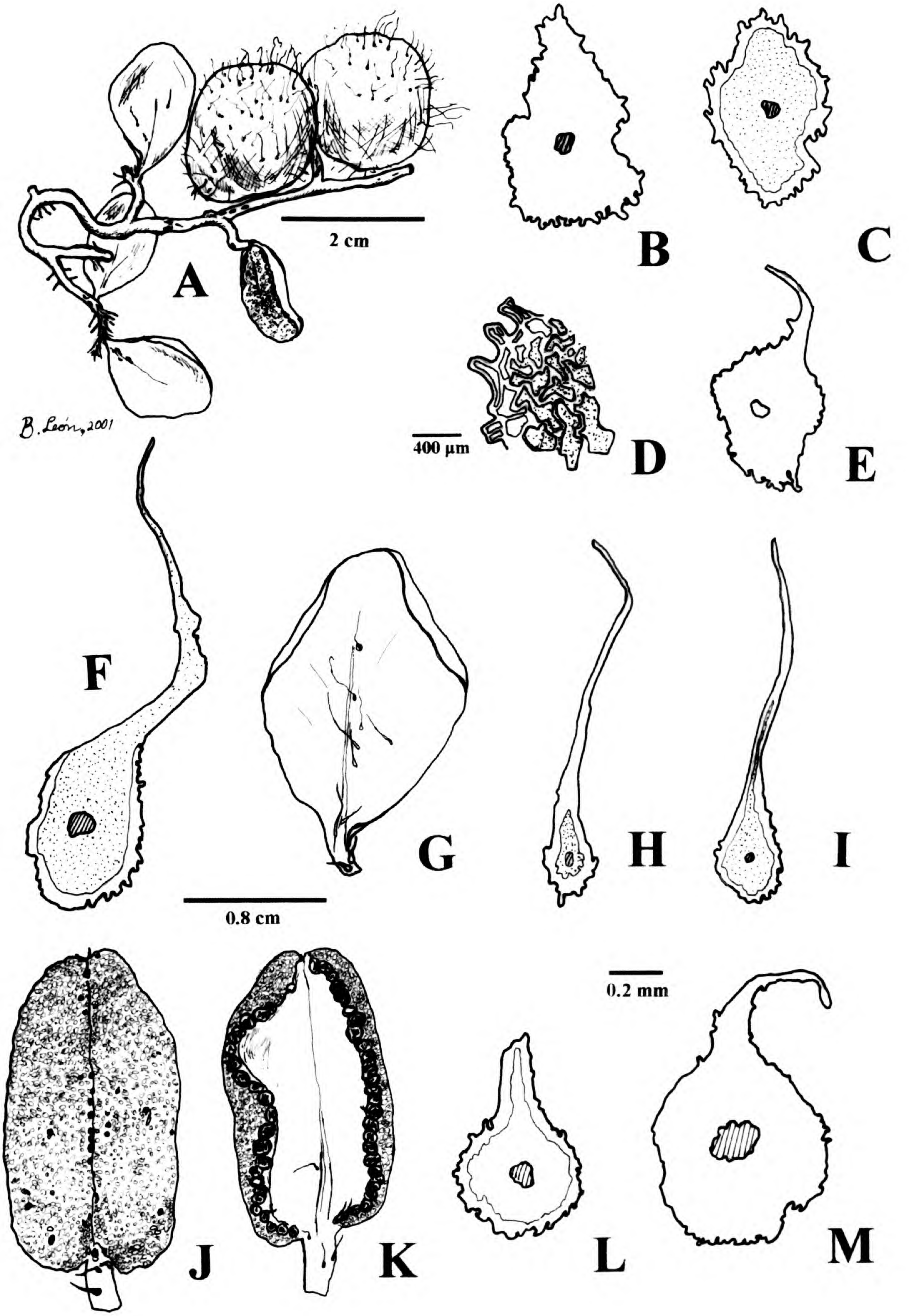
KEY TO THE SPECIES OF *MICROGRAMMA* SUBG. *SOLANOPTERIS*

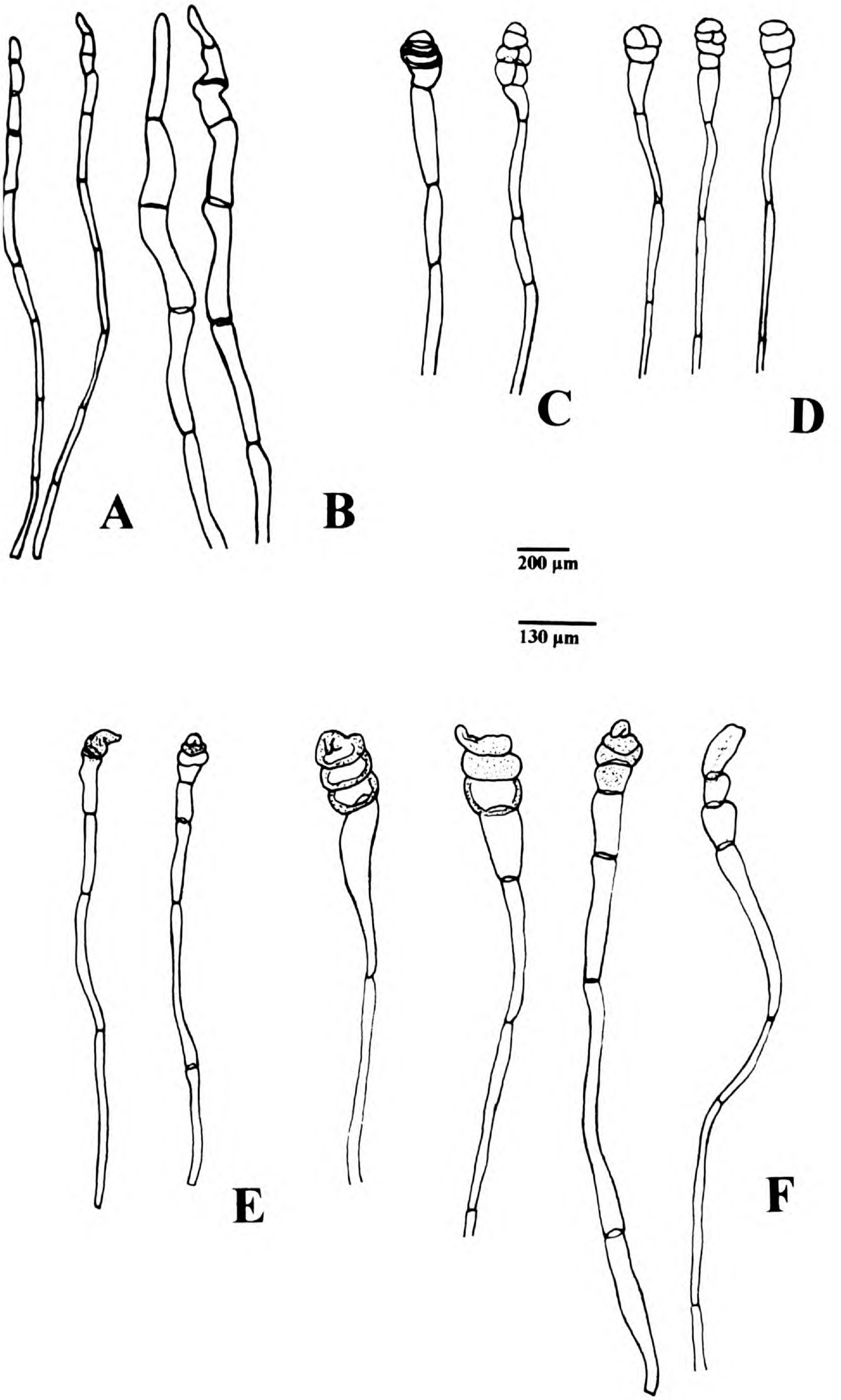
1. Sporophylls with discrete sori; leaves chartaceous to subcoriaceous; paraphyses with blunt apical cells 2

1'. Sporophylls only with coenosori, occasionally intermixed discrete sori present; leaves coria-

→

Figure 1. *Microgramma fosteri* B. León & H. Beltrán. —A. Habit. —B–E. Rhizome scales. —D. Central basal portion of rhizome scale. —F. Tuber scale. —G. Abaxial view of trophophyll. —H. Adaxial trophophyll scale. —I. Abaxial trophophyll scale. —J. Abaxial view of sporophyll. —K. Adaxial view of sporophyll. —L. Adaxial sporophyll scale. —M. Abaxial sporophyll scale. Drawn from *Beltrán, Foster & Alverson 3824* (USM). Stippled areas represent dark lumina cells; striped areas represent insertion. The 0.2 mm bar applies to B, C, E, F, H, I, L, and M. The 0.8 cm bar applies to G, J, and K.


A
2 cm
B. León, 2001
B
C
D
400 µm
E
F
G
H
I
0.8 cm
0.2 mm
J
K
L
M


A
B
C
D
200 µm
130 µm
E
F

ceous; paraphyses with elongate apical cells or broader than long apical cells with lumina filled with tannin 3

2(1). Trophophyll margins lobed; leaves chartaceous . . . . *M. bifrons*

2′. Trophophyll margins entire or rarely slightly repand; leaves subcoriaceous . . . . *M. brunei*

3(1). Sporophylls with retuse apex; sori acrostichoid; dark brown laminar scales dispersed on both surfaces; paraphyses with elongate apical cells and terminal cell without tannin . . . . . *M. fosteri*

3′. Sporophylls with mucronate to acute apex; sori elongate to discrete; laminar scales absent or inconspicuous; paraphyses with distal cells broader than long; terminal cell brown filled with tannin 4

4(3). Trophophyll apex mucronate . . . . . *M. bismarckii*

4′. Trophophyll apex acute or obtuse . . *M. tuberosa*

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Figure 2. Paraphyses. A, B. Paraphyses of *Microgramma fosteri*. Drawn from *Beltrán, Foster & Alverson 3824* (USM). —A. Paraphyses. —B. Detail of distal portion. —C. Paraphyses of *Solanopteris bifrons*. Drawn from *Dick 270* (MO). —D. Paraphyses of *Solanopteris brunei*, drawn from *Forero et al. 6022* (MO). —E. Paraphyses of *Solanopteris bismarckii*, drawn from *Rauh 35685* (USM). —F. Paraphyses of *Solanopteris bismarckii*, two left figures drawn from *Cerón et al. 5799* (MO), two right figures from *Gentry & Smith 45184* (MO). The 200 μm bar applies to A, C, D, and E. The 130 μm bar applies to B and F.

Two New Taxa of *Maianthemum* (Convallariaceae) from Northwestern Yunnan, China

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ABSTRACT. As a result of expeditions to the Gaoligong Mountains in western Yunnan, China, the authors discovered two new taxa. *Maianthemum dulongense* H. Li var. *coriaceum* R. Li & H. Li and *M. fuscum* (Wallich) LaFrankie var. *cordatum* R. Li & H. Li are described, and their differences from the type varieties are discussed.

Key words: China, Convallariaceae, *Maianthemum.*

Maianthemum G. Weber ex Wiggers (including *Smilacina* Desfontaines) is a genus of about 35 species distributed widely in the northern temperate region, the Himalayas, as well as subtropical montane Asia and Central America (Mabberley, 1997; Chen & Kawano, 2000). In the past (Wang & Tang, 1978; Dahlgren, 1980), it was separated into two genera, *Maianthemum* and *Smilacina*, based on whether the flowers are dimerous (4 tepals, 4 stamens, 2 carpels) or trimerous (6 tepals, 6 stamens, 3 carpels). However, because of their overall similarity, the two genera have been continuously combined (Pursh, 1814; Link, 1821; Greene, 1888). Therman (1956) challenged the separation of the two genera on the basis of their uniform karyotype. LaFrankie (1986a, 1986b) studied the New World species of *Maianthemum* and concluded that *Smilacina* and *Maianthemum* should be combined. In his note, LaFrankie summarized the evidence for this combination and transferred the species of *Smilacina* to *Maianthemum* (1986b). Along with Li (1990) and Chen and Kawano (2000), the present authors agree with LaFrankie's transfers.

During the summer of 2000, a botanical expedition was carried out in Gongshan County and Dulongjiang Valley, Northwest Yunnan Province, China, to study the flora of the Gaoligong Mountains. In addition to the two new varieties (*Maianthemum dulongense* var. *coriaceum* and *M. fuscum* var. *cordatum*) herein described, eight other species of *Maianthemum* were found in this region: *M. atropurpureum* (Franchet) LaFrankie, *M. dulongense* H. Li, *M. fuscum* (Wallich) LaFrankie, *M. gongshanense* (S. Y. Liang) H. Li, *M. henryi* (Baker) LaFrankie, *M. oleraceum* (Baker) LaFrankie, *M. purpureum* (Wallich) LaFrankie, and *M. tatsienense* (Franchet) LaFrankie.

LaFrankie (1986b) transferred all the species of *Smilacina* to *Maianthemum*; however, in his note he did not present an infrageneric system for *Maianthemum.* Hara (1987) studied the Asiatic species of *Smilacina* (Hiroshi Hara passed away in September 1986 and had not seen LaFrankie's paper about the transfer of this genus) and gave a synopsis for the infrageneric system. In his note (Hara, 1987), *Smilacina* can be divided into four sections based on the combination of several significant features, such as corolla shape, insertion of stamens, sexuality of flowers, and the surface structure of pollen grains. Hara's (1987) infrageneric classification of the genus *Smilacina* is as follows: Sect. 1. *Smilacina,* Subsect. 1a. *Smilacina*; Subsect. 1b. *Dioica* Hara; Sect. 2. *Tubifera* Hara; Sect. 3. *Oligobotrya* (Baker) Hara; Sect. 4. *Medora* (Kunth) Hara. Li (1990) (the second author) agreed with LaFrankie's taxonomic treatment of *Smilacina* and studied all the species of *Maianthemum* in the world. In her note (Li, 1990), according to the shape of the rhizomes, the number of foliage leaves, the branching pattern of the inflorescence, the basic number and the color of the flowers, a new infrageneric system for *Maianthemum* was presented, which divided the genus into two subgenera and five sections. Also, all the species of *Maianthemum* were recombined and rearranged as a new classification system. Li's infrageneric system of *Maianthemum,* based on Li (1990), is as follows:

I. *Maianthemum* subg. *Medora* (Kunth) H. Li
  Individual rhizome units swollen and tuberous; flowers trimerous; foliage leaves numerous.
  1. Section *Medora*
    Individual rhizome units spherical or subspherical, ovoid; corolla cyathiform, purple, or ashy pale, rarely white.
    a. Subsection *Medora*
      Inflorescence a panicle.
    b. Subsection *Dulongensis* H. Li
      Inflorescence a raceme.

2. Section *Oligobotrya* (Baker) H. Li
   Individual rhizome units ovoid; corolla tubiform; inflorescence racemose or paniculate with a few branches, main axis with a single flower at each node or with 2 to 7 flowers clustered at each node; stamens inserted the throat of the corolla.
3. Section *Tatsienensis* H. Li
   Individual rhizome units claviform or horizontal cylindrical; corolla cyathiform.

II. *Maianthemum* subgenus *Maianthemum*
Individual rhizome units extended and stoloniferous; flowers dimerous or trimerous, snow white; foliage leaves 2 to 4.

1. Section *Smilacina* (Desfontaines) H. Li
   Flowers trimerous.
2. Section *Maianthemum*
   Flowers dimerous.

According to Li's infrageneric system, the new variety *Maianthemum dulongense* var. *coriaceum*, with subspherical individual rhizome units, numerous leaves, racemose inflorescence, trimerous flowers, cyathiform corolla, and maroon perianth, belongs to subsection *Dulongensis* H. Li of section *Medora*. The new variety *Maianthemum fuscum* var. *cordatum*, with moniliform individual rhizome units, numerous leaves, paniculate inflorescence, trimerous flowers, cyathiform corolla, and purple perianth, belongs to subsection *Medora* of section *Medora*.

Maianthemum dulongense H. Li var. **coriaceum** R. Li & H. Li, var. nov. TYPE: China. Yunnan: Gongshan Xian, E side of Gaoligong Mountains, on the trail from Qiqi to Dongshao Fang, wet sloping meadow, 27°41′23″N, 98°28′26″E, 3400–3600 m, 17 July 2000, *Li Heng* with *Bruce Bartholomew, Philip Thomas, Peter Fritsch, Dao Zhi-lin, Wang Zhong-lan & Li Rong 12721* (holotype, KUN). Figure 1A–E.

A *Maianthemo dulongensi* var. *dulongensi* folio coriaceo, cordato-oblongo, nervis 21, nervillis conspicuis, floribus 24, perianthi marronini tepalis interioribus exterioribus longioribus differt.

Terrestrial herb, 22–28 cm tall. Roots uniform, 10 to 15 per rhizome unit, at nodes and internodes, 8–13 cm × 0.5–1 mm. Rhizome a sympodium, 3–4 cm long, the individual units subspherical, densely connected, 4–8 mm diam., stem scar on node conspicuous, orbicular, 3–4 mm diam., internodes very short. Leafy stem upright, 16–18 cm long, dark purple, densely pubescent; foliage leaves 5; internodes 1–2 cm long, shorter apically. Leaf sessile or subsessile; blade deep green, coriaceous, above cordate to oblong, glabrous, apex short-acute, base cordate, 3.6–4.3 × 2.3–3 cm, veins 21, dense-ranked, conspicuous, venulae between veins slightly conspicuous. Inflorescence 10 cm long, a cylindric raceme with 24 flowers, fertile axis erect or arching upward, densely pubescent. Flowers trimerous; pedicel 2–5 mm long, densely pubescent, with a broad triangular bract; perianth maroon, cupuliform, ca. 4 mm diam.; tepals oblong, cuspidate apex, outer ca. 3 × 2 mm, inner longer, ca. 4 × 2 mm; stamens 6, white, filaments short, ca. 1 mm long, anthers ovate, ca. 1 mm long; ovary conical, pubescent, 3 locules, style inconspicuous, stigma 3-lobed. Flowering in July. Fruit not seen.

Distribution and habitat. Known only from the type locality, where it has been collected in primarily evergreen broadleaf forest at 3400–3600 m. This new variety is common in wet sloping meadows by rivers.

Maianthemum dulongense var. *coriaceum* differs from variety *dulongense* in having a coriaceous, cordate-oblong leaf blade with 21 veins and conspicuous venulae, an inflorescence with 24 flowers, a maroon perianth, and inner tepals longer than outer tepals. By contrast, *M. dulongense* var. *dulongense* has a papyraceous, ovate leaf blade with 15 veins and inconspicuous venulae, an inflorescence with 6 to 15 flowers, and a light purple perianth.

Maianthemum dulongense var. *coriaceum* is restricted to the east side of the Gaoligong Mountains and occurs in a geographical area allopatric to the typic variety, which occurs on the west side of the Gaoligong Mountains and extends to southeastern Xizang (H. Li, 1990, 1997). In our opinion, the shape of the rhizomes, the number of foliage leaves, the branching pattern of the inflorescence, and the basic number and color of the flowers are usually important diagnostic features for evaluating species limits throughout the genus. However, the variety *coriaceum* is distinguished from the typic variety by the shape of the leaf blade, the number of veins, and the number of flowers. Other features are the same, and hence we recognize it as a variety of *M. dulongense*.

Maianthemum dulongense var. *dulongense* was first described in 1990 in *Acta Botanica Yunnanica*, Suppl. 3. In Li's (1990) infrageneric system of *Maianthemum*, it was included in section *Medora* subsect. *Dulongensis* because of its moniliform individual rhizome units, numerous leaves, racemose inflorescence, trimerous flowers, and cyathiform corolla.

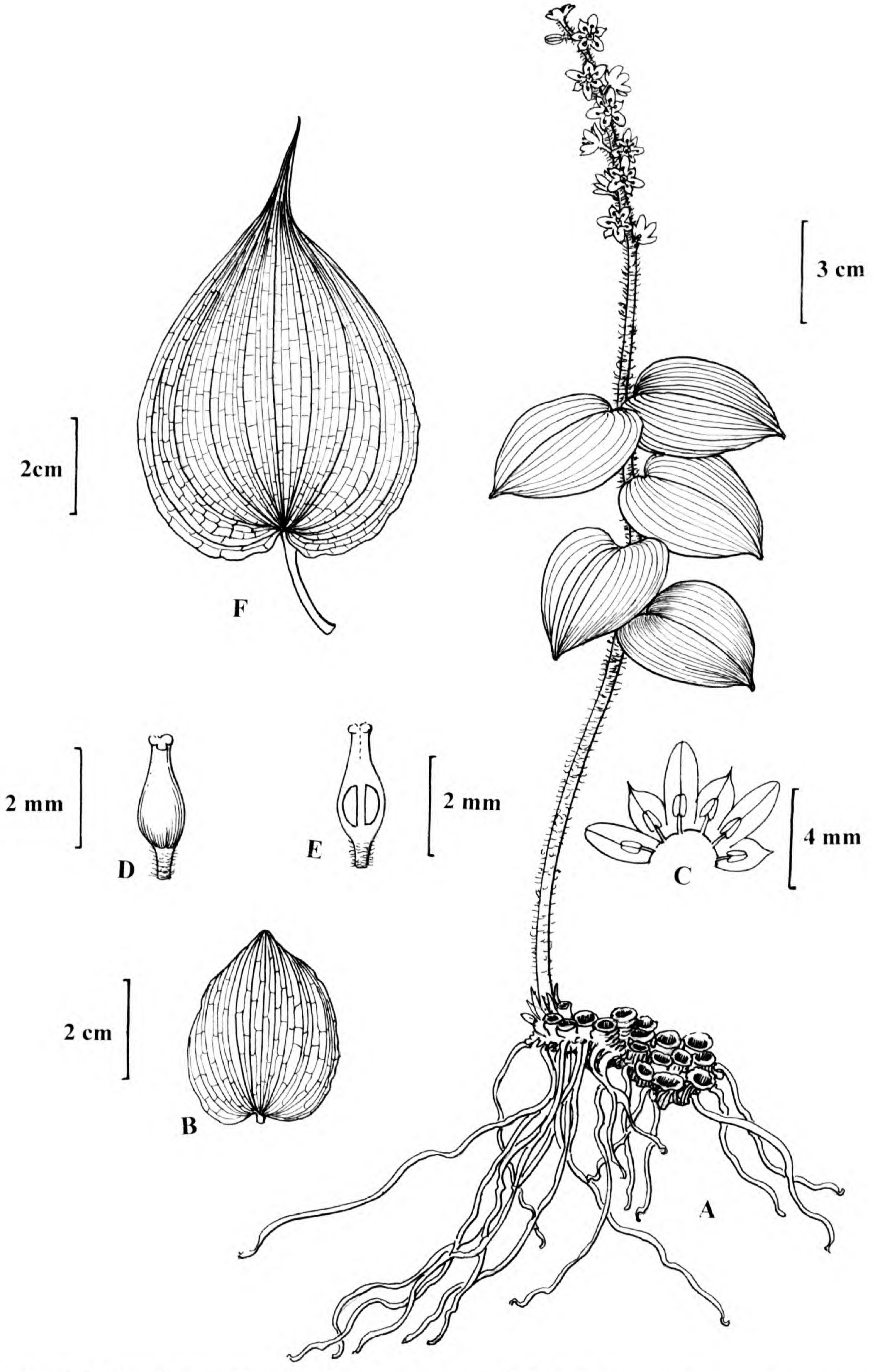

Figure 1. A–E. *Maianthemum dulongense* H. Li var. *coriaceum* R. Li & H. Li. —A. Rhizome, leafy shoot, and infructescence. —B. Leaf. —C. Tepals and stamens. —D. Gynoecium. —E. Ovary, longitudinal section. F. *Maianthemum fuscum* (Wallich) LaFrankie var. *cordatum* R. Li & H. Li. —F. Leaf. (Drawn by Wang Ling from the holotypes.)

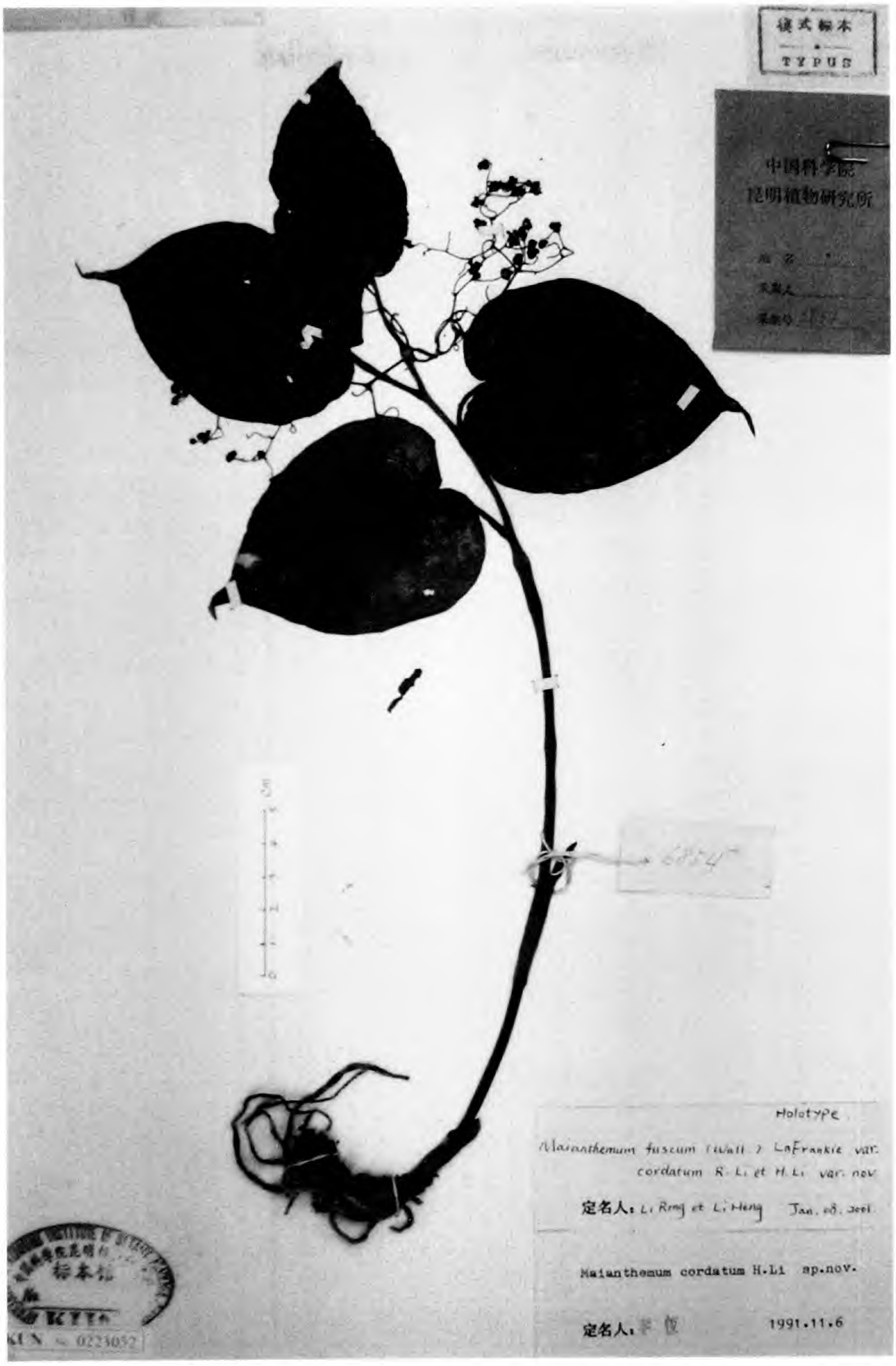

Figure 2. *Maianthemum fuscum* var. *cordatum* (*Dulong Jiang Expedition 6854*, holotype, KUN).

Maianthemum fuscum (Wallich) LaFrankie var. **cordatum** R. Li & H. Li, var. nov. TYPE: China. Yunnan: Gongshan Xian, Dulong Jiang Valley, W side of Gaoligong Mountains, under forest, 2200 m, 16 May 1991, *Dulong Jiang Expedition 6854* (holotype, KUN; isotype, MO). Figures 1F, 2.

A *Maianthemo fusco* var. *fusco* folio cordato, floribus 20, pedicello tenui differt.

Terrestrial herb, 20–40 cm tall. Roots uniform, 8 to 13 per rhizome unit, at nodes and internodes 7–15 cm long. Rhizome a sympodium, 3–8 cm long, the individual units moniliform or subcylindrical, densely connected, 1–1.5 cm diam., stem scar on node conspicuous, discoidal, 3.4 mm diam., internodes very short. Leafy stem arcuately ascending, 15–30 cm long, green, cylindrical, glabrous; foliage leaves 3–7; internodes 1.5–3 cm long. Leaf petiolate, 2–3 cm long; blade green, chartaceous, glabrous, ovate-cordate, 7–12 × 4–6.5 cm, abruptly attenuate with an acumen of 1.1–1.8 cm at the apex, deeply cordate at the base. Inflorescence 5–10 cm long, a panicle with 20 flowers, rachis conspicuously zigzagged, glabrous; shortly pedunculate, 8–15 mm long, glabrous, bractless. Flowers trimerous; pedicel tenuous, 4–9 mm long, glabrous, with a ca. 1 mm long triangular bract at the base; perianth purple, subrotate, ca. 5–8 mm diam., 6-lobed nearly to the base, connate part ca. 0.5 mm long; tepals ovate, obtuse at the apex, outer 3 lobes much smaller, ca. 2 × 2 mm, inner 3 lobes larger, ca. 3 × 3 mm wide; stamens 6, light yellow, filaments ovoid, carnose, white, ca. 0.5 mm long, inserted to the base of the corolla lobes, anthers small, roundish, yellow, ca. 0.4–0.5 mm long, basifixed; ovary ovate, ca. 1 mm long, 3 locules, style very short, pyramidal, ca. 0.4 mm long, stigma obscurely 3-lobed. Flowering in April–May, fruiting in June–December.

Distribution and habitat. The new variety occurs in northwestern Yunnan and southeastern Xizang, China. The type specimen was collected in Dulong Jiang Valley by the Dulong Jiang Expedition in 1991. The plant grows in evergreen broadleaf forest at 1800–3000 m.

Maianthemum fuscum var. *cordatum* differs from variety *fuscum* in having a cordate leaf blade, an inflorescence with 20 flowers, and a tenuous pedicel. By contrast, variety *fuscum* has a lanceolate leaf blade, an inflorescence with 3 to 10 flowers, and a filiform pedicel.

Maianthemum fuscum var. *cordatum* is restricted to the northern Gaoligong Mountains and southern Xizang and occurs in a geographical area sympatric with the typic variety, which occurs in western Yunnan, southern Xizang, and extends to eastern Himalaya (including Nepal, Sikkim, Bhutan, northeastern India, and northern Burma) (Noltie, 1994; H. Li, 1997). As mentioned earlier, we consider the shape of the rhizomes, the number of foliage leaves, the branching pattern of the inflorescence, and the basic number and the color of the flowers usually to be the important diagnostic features for evaluating species limits throughout the genus. However, the shape of the blade and the number of flowers are quite variable for variety *fuscum*. With the exception of the minor differences mentioned above, other morphological features between the new taxon and variety *fuscum* are the same, and hence we recognize this taxon as a variety of *M. fuscum*.

Maianthemum fuscum var. *cordatum* resembles *M. fuscum* var. *pilosum* (Hara) S. Karthikeyan but grows allopatric to it (the latter occurs in Nepal and Bhutan [Hara, 1987]), and it can be separated by a few constant characters. Variety *cordatum* is distinguished from variety *pilosum* in having a glabrous leaf blade and the rachis of the inflorescence conspicuously zigzagged and glabrous. By contrast, variety *pilosum* is ciliate on the margin of the leaf blade, and the rachis of the inflorescence is almost straight, sometimes with stiff spreading hairs.

In Hara's (1987) opinion, *Maianthemum fuscum* var. *fuscum* belonged to *Smilacina* sect. *Medora*, but it was subsequently transferred to *Maianthemum* by LaFrankie (1986b). In Li's (1990) infrageneric system of *Maianthemum*, it was rearranged in section *Medora* subsect. *Medora* because of its moniliform individual rhizome units, numerous leaves, paniculate inflorescence, trimerous flowers, cyathiform corolla, and purple perianth. Therefore, both *M. fuscum* and *M. dulongense* belong to the same subgenus and section, but in different subsections.

Paratypes. CHINA. **Yunnan:** Gongshan Xian, Dulong Jiang Valley, W side of Gaoligong Mountains, in evergreen forest, 2200 m, 20 May 1991, *Dulong Jiang Expedition 6939* (KUN); Zhiyenandai, in broadleaf evergreen forest, 2200 m, 4 Sep. 1982, *Qizang Expedition 9918* (KUN); Fugong Xian, Quanmugulu-A'ludeng, 2500–3000 m, 31 July 1979, *Nujiang Expedition 791658* (KUN). **Xizang:** Dingjie Xian, Chengtangqi, in broadleaf forest, 2300 m, 6 June 1975, *Qizang Expedition 5545* (KUN); Medog, Hanmi, under forest, 2300 m, 26 Oct. 1992, *Expedition to Medog 0571* (KUN), 2100 m, 27 Oct. 1992, *Expedition to Medog 0846* (KUN), 1900 m, 28 Oct. 1992, *Expedition to Medog 0938* (KUN); Beiben, the back hill of Xirah, under forest, 2200 m, 8 Dec. 1992, *Expedition to Medog 2074* (KUN); Pangxin, Pangguo, in forest, 2100 m, 28 Feb. 1993, *Expedition to Medog 4090* (KUN); Damu, under forest, 2000 m, 6 Mar. 1993, *Expedition to Medog 4234* (KUN); Rengqiangpeng, in forest, 2000 m, 22 Apr. 1993, *Expedition to Medog 5691* (KUN); Denxin, Wenlang, in forest, 1800 m, 29 Apr. 1993, *Expedition to Medog 6069* (KUN).

The following key to the species of *Maianthemum* in the Gaoligong Mountains includes the two new varieties described herein.

KEY TO THE SPECIES OF *MAIANTHEMUM* IN THE GAOLIGONG MOUNTAINS

1a. Corolla distinct or connate at the base.
  2a. Inflorescence a raceme.
    3a. Leaf papyraceous, ovate; blade with 15 veins and inconspicuous venulae; inflorescence with 6 to 15 flowers; perianth light purple . . . . *M. dulongense* var. *dulongense*
    3b. Leaf coriaceous, cordate-oblong; blade with 21 veins and conspicuous venulae; inflorescence with 24 flowers; perianth maroon . . . . *M. dulongense* var. *coriaceum*
  2b. Inflorescence a panicle.

4a. Plant pubescent.
  5a. Foliage leaves more than 4; inflorescence with more than 10 flowers.
    6a. Leaf elliptic-ovate to broadly lanceolate, 12–21 cm long, long-cuspidate at the apex; style conspicuous, 2–2.5 mm long . . . . *M. oleraceum*
    6b. Leaf elliptic to oblong, 7–13 cm long, acuminate at the apex; style short, 1.2 mm long . . . . *M. purpureum*
  5b. Foliage leaves 2; inflorescence with 1 to 4 flowers; plant 5–20 cm tall; leaf ovate to elliptic-ovate, pubescent, 2–5 cm long, 1.5–3 cm wide . . . . *M. gongshanense*
4b. Plant glabrous.
  7a. Petioles 1–4 cm long; tepals ovate, 3–4 mm long; stigma obscurely 3-lobed.
    8a. Blade lanceolate; inflorescence with 3 to 10 flowers, pedicel filiform . . *M. fuscum* var. *fuscum*
    8b. Blade cordate; inflorescence with 20 flowers, pedicel tenuous . . . . . . *M. fuscum* var. *cordatum*
  7b. Petioles short, less than 1 cm long; tepals narrowly lanceolate, 2–2.5 mm long; stigma deeply 3-lobed . . . . *M. tatsienense*
1b. Corolla conspicuously connate.
  9a. Plant 30–80 cm tall; rhizome moniliform; flowers salver-shaped; corolla tube cylindric, 6–7 mm long; style ca. 2 mm long, stigma 3-lobed; berries green with purple spots . . . . *M. henryi*
  9b. Plant 80–150 cm tall; rhizome nodose; flowers broadly campanulate or rotate; corolla tube cupulate, 1–2 mm long; style ca. 0.5 mm long, stigma obscurely 3-lobed; berries red . . . . *M. atropupureum*

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A New Species of *Chirita* (Gesneriaceae) from Guangxi, China

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ABSTRACT. A new species from northern Guangxi, China, *Chirita longii* Z. Y. Li, is described.

Key words: China, *Chirita*, Gesneriaceae.

An early-flowering plant of *Chirita* Buchanan-Hamilton ex D. Don found in South China is here recognized as a new species. Most Chinese species in this genus bloom in spring, summer, or autumn; only *C. atropurpurea* W. T. Wang blooms in winter (February) (Wang et al., 1998). The new species was first collected and photographed by Long Guang-Ri in January 1992 in the karst region of Longan County of northern Guangxi. When he returned to this locality in February 1993 for further exploration, he found that the habitat had been entirely destroyed due to human activities. Unfortunately, this plant has not yet been rediscovered in the type locality or in adjacent regions (Long Guang-Ri, pers. comm., 1993, 1994, 1995).

Chirita longii Z. Y. Li, sp. nov. TYPE: China. Guangxi: Longan Co., Qiaoban, Qinzhan, on cliff, alt. 350 m, 12 Jan. 1992, *Long Guang-Ri 91004* (holotype, PE). Figure 1.

A *C. tenuifolia* W. T. Wang foliis minoribus, laminis oblanceolatis, pedunculis brevioribus 1.2–2.3 cm longis, calyce 8–12 mm longo, corolla majore ca. 4.3 cm longa, stigmatis labio antico 2-fido differt.

Perennials, stemless. Rhizome obconic, to 25 × 14 mm, internodes inconspicuous. Leaves 3 to 8, crowded at apex of rhizome, opposite, petiolate; blades oblanceolate, 1.5–2.5 × 0.4–0.9 cm, herbaceous, upper surface dark green, paler beneath, both surfaces appressed white-puberulous, base decurrent, margin remotely undulate or undulate-crenate, apex acute to obtuse; lateral veins 3 pairs, inconspicuous; petioles 5–10 × 1–2.5 mm, velutinous. Inflorescence of 1 or 2 cymes from the axils of the crowded leaves, each with 1 flower; peduncles 12–23 mm, densely pubescent; bract 1, linear, 3–3.5 × 0.5 mm, both surfaces densely pubescent; pedicels 3–4 mm, densely pubescent. Calyx 5-parted from base, segments linear, unequal, 8–12 × 0.8–1.2 mm, outside densely pubescent, inside sparsely puberulent, margin entire, apex acuminate. Corolla lilac purple, ca. 4.3 cm, outside sparsely puberulous, inside glabrous; tube ca. 2.7 cm, ca. 1 cm diam. at mouth; upper lip ca. 9 mm, 2-lobed, lobes suborbicular; lower lip ca. 16 mm, 3-lobed, each lobe oblong. Stamens 2; filaments narrowly linear, adnate for ca. 12 mm to corolla base, ca. 12 mm, geniculate above base, to 0.5 mm wide, 0.3 mm wide apically, upper part puberulent, lower glabrous; anthers elliptic, ca. 2.5 mm, glabrous. Staminodes 2, narrowly linear, adnate for ca. 14 mm to corolla base, ca. 2.5 mm, glabrous. Disc annular, ca. 0.6 mm, margin lobed, glabrous. Pistil ca. 23 mm, densely puberulous, ovary linear, ca. 8 × 0.8 mm; lower lobe of stigma obtrapezoid, 1.2 mm, 2-parted, each lobe oblong-lanceolate, ca. 0.9 mm. Fruit unknown.

Habitat. Growing on a limestone cliff at 350 m. Flowering occurs at least in January.

Distribution. Known only from the type locality at Zhan Qin, Qiaoban, the karst region of Longan County, Guangxi, China.

Etymology. This species is named in honor of Long Guang-Ri (1952–), a dendrologist at the Forestry Bureau of Liuzhou Prefecture of Guangxi.

The genus *Chirita* consists of about 140 species, distributed in subtropical and tropical Asia, ranging from northwestern India (Gujarat and Simla) eastward to eastern China (Taiwan, Taidong) and from central China (Gansu, Wenxian) southward to southern Indonesia (Lessersunda Islands), at 90–3200 m altitude (Wood, 1974; Wang et al., 1998). There are 102 species in China, 54 in Guangxi (Wang et al., 1998; Fang et al., 1999; present paper); most species discovered from the karst regions were found at the lower elevation. Following Clarke's subdivision (Clarke, 1883; Wood, 1974; Wang et al., 1990), *C. longii* Z. Y. Li is referred to *Chirita* sect. *Gibbosaccus* Clarke. It is closely allied to *C. tenuifolia* W. T. Wang (Wang, 1985; Wang et al., 1998), but differs from the latter in its smaller and thicker leaves, oblanceolate lamina (vs. elliptic or broadly elliptic), shorter peduncles (1.2–2.3 cm vs. ca. 5 cm), longer calyx (8–12 mm vs. ca. 4.8 mm), larger corolla (ca. 4.3 cm vs. ca. 2.8 cm),

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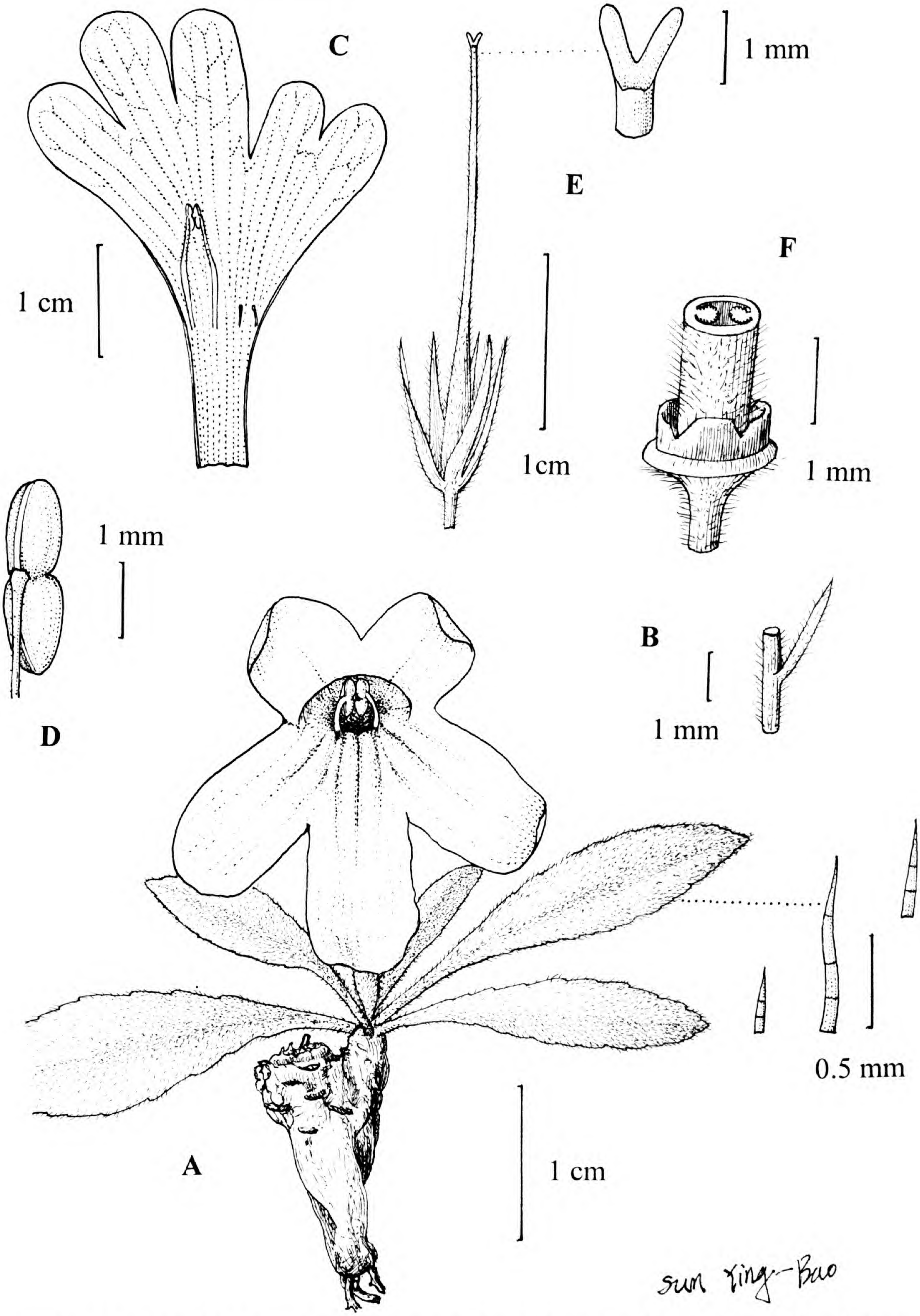

Figure 1. *Chirita longii* Z. Y. Li. —A. Flowering plant (with hairs enlarged). —B. Bract. —C. Opened corolla showing stamens and staminodes. —D. Anther. —E. Calyx and pistil (with stigma enlarged at right). —F. Disc and cross section of ovary. (Drawn from the holotype.)

obtrapezoid and 2-parted lower lip of stigmas (vs. ligulate, apex rounded, never divided), and flowering in January (vs. August).

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New Combinations in Chinese *Cotoneaster* (Rosaceae)

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ABSTRACT. During preparation of the account of *Cotoneaster* Medikus for the *Flora of China*, volume 9, it was found that some taxa required the following new combinations, namely *Cotoneaster glaucophyllus* Franchet var. *serotinus* (Hutchinson) L. T. Lu & A. R. Brach, *C. bullatus* Bois var. *floribundus* (Stapf) L. T. Lu & A. R. Brach, and *C. gracilis* Rehder & E. H. Wilson var. *difficilis* (G. Klotz) L. T. Lu.

Key words: China, *Cotoneaster*, Maloideae, Rosaceae.

In the broad sense, the genus *Cotoneaster* Medikus consists of about 90 species and is widely distributed in temperate regions of northern Africa, continental Asia, Europe, and North America (mainly in Mexico). It is most abundant in southwestern China, with about 58 species recorded from that country which have been variously placed into about seven (to more than 20) series. Their taxonomy is complicated by hybridization and apomixis. Further studies could help elucidate relationships between and within species. While preparing an account of *Cotoneaster* for the *Flora of China*, volume 9 (Lu & Brach, in press), the present authors noted that the following new combinations are necessary.

Cotoneaster glaucophyllus Franchet (1890: 222) is a semi-evergreen shrub endemic to southwestern China (Guangxi, Guizhou, Sichuan, and Yunnan Provinces), with elliptic to ovate, glaucous leaves, compact, compound, to more than 50-flowered corymbs, spreading, white petals, and reddish yellow, ovoid to obovoid fruit.

In addition to its typical variety, two other named varieties occur in China: *Cotoneaster glaucophyllus* var. *vestitus* W. W. Smith (1917: 21) and variety *meiophyllus* W. W. Smith (loc. cit.). A form of this species, f. *serotinus* (Hutchinson) Stapf, which was originally described at specific rank (*C. serotinus* Hutchinson), is best treated as a fourth variety; thus a new combination is required.

Cotoneaster glaucophyllus Franchet var. **serotinus** (Hutchinson) L. T. Lu & A. R. Brach, comb. nov. Basionym: *Cotoneaster serotinus* Hutchinson, Bot. Mag. 146: t. 8854. 1920. *Cotoneaster glaucophyllus* Franchet f. *serotinus* (Hutchinson) Stapf, Bot. Mag. 153: t. 9171. 1929. TYPE: plant cultivated in the garden of Mr. G. H. Wollaston, Flaxley Cottage, Flax Bourton, United Kingdom, 1919 (fr), grown from seeds collected in China. Yunnan: *G. Forrest 6754* (holotype, K).

This fourth variety occurs from 1900 to 3000 m in mountainous regions of western Yunnan Province. It is characterized by having leaf blades 4–6 cm, abaxially pubescent when young, gradually glabrescent, and inflorescences 50- to 60-flowered, white tomentose initially, later glabrescent. The four varieties of *Cotoneaster glaucophyllus* are distinguished as follows:

KEY TO VARIETIES OF *COTONEASTER GLAUCOPHYLLUS*

1a. Leaf blade 3.5–6 cm.
  2a. Inflorescences to 40-flowered, with soft yellow hairs . . . . var. *glaucophyllus*
  2b. Inflorescences 50- to 60-flowered, white tomentose initially, later glabrescent . . . . var. *serotinus*
1b. Leaf blade 1.5–3 cm.
  3a. Leaf blade abaxially densely yellow tomentose when young, later glabrescent; inflorescences to 40-flowered, larger, densely white tomentose when young . . . . var. *vestitus*
  3b. Leaf blade abaxially slightly pubescent or subglabrous; inflorescences 6- to 12-flowered, smaller, with soft hairs . . var. *meiophyllus*

Cotoneaster bullatus Bois (in Vilmorin & Bois, 1904: 119) is a deciduous shrub endemic to southwestern China (Hubei, Sichuan, Xizang, and Yunnan Provinces), with conspicuously rugose, bullate

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leaves, lax, 5- to 31-flowered corymbs, erect, pink petals, and red to dark purple, globose or obovoid fruit. In addition to its typical variety, another named variety occurs in China: *C. bullatus* var. *macrophyllus* Rehder & E. H. Wilson (in Sargent, 1912: 164). A form of this species, f. *floribundus* (Stapf) Rehder & E. H. Wilson (originally described as a form of *C. moupinensis* Franchet), is best treated as a third variety of *C. bullatus*; thus a new combination is required.

Cotoneaster bullatus Bois var. **floribundus** (Stapf) L. T. Lu & A. R. Brach, comb. nov. Basionym: *Cotoneaster moupinensis* Franchet f. *floribundus* Stapf, Bot. Mag. 135: t. 8284. 1909. *Cotoneaster bullatus* f. *floribundus* (Stapf) Rehder & E. H. Wilson, in Sargent, Pl. Wilson. 1: 165. 1912. TYPE: plant cultivated at the Royal Botanic Gardens, Kew, United Kingdom, from seed collected in China. Sichuan: "near Tachienlu" [Kangding], *M. Vilmorin 2123* (holotype, K).

This second variety occurs in mountain forests from 900 to 2100 m in western Sichuan Province. It is characterized by having petioles 1.5(–2.5) mm, leaf blades ovate or obovate, less than 5 cm, and inflorescences 4–6 cm in diameter, 15- to 31-flowered.

The three varieties of *Cotoneaster bullatus* are distinguished as follows:

KEY TO VARIETIES OF *COTONEASTER BULLATUS*

1a. Petiole 3–6 mm; inflorescences 5- to 13-flowered . . . . var. *bullatus*
1b. Petiole 1.5–2.5 mm; inflorescences 11- to 31-flowered.
  2a. Leaf blade 5–15 × 2.5–8 cm, petiole ca. 2 mm; inflorescences 5–8 cm diam., 11- or more flowered . . . . var. *macrophyllus*
  2b. Leaf blade usually less than 5 cm, petiole usually less than 2 mm; inflorescences 4–6 cm diam., 15- or more flowered . . . . var. *floribundus*

Cotoneaster gracilis Rehder & E. H. Wilson (in Sargent, 1912: 167) is a deciduous shrub endemic to central China (Gansu, Hubei, Shaanxi, and Sichuan Provinces), with ovate to broadly elliptic leaves, lax, 1- to 7-flowered corymbs, erect, red petals and red, obovoid, puberulous fruit. In addition to its typical variety, another species, *Cotoneaster difficilis* G. Klotz, is very similar to it, but differs mainly by its smaller leaf blades and few-flowered inflorescences. This latter species is best treated at varietal rank under *C. gracilis*; thus a new combination is required.

Cotoneaster gracilis Rehder & E. H. Wilson var. **difficilis** (G. Klotz) L. T. Lu, comb. nov. Basionym: *Cotoneaster difficilis* G. Klotz, Wiss. Z. Friedrich-Schiller-Univ. Jena, Math.-Naturwiss. Reihe 21(5–6): 1017. 1972. TYPE: China. Sichuan: "valley of Hsao chin ho [Xiaojin River] near Mon kong ting, 7–10.000 ft.," June 1908, *E. H. Wilson 2169* (holotype, A; isotype, BM).

This variety occurs from 1800 to 3000 m in mountain regions of southeastern Gansu and western Sichuan Provinces. *Cotoneaster gracilis* var. *difficilis* is characterized by having leaf blades ovate-elliptic to broadly elliptic, 7–14 × 5.5–8 mm, abaxially tomentose initially, and inflorescences 1- to 3(to 6)-flowered. It is distinguished from the typical variety as follows:

KEY TO VARIETIES OF *COTONEASTER GRACILIS*

1a. Leaf blade ovate to oblong-ovate, 20–35 × 10–20 mm, densely tomentose abaxially; inflorescences 3- to 7-flowered . . . . var. *gracilis*
1b. Leaf blade ovate-elliptic to broadly elliptic, 7–14 × 5.5–8 mm, initially tomentose abaxially; inflorescences 1- to 3(to 6)-flowered . . var. *difficilis*

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Stylosanthes seabrana (Leguminosae: Papilionoideae), a New Species from Bahia, Brazil

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ABSTRACT. During agronomic evaluation of introduced accessions of *Stylosanthes* Swartz in Colombia and Queensland, Australia, a genotype differing in morphology, chromosome number, and genetic markers was discovered. The new species *Stylosanthes seabrana* is closely related to *S. scabra* Vogel and has been collected in Bahia, Brazil. Two cultivars, 'Primar' and 'Unica,' of this species now newly recognized were released in Queensland, Australia, in 1996 for use as pasture legumes.

Key words: Bahia, diploid, genetic resources, germplasm, *Stylosanthes seabrana*, tropical pasture legume.

Within a large germplasm collection of *Stylosanthes scabra* Vogel at the Centro Internacional de Agricultura Tropical (CIAT), Colombia, Maass (1989) found plants that were morphologically, agronomically, and biochemically very different from *S. scabra*, while not belonging to any other known species within this genus. They were referred to as "cf. scabra-type" (Maass, 1989) and were also introduced to Queensland, Australia (Jansen & Edye, 1996), where they were called "aff. scabra" and became commonly known as "Caatinga stylo." Two cultivars, 'Primar' and 'Unica,' were released in Australia in 1996 for use as pasture legumes (Anonymous, 1996).

In the morphological study of Jansen and Edye (1996), the diploid accessions of "aff. scabra" were compared to *S. hamata* Taubert 'Verano' and *S. scabra* 'Seca,' which are both tetraploid (Oram, 1990; Stace & Cameron, 1987). However, these accessions from an undescribed taxon could morphologically be distinguished from *S. hamata* by their bristly leaflets (vs. non-bristly in *S. hamata*) and from *S. scabra* by their narrower and glabrous leaflets (vs. elliptical to obovate and pubescent in *S. scabra*) except for prominent viscid bristles on the lower surface and margins; prominent bristles on stem nodes and stipules, stipule teeth with long lateral bristles in combination with an absent or very short terminal bristle, bristles often on part of the internodes and on the inflorescence (vs. overall pubescence with occasional appearance of short, viscid bristles in *S. scabra*, but not as prominent); relatively longer pods and longer stylar remnants (beaks) (vs. shorter pods and beaks in *S. scabra*) (Jansen & Edye, 1996).

Additional morphological, rhizobial, cytological, and molecular evidence supports the conclusion that this is a separate, as yet unnamed, diploid ($2n = 20$) (Liu, 1997; Liu & Musial, 1997) species (Table 1), which belongs to *Stylosanthes* sect. *Styposanthes*. From genetic evidence, Liu et al. (1996) and Liu and Musial (1997) postulated that this unknown species and *S. viscosa* Swartz might be the putative diploid progenitors of the allotetraploid *S. scabra* ($2n = 40$). Unlike *S. scabra*, the unnamed species demonstrated a highly specific requirement for effective nitrogen-fixing strains of *Bradyrhizobium* (Date et al., 1996).

KEY TO *STYLOSANTHES SEABRANA*, *S. HAMATA*, AND *S. SCABRA*

1a. Beak equal to or exceeding the upper article, leaflets without bristles . . . . *S. hamata*
1b. Beak shorter than the upper article, leaflets with bristles.
    2a. Leaflets narrowly elliptical, glabrous except for long bristles on the margins and midrib and prominently raised veins on the lower surface . . . . *S. seabrana*
    2b. Leaflets elliptical to obovate, pubescent with bristles at least underneath or on the margins without prominently raised veins on the lower surface . . . . *S. scabra*

Stylosanthes seabrana B. L. Maass & L. 't Mannetje, sp. nov. TYPE: Brazil. Bahia: State Road BA052 from Irecê 80 km to Xique-Xique, 10°56'S, 42°29'W, 29 June 1983, *L. Coradin, R. Baker, F. B. de Souza, R. M. Harley & S. Linington LC 6261* (holotype, CEN; isotypes, K, M, PAMG, RB, WAG).

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Table 1. Herbarium specimens, germplasm accessions, and ploidy status of *Stylosanthes seabrana*.

Collector's number	Collectors	Latitude	Longitude	Herbarium specimens[1]	Other Herbaria[2]	Germplasm accessions[3]	Ploidy status[4]
LC 1172	Coradin, L.; Schultze-Kraft, R.; Da Silva, G. P.; Silva, J. C.	12°03′S	44°24′W	CEN, PAMG	CIAT	BRA-007951; CIAT 2050; CPI 110341	2x
LC 5186	Coradin, L.; Schultze-Kraft, R.; Da Silva, G. P.; Silva, J. C.	12°12′S	45°03′W	ILCA	CIAT	BRA-007901; CIAT 2043; CPI 110340; ILCA 15767	2x
LC 5208	Coradin, L.; Schultze-Kraft, R.; Da Silva, G. P.; Silva, J. C.	12°27′S	42°11′W	ILCA	CIAT	BRA-008095; CIAT 2070; CPI 092454; CPI 110342; ILCA 15768	2x
LC 5221	Coradin, L.; Schultze-Kraft, R.; Da Silva, G. P.; Silva, J. C.	12°27′S	41°39′W	ILCA	CIAT	BRA-008206; CIAT 2085; CPI 092463; CPI 110343; ILCA 15769	2x
LC 1234	Coradin, L.; Schultze-Kraft, R.; Da Silva, G. P.; Silva, J. C.	12°28′S	41°07′W	CEN, PAMG	CIAT	BRA-008915; CIAT 2107; CPI 092476; CPI 110344	n.a.
LC 1417	Coradin, L.; Vieira, J. G. A.; Silva, M. C. M.	9°54′S	40°15′W	—	CIAT	BRA-009318; CIAT 10517; CPI 110372	2x
75	Bastos	n.a.	n.a.	CEPEC, K	—	—	n.a.
1017	Hage, J. L. & Brito, H. S.	n.a.	n.a.	CEPEC, K	—	—	n.a.
LC 4335	Coradin, L.; Schultze-Kraft, R.; Da Silva, G. P.; Silva, J. C.	12°20′S	42°48′W	—	CIAT	BRA-022462; CIAT 10026; CPI 104710	n.a.
LC 4351	Coradin, L.; Schultze-Kraft, R.; Da Silva, G. P.	12°53′S	41°51′W	CEN, HUEFS, K, NY	CIAT	BRA-022594; CIAT 10113	n.a.
LC 4402	Coradin, L.; Schultze-Kraft, R.; Da Silva, G. P.; Silva, J. C.	12°33′S	41°06′W	—	CIAT	BRA-022811; CIAT 10033; CPI 110361 = cv. Unica	2x
LC 4447	Coradin, L.; Schultze-Kraft, R.; Da Silva, G. P.	12°40′S	41°33′W	CEN, ILCA	CIAT	BRA-022977; CIAT 10119; CPI 110370; ILCA 15793	(2x)[5]
LC 5782a	Coradin, L.; Da Silva, G. P.; Harley, R. M.	11°08′S	45°12′W	—	CIAT	BRA-029220; CIAT 10537	n.a.
LC 6257	Coradin, L.; Souza, F. B. de; Da Silva, G. P.; Vieira, J. G. A.; Baker, R.; Harley, R. M.; Linington, S.	11°29′S	41°20′W	—	CIAT	BRA-029327; CIAT 10547; CPI 110373	2x
LC 6171	Coradin, L.; Baker, R.; Souza, F. B. de; Harley, R. M.; Linington, S.	11°05′S	40°38′W	CEN, K, PAMG	—	MSB 48767	n.a.
LC 6261	Coradin, L.; Baker, R.; Souza, F. B. de; Harley, R. M.; Linington, S.	10°56′S	42°29′W	CEN, K, M, PAMG, RB, WAG	CIAT	BRA-028961; MSB 48918; CIAT 10471; ATF 2350	2x
2962	De Carvalho, A. M. & Saunders, J.	n.a.	n.a.	CEPEC, K	—	—	n.a.

[1] Registered in *Index Herbariorum*; specimens at ILCA from cultivated plants.

[2] Herbarium specimens from cultivated plants, maintained for reference of germplasm collections and not registered in *Index Herbariorum*.

[3] Prefixes of the germplasm registration systems of Centro Nacional de Recursos Genéticos e Biotecnologia (CENARGEN) = BRA; Centro Internacional de Agricultura Tropical = CIAT; Commonwealth Scientific and Industrial Research Organisation (CSIRO) = CPI or ATF; International Livestock Research Institute (ILRI) = ILCA; Millennium Seed Bank Project of the Royal Botanic Gardens, Kew = MSB. Additional passport information may be requested from the mentioned institutions.

[4] Assessed by Liu (1997) on the accessions introduced to Australia (CPI); n.a. = not available.

[5] Under this CPI accession number, there were different plant types, but not all were diploid.

S. scabrae affinis sed diploidea vice tetraploidea, rudimento axis multo longiore (> 6 mm), foliolis angustioribus et glabrescentibus infra et ad marginen setis longioribus vulgo viscidis munitis et infra venis manifeste prominentibus albidis munitis, dentibus stipularum setis lateralibus longis munitis, seta terminali nulla vel brevissima differt.

Perennial, woody at base; stems pilose on one side, except at base, viscid bristles (> 1 mm) near the nodes; stipules pilose, very bristly, long lateral bristles present on stipule teeth, but rarely with a terminal bristle, if so this very short. Leaflets lanceolate to elliptic-acute, upper surface glabrous, lower surface glabrous, except for long often viscid bristles on the midrib below and on the margins, veins raised, prominent below, whitish. Spikes capitate, small with several papilionaceous flowers, with obovoid sulphur-yellow standard. Each flower surrounded by a trifoliolate outer bract and two inner bracteoles, ciliate at the apex. Outer bract bristly, pilose on the margins, 3 pairs of veins. Axis rudiment reaching a height halfway up the upper article (7–8 mm long), pilose. Loment with 2 articles; the upper article appressed pilose to woolly, sometimes glabrous or slightly hairy on the inside of the beak (stylar remnant), with a clear central vein and weak lateral veins. Beak uncinate, pilose to woolly, half the length of the upper article (ca. 2–3 mm from base to top of the bend). The lower article densely pilose. Seed cream-colored. Chromosome number $2n = 20$.

Etymology. Specimens and several germplasm accessions from the region around the town of Seabra, in the Brazilian state of Bahia were among the earliest collections of the species.

Distribution. Endemic to Bahia, Brazil, between 9–13°S and 40–46°W.

Ecology. *Stylosanthes seabrana* occurs in areas with low rainfall, long dry seasons, mainly on medium to heavy textured red or yellow soils with Caatinga vegetation (Jones et al., 1996). It is often found growing sympatrically with *S. scabra*. The released cultivars in Queensland, Australia, are frost and anthracnose tolerant.

Paratypes. BRAZIL. **Bahia:** Mun. Barreiras, 28 Sep. 1978, *L. Coradin et al. LC 1172* (CEN, PAMG); Mun. Barreiras, 28 Sep. 1978, *L. Coradin et al. LC 5186* (ILCA); Mun. Seabra, 29 Sep. 1978, *L. Coradin et al. LC 5208* (ILCA); Mun. Seabra, 29 Sep. 1978, *L. Coradin et al. LC 5221* (ILCA); Mun. Seabra, 4 Oct. 1978, *L. Coradin et al. LC 1234* (CEN, PAMG); Rd. Irecê-Xique Xique 3 km NW of Irecê, 18 Feb. 1981, *Bastos 75* (CEPEC, K); Rd. Ilhéus–Itabuna km 22, 1 July 1981, *Hage & Brito 1017* (CEPEC, K); Mun. Boninal 52 km S from Rd. BR 242 to Piatã, 20 Aug. 1981, *L. Coradin et al. LC 4351* (CEN, HUEFS, K, NY); Mun. Palmeiras, 22 Aug. 1981, *L. Coradin et al. LC 4447* (CEN, ILCA); Rd. Jacobina–Lage do Batata km 15, 28 June 1983, *L. Coradin et al. LC 6171* (CEN, K, PAMG); Palmeiras ca. 250 km on Rd. BR 242, 19 Mar. 1990, *de Carvalho & Saunders 2962* (CEPEC, K).

Germplasm accessions. The largest part of the herbarium specimens listed here was collected during different germplasm collecting missions directed by L. Coradin from the Brazilian Centro Nacional de Recursos Genéticos e Biotecnologia (CENARGEN) in collaboration with scientists from CIAT (Coradin & Schultze-Kraft, 1990) or the Royal Botanic Gardens, Kew. For purposes of conservation, research, and breeding, seed of most of the collections is consequently stored in genebanks of the respective institutions as well as in other relevant genetic resource collections, such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia or the International Livestock Research Institute (ILRI) in Ethiopia (Table 1). A number of additional germplasm accessions that belong to the same diploid species were mentioned by Jansen and Edye (1996) and Liu (1997).

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New Combinations and Synonyms in the Moss Family Diphysciaceae

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ABSTRACT. Phylogenetic analyses of sequence data of the chloroplast protein coding genes *rbcL* and *rps4*, and the chloroplast encoded *trnL* (UAA) intron suggest that morphological characters traditionally used in delimiting the genera *Diphyscium* Mohr, *Muscoflorschuetzia* Crosby, and *Theriotia* Cardot in the moss family Diphysciaceae are homoplastic; *Diphyscium* is paraphyletic, and *Theriotia* and *Muscoflorschuetzia* are nested in *Diphyscium*. Therefore, only *Diphyscium* Mohr should be recognized in Diphysciaceae, and *Muscoflorschuetzia* Crosby and *Theriotia* Cardot should be made synonyms of *Diphyscium*. Consequently, three combinations are newly made: *Diphyscium kashmirense* (H. Robinson) Magombo, *Diphyscium lorifolium* (Cardot) Magombo, and *Diphyscium pilmaiquen* (Crosby) Magombo.

Key words: Diphysciaceae, *Diphyscium*, moss, *Muscoflorschuetzia*, *Theriotia*.

The Diphysciaceae are a small family of mosses distinguished by the unique combination of short setae, immersed capsules, collared axillary hairs, distinctly differentiated perichaetial leaves that have crenulate, dissected, laciniate or ciliate margins at apex, and arthrodontous peristomes that have pleated endostomes and exostomes that are rudimentary or lacking. The Diphysciaceae grow on rocks (limestone or sandstone) or in rock crevices, on soil, sometimes on rotten wood, and rarely on tree trunks. They are found in forests, along trails or footpaths, along streams and riverbanks, and sometimes close to waterfalls, on wet or frequently watered substrates, in fully or partially shaded places. Occasionally, the Diphysciaceae occur fully submerged in water. The Diphysciaceae grow at an altitudinal range from close to sea level to as high as 3400 m.

Most species in the Diphysciaceae are restricted in their distributions, although a few are widespread and exhibit disjunct distribution patterns (Robinson, 1965; Allen, 1996; Crosby, 1977; Deguchi, 1975, 1984a, 1984b; Norris, 1981; Noguchi & Iwatsuki, 1987; Deguchi et al., 1997; Tan, 1998). Twelve species occur in the Old World, and seven of these are restricted to Asia (*Diphyscium fasciculatum* Mitten, *D. satoi* Tuzibe, *D. perminutum* Takaki, *D. suzukii* Z. Iwatsuki, *D. fulvifolium* Mitten, *Theriotia lorifolia* Cardot, and *T. kashmirensis* H. Robinson). The Old and the New World share five species (*D. foliosum* (Hedwig) Mohr, *D. mucronifolium* Mitten, *D. longifolium* Griffith, *D. pocsii* (Bizot) R. H. Zander, and *D. chiapense* D. H. Norris). Three species, *D. fendleri* Müller Halle, *D. domingense* (Bridel) W. R. Buck & Steere, and *Muscoflorschuetzia pilmaiquen* (Crosby) Crosby, are restricted to the New World. *Diphyscium foliosum* is the most widely distributed species of all Diphysciaceae. It is known from Central and North America, throughout Europe (including the Arctic regions), and Asia.

The Diphysciaceae traditionally consist of three genera: *Diphyscium* Mohr (12–15 species), *Theriotia* Cardot (2 species), and *Muscoflorschuetzia* Crosby (1 species). The first taxon now placed in *Diphyscium* was originally described as *Buxbaumia foliosa* Hedwig. Hedwig (1801) used the genus *Buxbaumia* to accommodate two species, *Buxbaumia aphylla* Hedwig and *Buxbaumia foliosa* Hedwig, which he characterized as dioicous species with terminal inflorescences and double peristomes that have truncate exostomes and plicate endostomes. Based on differences in gametophyte morphology, Mohr (1803) established the genus *Diphyscium*, with a single species *Diphyscium foliosum* (Hedwig) Mohr. Schwaegrichen (1830) returned *D. foliosum* to *Buxbaumia*, choosing not to recognize *Diphyscium* Mohr because of its similar peristome structure. However, Fleischer (1919) agreed with Mohr and established the family Diphysciaceae for *D. foliosum*.

The genus *Theriotia* was erected by Cardot (1904) based on a sterile collection (*Faurie 136*) from Ouen-San (Wonsan) in North Korea, which he named *Theriotia lorifolia* Cardot. Lamina thickness has traditionally been the main feature for distinguishing *Theriotia* (3 to 14 cells thick) from *Diphyscium* (1 to 2 cells thick). Cardot (1904) originally placed *Theriotia* in the Syrrhopodontaceae, because its leaf form resembles that of *Syrrhopodon* Schwaegrichen subg. *Calymperidium* Dozy & Molkenboer. The multistratose leaf structure of *Theriotia* was also compared to that of *Exodictyon* Cardot (Leucobryaceae), a genus that Cardot (1904) considered intermediate between Syrrhopodontaceae and Leucobryaceae. Brotherus (1925) was the first to place *T. lorifolia* in the Diphysciaceae, because its peristome is similar to that of *Diphyscium*. A second species was added to *Theriotia* when Robinson (1965) described *T. kashmirensis* H. Robinson with a leaf structure similar to that of *T. lorifolia*.

Crosby (1977, 1978) added a third genus to the Diphysciaceae when he described *Muscoflorschuetzia*. He placed this genus in the Diphysciaceae, because of its short setae, collared axillary hairs, and inner perichaetial leaves that have ciliate margins at the apex. *Muscoflorschuetzia* differs from other members of the Diphysciaceae in its lack of a peristome, long and narrow capsule shape, and consistently unistratose lamina (Crosby, 1977, 1978).

Variation in morphological characters, particularly plant size, leaf morphology, lamina cell structure, capsule morphology, exothecial cell morphology, stomata, peristome, annulus, and sexuality has led to debate on character evolution and has affected ideas on how genera and species might be related in the Diphysciaceae (Crosby, 1977, 1978; Deguchi, 1975, 1984b; Allen, 1996; Deguchi et al., 1997; Norris, 1981; Robinson, 1965). On the basis of molecular data the Diphysciaceae are considered monophyletic (Goffinet et al., 2001; Magombo, 2002) and are sister to haplolepideous and diplolepideous mosses (Beckert et al., 1999, 2001; Newton et al., 2000; Goffinet et al., 2001; Magombo, 2002). However, phylogenetic analyses of sequence data of the chloroplast protein coding genes *rbc*L and *rps*4, and the chloroplast encoded *trn*L (UAA) intron (see Magombo, 2002) suggest that the morphological characters traditionally used in delimiting *Diphyscium*, *Muscoflorschuetzia*, and *Theriotia* are homoplastic; recognition of *Theriotia* and *Muscoflorschuetzia* makes *Diphyscium* paraphyletic since both genera are nested in *Diphyscium*. Therefore, only *Diphyscium* should be recognized in the Diphysciaceae; *Theriotia* and *Muscoflorschuetzia* are synonyms of *Diphyscium*. Consequently, three combinations are newly made in *Diphyscium*. A detailed taxonomic account of the Diphysciaceae is presented in the forthcoming revision of the family in the *Journal of the Hattori Botanical Laboratory*.

Diphyscium Mohr, Observ. Bot. 34. 1803. TYPE: *Buxbaumia foliosa* Hedwig (= *Diphyscium foliosum* (Hedwig) Mohr).

Theriotia Cardot, Beih. Bot. Centralbl. 17: 8. 1904. Syn. nov. TYPE: *Theriotia lorifolia* Cardot.

Muscoflorschuetzia Crosby, Bryologist 81: 338. 1978. Syn. nov. Replacement name for *Florschuetzia* Crosby, hom. illeg., non *Florschuetzia* Hopping & Muller. TYPE: *Florschuetzia pilmaiquen* Crosby (= *Muscoflorschuetzia pilmaiquen* (Crosby) Crosby).

1. **Diphyscium kashmirense** (H. Robinson) Magombo, comb. nov. Basionym: *Theriotia kashmirensis* H. Robinson, Bryologist 68: 314. 1965. TYPE: [Pakistan] Kashmir. Karakorum Range, upper Hushe Valley, Atosar Valley, 17 July 1955, *G. L. Webster & E. Nasir 6173a* (holotype, US).

Robinson (1965) used the name *Theriotia kashmirensis* when he first described this species because its leaf structure (3 to 14 cells thick) is similar to that of *Theriotia lorifolia*. The two taxa have indeed been considered closely related and have traditionally been separated from members of *Diphyscium*, which have lamina of one or two cells thick. However, *Theriotia kashmirensis* is similar to members of *Diphyscium* in peristome structure, collared axillary hairs, and inner perichaetial leaves with ciliate margins. Furthermore, phylogenetic analysis of molecular evidence (Magombo, 2002) shows *Theriotia kashmirensis* nested in *Diphyscium*. Therefore, a new combination is made.

2. **Diphyscium lorifolium** (Cardot) Magombo, comb. nov. Basionym: *Theriotia lorifolia* Cardot, Beih. Bot. Centralbl. 17: 8. 1904. TYPE: Corée [North Korea]. Ouen-San, October 1901, *P. U. J. Faurie 136* (holotype, PC).

Like *D. kashmirense*, *D. lorifolium* is different from other Diphysciaceae because of the lamina structure (3 to 14 cells thick). However, it is similar to other *Diphyscium* species in its peristome structure, collared axillary hairs, as well as inner perichaetial leaves with ciliate margins. Furthermore, placement of this species in a separate genus, *Theriotia*, is not supported by molecular evidence (Magombo, 2002). Consequently, a new combination is made. Both *D. kashmirense* and *D. lorifolium* occur in the Old World (Asia).

3. **Diphyscium pilmaiquen** (Crosby) Magombo, comb. nov. Basionym: *Florschuetzia pilmaiquen* Crosby, Bryologist 80: 149. 1977. *Muscoflorschuetzia pilmaiquen* (Crosby) Crosby, Bryologist 81. 338. 1978. TYPE: Chile. Province Valdivia/Prov. Osorno: Forest Reserve at Planta Hydroeléctrica Pilmaiquén, along Río Pilmaiquén, 29 Jan. 1976, *M. R. Crosby 12235* (holotype, MO).

Diphyscium pilmaiquen is the most distinctive species in Diphysciaceae because of its lack of peristome, lamina consistently unistratose, and a long and gradually narrow capsule. Its placement in *Diphyscium*, and therefore the need for a new combination, is supported by collared axillary hairs, immersed capsule, perichaetial leaves with ciliate margins, and molecular evidence (see Crosby, 1977, 1978; Magombo, 2002). *Diphyscium pilmaiquen* is rare, known only from the type locality in southern Chile.

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Isoetes toximontana (Isoetaceae), a New Quillwort with Green Megaspores from the Northern Cape of South Africa

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Abstract. *Isoetes toximontana* is only the second quillwort reported from the Northern Cape region in South Africa. It occurs in shallow water on the Gifberg. Megaspores are uniformly tuberculate on the proximal surface; their distal surfaces may have occasional rugi along with bullae. They are olive green when dry. Microspores are brown and aculeate. Preliminary field studies suggest that an unexpected diversity of quillworts is found in this region.

Key words: Gifberg, Isoetaceae, *Isoetes*, Northern Cape Province, Quillwort, South Africa.

Burrows (1990) recorded six species of *Isoetes* L. from South Africa, with only two from the Cape region (Cape Agulhus to the Namibian border): *I. capensis* Duthie and *I. stellenbossiensis* Duthie. Their presence as the only quillworts in the flora is confirmed in a recent comprehensive treatment of the ferns and fern allies of the Cape (Roux, 2000). Our report here of a new species is the first quillwort documented across this large geographical area.

Isoetes toximontana L. J. Musselman & J. P. Roux, sp. nov. TYPE: South Africa. Northern Cape Province: Gifberg, shallow water along Gifberg Road, 1 km S of Oubergpad, 31°47′09″S, 18°45′71″E, ca. 22 km SE of Vanrhynsdorp, 565 m, 20 Sep. 2001, *Lytton J. Musselman & Elizabeth R. Musselman 2001-35* (holotype, NBG; isotype, MO). Figures 1, 2.

Planta amphibia, emergens. Excaudex trigonus et radicibus simplicibus. Folia usque ad 10, obscure viridia, rigida, spiralia, usque ad 42 mm longa, apicibus obtusa, in medio longitudinis ca. 0.5 mm lata, in sectione transversali elliptica, cellulis epidermalibus omnibus processibus tuberculatis ornatis, prope basim folii tantum, cavernulis aeriis quatuor etiam seriebus stomatum ad as parallelis praeditis, littis peripheralibus absentibus. Megasporophylla microsporophyllaque in eadem planta portata. Velum absente; parietes sporangii pellucidos. Megasporae paucae (usque ad 36 per sporangium), olivaceae, 275–320 μm in diam., in parietibus proximalibus distalibusque, aeque tuberculatae, tuberculis altitudine variantibus, cingulo angusto sub crista aequatoria posito. Microsporae brunneae usque ad 25 μm longae, aculeatae stelis remotis.

Plants amphibious, emergent. Rootstock three-sided. Roots simple. Leaves 3 to 10 per plant, dull green, stiff, spirally arranged, up to 42 mm long, obtuse, ca. 0.5 mm wide at mid length, elliptic in cross section. Leaf epidermal cells with tuberculate outgrowths, with four air chambers near the base, but these absent toward the leaf apex, with four rows of stomata parallel to the air chambers, peripheral strands lacking. Scales present. Megasporophylls and microsporophylls on the same plant. Velum absent. Sporangium wall clear. Megaspores few (up to 36 per sporangium), gray-green in color, 275–320 μm diam., uniformly tuberculate on the proximal surface, the distal surface with occasional rugi. Tubercules of varying heights, with a narrow girdle below the equatorial flange. Microspores brown en masse, to 25 μm long, aculeate with remote stelae. The name is derived from Gifberg, Afrikaans for "poison mountain," where the type was collected.

Spore color, ornamentation, and size. *Isoetes toximontana* has green megaspores, a character first reported in the genus by Duthie (1929) for *I. stellenbossiensis* (Fig. 1B, D). It can be distinguished from other Southern African quillworts by megaspore ornamentation and leaf features. *Isoetes stellenbossiensis* has reticulate megaspore ornamentation; *I. capensis* megaspores are boldly rugate on the distal surface. (Terminology for spore ornamentation follows Lellinger & Taylor, 1997.) Based on the figures in Burrows (1990), there are four quillworts in southern Africa with tuberculate mega-

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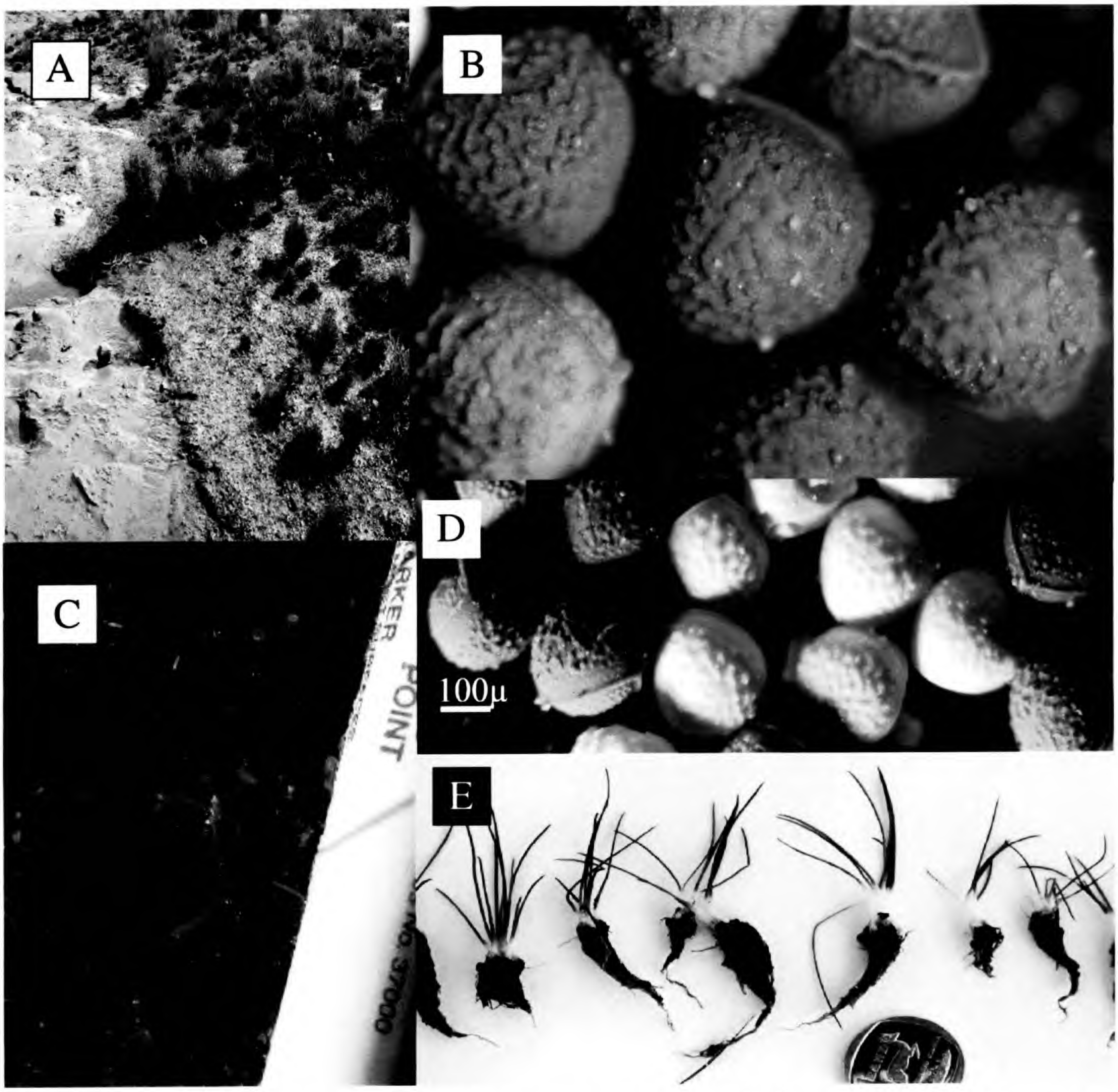

Figure 1A–E. —A. Roadside ditch with shrubby restio. Type location. —B. Megaspores. Brown microspores are evident on the surface. —C. *Isoetes toximontana.* Note the size of the plants. —D. Mixture of megaspores of *I. toximontana* (green) and *Musselman & Musselman 2001-33* (white). —E. Representative plants of *I. toximontana.* The coin is ca. 2 cm in diameter.

spores: *I. giessi* Launert, *I. transvaalensis* Jermy & Schelpe, *I. welwitschii* A. Braun ex Kuhn, and *I. alstonii* Reed & Verdcourt. Of these, only *I. giessi* and *I. welwitschii* lack a velum. *Isoetes welwitschii* is more tropical in its distribution and in South Africa is known from only a few collections in the eastern part of the country (Burrows, 1990). Quillworts of Namibia are poorly understood, including the taxon known as *I. giessi* from central Namibia, which does have tuberculate megaspores. However, ornamentation is sparse and megaspores are white. The size of megaspores and microspores of *I. toximontana* is similar to that of *I. stellenbossiensis* and *I. capensis,* both diploids (R. D. Bray, unpublished), suggesting that *I. toximontana* is also diploid. Microspores are brown (Fig. 1B) and have aculeate macro ornamentation (Fig. 2C). Megasporophylls and microsporophylls were found in mid September on the same plant.

Leaves. Unlike *I. stellenbossiensis,* the Gifberg quillwort has stomata in rows on the adaxial surface (Fig. 2B, F, G). Leaf epidermal cells have a distinctive ornamentation consisting of knobby outgrowths (Fig. 2F, G). No peripheral strands (collenchyma-like cells) were found (Fig. 2D).

Rootstock and roots. The rootstock is three-sided (Fig. 2H). No branched roots, characteristic of most *Isoetes* species, were evident in *I. toximontana.*

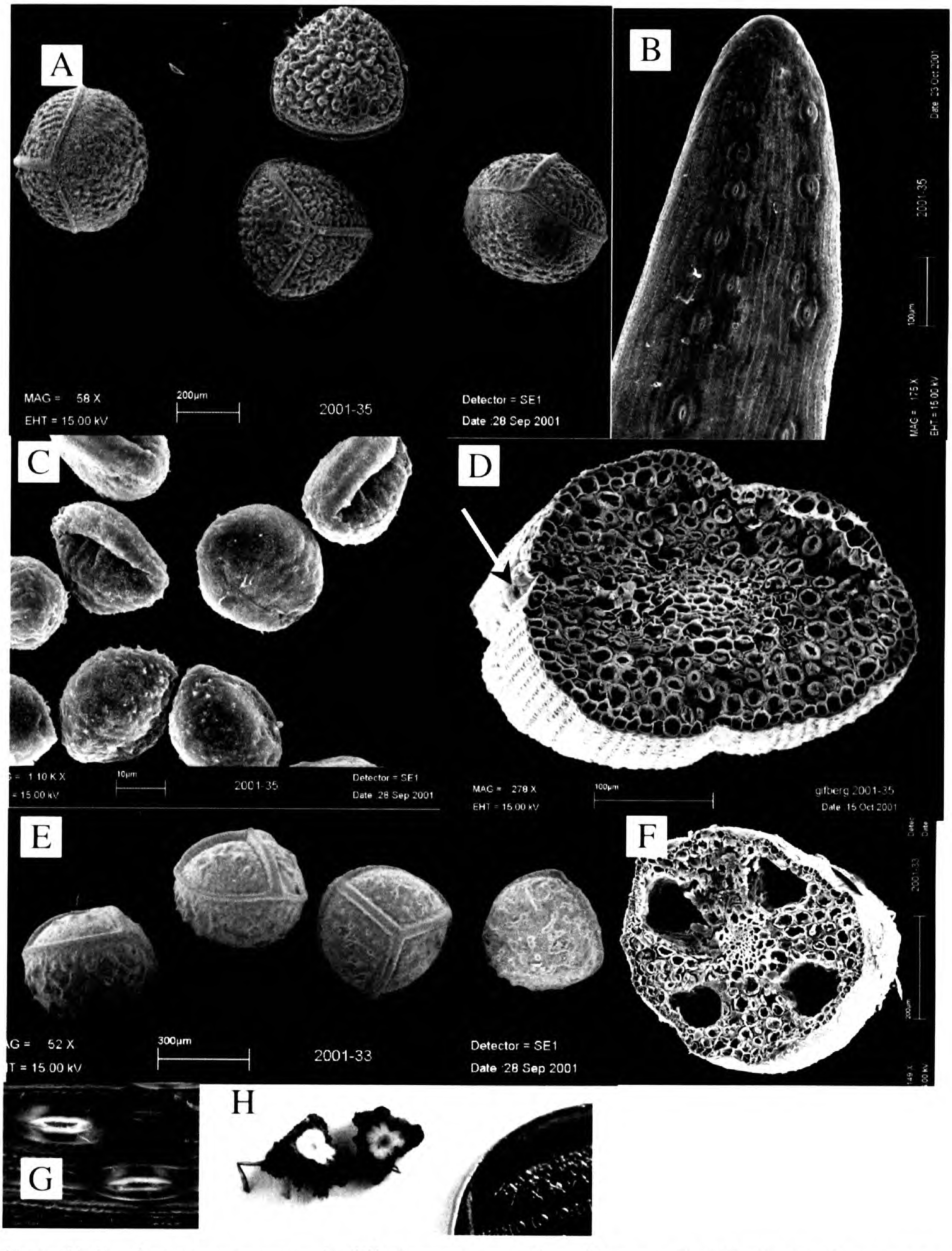

Figure 2A–G. *Isoetes toximontana*. —A. SEM of megaspores. Scale = 200 μm. —B. SEM of leaf tip. Note the rows of stomata on the adaxial side. Scale = 100 μm. —C. SEM of microspores. Scale = 10 μm. —D. SEM of cross section of leaf at midpoint. Arrow indicates stomatal apparatus. Scale = 200 μm. —E. Megaspores of *Musselman & Musselman 2001-33* with rugulate ornamentation. —F. Cross section of leaf of *Musselman & Musselman 2001-33*. Note the four air chambers. —G. Two stomata of *I. toximontana*. —H. Cross sections of rootstocks of *I. toximontana*.

Habitat. This diminutive species (Fig. 1C, E) was found only as a submergent in a temporary pond dominated by a semi-shrubby restio (Restionaceae) (Fig. 1A). Our preliminary fieldwork in the Gifberg, the southwestern-most escarpment of sandstone of the Cape System, indicates that several taxa of quillworts may be present. One of these quillworts has white megaspores with rugate ornamentation (Fig. 1D, 2E). At least one putative hybrid was found, distinguished by aborted spores, another indication of the diversity of *Isoetes* taxa previously unknown in this part of southern Africa.

Preliminary molecular work using ITS sequences indicates that *I. toximontana* is a distinct species with nine unique substitutions located in a clade with *I. capensis* (W. C. Taylor, pers. comm.).

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Seven New Species and One New Combination in *Carex* (Cyperaceae) from North America

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Abstract. Seven species in four sections of *Carex* are described as new from North America: *C. acidicola* Naczi, *C. calcifugens* Naczi, *C. paeninsulae* Naczi, E. L. Bridges & Orzell, and *C. thornei* Naczi (all sect. *Griseae*); *C. kraliana* Naczi & Bryson (sect. *Laxiflorae*); *C. gholsonii* Naczi & Cochrane (sect. *Granulares*); and *C. infirminervia* Naczi (sect. *Deweyanae*). *Carex acidicola, C. calcifugens, C. paeninsulae*, and *C. thornei*, all members of the *C. oligocarpa* complex, have distichous perigynia and purple-red shoot bases. *Carex acidicola*, from a few sites in Alabama and Georgia, is distinctive in having the bases of the proximal bract blades whitish. *Carex calcifugens* occurs in a few populations in Florida, Georgia, North Carolina, and South Carolina. It is characterized by having the purple-red coloration at the plant base less extensive than in other members of the *C. oligocarpa* complex, the vegetative shoots exceeding the reproductive ones, and by bearing the proximal-most spikes at the bases of the shoots. *Carex paeninsulae* is restricted to a few sites in Florida. It is unique in the *C. oligocarpa* complex in having relatively long rhizomes. *Carex thornei* occurs in a few sites in Alabama, Florida, and Georgia. It has short bract blades and terminal spikes with long peduncles. *Carex kraliana* is widespread and frequent throughout most of the southeastern United States. It is distinctive in its lanceolate or narrowly lanceolate, wide bract blades. *Carex gholsonii* occurs in Alabama, Florida, Georgia, North Carolina, and South Carolina. It is rare in all portions of its range except for parts of Florida. It is distinctive in being loosely caespitose, having short ligules, short bract blades, long and wide terminal spikes, and long perigynia. The chromosome number of *C. gholsonii*, determined from two populations in Florida, is 16 II + 1 IV. *Carex infirminervia* is widespread but infrequent throughout much of the western United States and western Canada. It is unique in its combination of papillose culms, long ligules, perigynium beaks occupying a high percentage of the perigynium length, and toothless or short-toothed perigynium apices. The new combination *C. digitalis* var. *floridana* (L. H. Bailey) Naczi & Bryson (*Carex* sect. *Careyanae*) is proposed to replace *C. digitalis* var. *asymmetrica* Fernald because of the priority of Bailey's epithet.

Key words: *Carex*, *Carex* sect. *Careyanae*, *Carex* sect. *Deweyanae*, *Carex* sect. *Granulares*, *Carex* sect. *Griseae*, *Carex* sect. *Laxiflorae*, Cyperaceae, North America.

Recent studies of North American sedges have resulted in the description of many new species, particularly for the southeastern United States and western North America. The southeastern U.S. hosts a great diversity of *Carex* (Cyperaceae) in a wide range of habitats. Tucker (1987) estimated 165 species of *Carex* for the region. Western North America also possesses a diverse array of *Carex* species. In this paper, we increase the number of known species of North American *Carex* by describing seven new species, six from the Southeast and one from the West. Four of these new species belong to *Carex* sect. *Griseae* (L. H. Bailey) Kükenthal, one belongs to *Carex* sect. *Laxiflorae* Kunth, one is a member of *Carex* sect. *Granulares* (O. Lang) Mackenzie, and one belongs to *Carex* sect. *Deweyanae* (Tuckerman ex Mackenzie) Mackenzie.

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We also propose one new combination in *Carex* sect. *Careyanae.*

FOUR NEW SPECIES OF *CAREX* SECT. *GRISEAE*

Carex sect. *Griseae* is a group of 21 species endemic to eastern North America. The center of diversity for the section is the southeastern United States, where 20 species occur. Most of them inhabit mesic deciduous forests.

Apomorphies diagnosing *Carex* sect. *Griseae* are the large number (usually 40 or more) of nerves (sclerenchyma traces) that are impressed in the surface of living and dried perigynia. Additional distinctive characters of the section, but not necessarily autapomorphic, are long-sheathing proximal bracts, usually unisexual spikes with only the terminal one staminate, and glabrous perigynia that are obtusely triangular or suborbicular in cross section and have entire orifices.

Carex oligocarpa Willdenow, *C. bulbostylis* Mackenzie, *C. edwardsiana* E. L. Bridges & Orzell, and *C. planispicata* Naczi constitute a morphologically distinctive lineage within *Carex* sect. *Griseae.* As identified by Naczi (1999a), members of this *C. oligocarpa* complex have distichously imbricate perigynia and purple-red coloration on the proximal (2.7–)3.0–12 cm of the shoot bases. Other members of *Carex* sect. *Griseae* have spirally imbricate perigynia and brown shoot bases or, if purple-red, the coloration is usually less than 3.7 cm high. Recent herbarium, field, and laboratory work by Naczi has resulted in the discovery of four new species within the *C. oligocarpa* complex, which are described below as *C. acidicola*, *C. calcifugens*, *C. paeninsulae*, and *C. thornei.* With these new species, the *C. oligocarpa* complex now contains eight species and becomes the largest species complex within *Carex* sect. *Griseae.* Members of this complex are also the most difficult to identify in *Carex* sect. *Griseae.* Most previous determinations of specimens of these new species were as *C. oligocarpa.* Each of these new species appears to be rare and quite limited in geographic distribution. The new species are distinguished from other members of the *C. oligocarpa* complex in the following key.

KEY TO MEMBERS OF THE *CAREX OLIGOCARPA* COMPLEX (MEMBERS OF *CAREX* SECT. *GRISEAE* WITH DISTICHOUS PERIGYNIA AND PURPLE-RED SHOOT BASES)

This key is designed for identification of complete and ample specimens bearing mature perigynia. Because collectors often fail to gather rhizomes of *C. paeninsulae*, this species is keyed twice to permit identification of incomplete specimens of it.

1a. Perigynia much inflated, orbicular or suborbicular in cross section, (1.8–)2.0–2.5(–2.8) mm wide, 1.6–2.0(–2.1) times as long as wide . . . . *C. bulbostylis*

1b. Perigynia tightly enveloping achene or slightly inflated, obtusely triangular in cross section, 1.4–1.9(–2.3) mm wide, (1.8–)2.1–3.3 times as long as wide.

2a. Loosely caespitose, longer rhizomes 10–58 mm long between shoots or branches of the rhizomes . . . . *C. paeninsulae* sp. nov.

2b. Densely caespitose, longer rhizomes 0.2–6(–8) mm long between shoots or branches of the rhizomes.

3a. Proximal bracts with bases of blades white between veins (most easily seen on abaxial surfaces of blades) . . . . *C. acidicola* sp. nov.

3b. Proximal bracts with bases of blades uniformly green.

4a. Perigynia (1.8–)2.1–2.6 times as long as wide, with bodies usually abruptly contracted near apices to beaks (0.4–)0.5–1.0 mm long; longest lateral spike with 4 to 8(10) perigynia (including undeveloped or aborted ones).

5a. Proximal-most spike usually considerably above base of shoot, inflorescence 46–94(–99)% of culm height; vegetative shoots exceeded by culms or slightly exceeding culms, tallest vegetative shoot 0.88–1.4 times as tall as tallest culm; hyaline band of sheaths of proximal bracts apically convex and elongated (0.8–)1.1–4.0 mm beyond sheath apex . . . *C. oligocarpa*

5b. Proximal-most spike usually at base of shoot, inflorescence (88–)94–99% of culm height; vegetative shoots usually greatly exceeding culms, tallest vegetative shoot (0.80–)1.4–4.4 times as tall as tallest culm; hyaline band of sheaths of proximal bracts apically concave or truncate.

6a. Purple-red coloration at shoot base 2.7–5.2(–5.6) cm high; bodies of pistillate scales (2.2–)2.5–3.0 mm long; achene beaks (0.10–)0.20–0.30 mm long *C. calcifugens* sp. nov.

6b. Purple-red coloration at shoot base (3.7–)4.7–11.7 cm high; bodies of pistillate scales 1.5–2.1(–2.5) mm long; achene beaks 0.05–0.10(–0.15) mm long . . . . . . *C. edwardsiana*

4b. Perigynia (2.4–)2.5–3.3 times as long as wide, with bodies gradually tapering to apices and thus beakless or with beaks 0.1–0.4 mm long; longest lateral spike with (5)7 to 14 perigynia (including undeveloped or aborted ones).

7a. Perigynia (1.9–)2.0–2.3 times as long as achene bodies; achene beaks (0.3–)0.4–0.7 mm long . . . . *C. planispicata*

7b. Perigynia 1.7–2.0 times as long as achene bodies; achene beaks 0.1–0.3(–0.4) mm long.

8a. Longest (per plant) peduncle of terminal spike (2.2–)5.1–8.9(–10.4) cm long (for this measurement, include the portion of the peduncle enclosed in the sheath of the distal-most lateral spike); 2 distal-most lateral spikes usually widely separate, longest (per plant) internode between distal lateral spikes (5.3–)8.8–15.2 cm; vegetative shoots exceeded by culms or slightly exceeding culms, tallest vegetative shoot 0.5–1.3 times as tall as tallest culm . . . . *C. thornei* sp. nov.

8b. Longest (per plant) peduncle of terminal spike 0.9–3.2(–6.8) cm long (for this measurement, include the portion of the peduncle enclosed in the sheath of the distal-most lateral spike); 2 distal-most lateral spikes usually approximate, longest (per plant) internode between distal lateral spikes 0.9–7.4(–9.8) cm; vegetative shoots greatly exceeding culms, tallest vegetative shoot 1.4–2.2 times as tall as tallest culm . . . . *C. paeninsulae* sp. nov.

Carex acidicola Naczi, sp. nov. TYPE: U.S.A. Georgia: Clarke Co., ca. 5 air mi. SSE of center of Athens, ca. 0.5 mi. S of end of Rock and Shoals Rd., 20 May 1995, *R. F. C. Naczi 4741* (holotype, DOV; isotypes, GA, MICH, NCU, NY, US, VDB, herb. Bryson). Figure 1.

A ceteris speciebus *Carici oligocarpae* affinibus interveniis albis ad bases laminarum bractearum proximalium differt.

Perennial, densely caespitose. Rhizomes 0.2–6 mm long between shoots or branches of the rhizomes. Shoot bases purple-red to (3.2–)4.1–7.4 cm high. Culms 11–41 cm tall. Leaves of reproductive shoots with widest blade per plant (3.7–)4.3–5.5 mm wide, deep green except proximal ones proximally whitish. Vegetative shoots 26–42 cm tall, 0.72–1.3 times as tall as culms. Infructescences 8.8–36 cm long, 68–95% of culm height, with the spikes widely separate or the distal-most 2 spikes overlapping, the internode between the distal lateral spikes 1.4–13 cm long, the longest (per plant) internode between the distal lateral spikes 3.1–13 cm long; proximal bract blades proximally white between veins, hyaline band of adaxial face of sheath with apex truncate or concave or slightly convex and elongated to 1.3 mm beyond sheath apex; bract blade of distal-most lateral spike usually exceeding terminal spike but occasionally shorter than terminal spike, longest (per plant) bract blade of distal-most lateral spike 4.9–12 cm long. Spikes 2 to 5; terminal spike 12–49 mm long, (1.3–)2.1–4.0 mm wide, the longest per plant (21–)26–49 mm long, usually much exceeding distal-most lateral spike, on peduncle 14–98(–141) mm long, the longest peduncle per plant 18–98(–141) mm long; lateral spikes 6–21 × 3.2–5.7 mm, entirely pistillate, (2)4- to 7(11)-flowered, the longest per plant 5- to 7(11)-flowered, the perigynia distichously imbricate, the internode between the proximal-most scales in the proximal-most spike 2.4–3.0 mm long, perigynia overlapping, with ratio of length of longest lateral spike per plant (in mm): number of perigynia = 2.0–2.4. Staminate scales 4.2–6.5 × 1.6–2.4 mm, obtuse or acute, awnless. Pistillate scales 2.8–4.8 × 1.6–2.1 mm; body (2.0–)2.3–2.9 mm long, with midrib prolonged as awn 0.6–2.8 mm long. Perigynia (3.7–)4.2–4.9 mm long, 1.6–1.9 mm wide, 2.3–2.7(–2.9) times as long as wide, 1.6–1.8(–1.9) times as long as achene bodies, ascending, obtusely triangular in cross section, nerves deeply impressed and 49 to 64, narrowly obovate or obovate or narrowly elliptic or elliptic in outline, gradually tapered from widest point to base, gradually tapered or somewhat abruptly tapered from widest point to apex, beakless or with straight beak; beaks 0–0.7(–0.9) mm long, 0–17% of perigynium length, vertical. Achenes 3.1–3.3 × 1.5–1.8 mm, faces tightly enveloped by perigynia, proximally abruptly contracted to stipe, distally abruptly contracted to minute beak; stipe 0.3–0.6 mm long, usually vertical; body 2.4–2.7 mm long; beak 0.20–0.30 mm long, vertical.

Carex acidicola is unique in the *C. oligocarpa* complex in having the proximal bracts with the bases of the blades white between the veins. This feature is seen most easily on the abaxial surface of the blades. All other members of the complex have bract blades that are uniformly green. The region of the blades that is whitish is limited to a small area at the very base of the bract blade (immediately distal to the sheath summit). In this region, the veins and tissues immediately flanking veins are green, whereas the intervenal spaces are contrastingly white. This whitish region occurs quite consistently on the proximal bracts of all specimens seen of *C. acidicola*, though it may be difficult to discern the contrast of white and green on older, faded specimens. Because the whitish region is limited in extent and consistent in appearance, it does not appear to be teratologic. Rather, it appears to be a regular, predictable character state of *C. acidicola*.

Carex acidicola is also distinctive in its relatively wide leaves (widest leaf blade per plant [3.7–]4.3–5.5 mm wide). All other members of the *C. oligocarpa* complex have the widest leaf blade 1.8–4.0

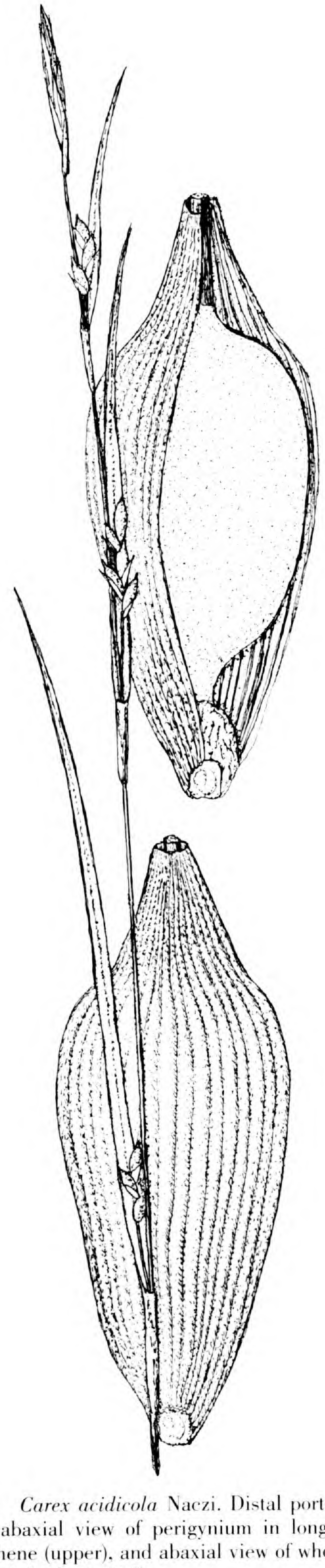

Figure 1. *Carex acidicola* Naczi. Distal portion of culm (× 0.9); abaxial view of perigynium in long section to reveal achene (upper), and abaxial view of whole perigynium (lower) (both × 17.5).

mm wide, except for *C. oligocarpa* (widest leaf blade 1.8–3.9[–4.6] mm wide), *C. paeninsulae* (3.0–4.6 mm wide), and *C. planispicata* ([3.0–]3.5–6.5 mm wide). Several features distinguish *C. acidicola* and *C. oligocarpa*. Besides different proximal bract blade coloration, *C. acidicola* has a shorter hyaline band of the adaxial face of the sheaths of the proximal-most bracts. In *C. acidicola*, the apex of the hyaline band is usually truncate or concave, but rarely elongated as much as 1.3 mm beyond the sheath apex. In *C. oligocarpa*, the apex of the hyaline band is convex and elongated (0.8–)1.1–4.0 mm beyond the sheath apex. Also, *C. acidicola* has perigynia with a higher length : width ratio (perigynia 2.3–2.9 times as long as wide in *C. acidicola* vs. 2.0–2.6 times as long as wide in *C. oligocarpa*). Differences between *C. acidicola* and *C. paeninsulae* include habit and rhizome length (densely caespitose, with rhizomes 0.2–6 mm long in *C. acidicola* vs. loosely caespitose and rhizomes 7–58 mm long in *C. paeninsulae*), and length of vegetative shoots relative to culms (vegetative shoots 0.72–1.3 times as tall as culms in *C. acidicola* vs. 1.4–2.2 times as tall as culms in *C. paeninsulae*). *Carex acidicola* differs from *C. planispicata* in three ways. First, *C. acidicola* has longer terminal spikes. The longest terminal spike per plant is (2.1–)2.6–4.9 cm long in *C. acidicola*, whereas it is 1.3–2.6(–3.0) cm long in *C. planispicata*. Second, perigynia of *C. acidicola* are 1.6–1.8(–1.9) times as long as the achene bodies versus (1.9–)2.0–2.3 in *C. planispicata*. Third, *C. acidicola* has the achene beaks 0.2–0.3 mm long versus (0.3–)0.4–0.7 mm long in *C. planispicata*.

Carex acidicola occurs disjunctly in three areas: central Alabama, central Georgia, and near the Chattahoochee River in easternmost Alabama and southwestern Georgia. It occurs in the Piedmont, Appalachian Plateaus, Ridge and Valley, and Coastal Plain. *Carex acidicola* is a very rare and local species, collected from only ten populations. The type and paratypes are all the specimens seen of *C. acidicola*. Few individuals occur at six of the seven populations studied by Naczi. Only at the type locality are plants relatively common.

Carex acidicola inhabits lightly shaded, acidic, humic, sandy loams in mesic forests. Vascular plants frequently associated with *C. acidicola* are *Aesculus sylvatica* Bartram, *C. superata* Naczi, Reznicek & B. A. Ford, *Carya* spp., *Cercis canadensis* L., *Hexastylis arifolia* (Michaux) Small, *Juniperus virginiana* L., and *Ostrya virginiana* (Miller) K. Koch. Unlike most of the other members of the *Carex oligocarpa* complex, notably the widespread and frequent *C. oligocarpa*, *C. acidicola* grows in acidic soils rather than circumneutral ones. Whereas analyzed soils of eight populations of *C. oligocarpa* have pH values of 6.3–7.6, those of four populations of *C. acidicola* have pH values of 5.2–5.8. This apparent requirement for acidic substrates makes "*acidicola*" (literally, "acid-dweller") an appropriate epithet for this ecologically distinctive species.

Paratypes. U.S.A. **Alabama:** Bibb Co., 3.7 mi. NW of town of Sixmile, N of Little Cahaba River, 31 May 1997, *Naczi 6346 & MacDonald* (DOV); Lee Co., ca. 1.5 mi. N of Smiths Station, 24 Apr. 2002, *Naczi 9136* (DOV, MICH, MO, NY, VDB, herb. Bryson); Tuscaloosa Co., valley of Rocky Branch, 19 Apr. 1936, *Harper 3487* (GH, MO, NY, US); N side of Croton bluff on Warrior River, 16 Apr. 1959, *Harper 4437* (GA, UNA); NE from Tuscaloosa, along Black Warrior River, 10 Apr. 1992, *McKinney 4925 & Pittman* (DOV); ca. 1.5 mi. NW of Peterson, at Black Warrior River, 15 May 1995, *Naczi 4624* (DOV, MICH); ca. 9.5 mi. NE of center of Tuscaloosa, Rocky Branch Public Use Area, 29 Apr. 1996, *Naczi 5075* (DOV), 22 May 1996, *Naczi 5437 & Bryson* (DOV), 22 Apr. 1999, *Bryson 17073 & MacDonald* (DOV, MICH, VDB, WIN, herb. Bryson); ca. 6.5 mi. NE of center of Tuscaloosa, near Hurricane Creek, 1 June 1997, *Naczi 6368* (DOV). **Georgia:** Clarke Co., type locality, 29 Apr. 1981, *Manhart 234* (DOV, herb. Bryson), 10 May 1986, *Naczi 1065 & Manhart* (DOV, MICH), 24 May 1988, *Naczi 1968* (FLAS, FSU, GA, DOV, MICH, UNA, herb. Bryson); Decatur Co., above Lake Seminole, 27 May 1984, *Saucier s.n.* (herb. Bryson); DeKalb Co., Stone Mountain, 27 Apr. 1929, *Miller 275 & Maguire* (BH, CU); Early Co., W of Hilton, bluff along Chattahoochee River, 14 May 1947, *Thorne 3886* (CU); opposite Columbia, Alabama, bluffs of Chattahoochee, 11 Apr. 1977, *Kral 59607* (DOV, VDB); Walton Co., ca. 1 mi. E of Walnut Grove, 24 May 1988, *Naczi 1967* (MICH), 20 May 1995, *Naczi 4745* (DOV, MICH).

Carex calcifugens Naczi, sp. nov. TYPE: U.S.A. Georgia: Screven Co., Blue Springs, Blue Springs Landing on Savannah River, 2 May 1991, *R. F. C. Naczi 2840* (holotype, DOV; isotypes, FLAS, FSU, GA, GH, MICH, MO, NCU, NY, PH, TENN, UNA, US, USCH, VDB, VPI, VSC, WIN, herb. Bryson). Figure 2.

A *Carice oligocarpa* spica infima plerumque e basi culmi portata, foliis surculorum vegetativorum culmos plerumque superantibus, vitta hyalina adaxiali vaginae bracteae infimae ad apicem truncata vel concava differt; a *Carice edwardsiana* basibus surculorum atrovinosis usque 2.7–5.2(–5.6) cm tantum altis, corporibus squamarum pistillatarum longioribus, rostris acheniorum longioribus differt.

Perennial, densely caespitose. Rhizomes 0.2–7 mm long between shoots or branches of the rhizomes. Shoot bases sparingly purple-red to 2.7–5.2(–5.6) cm high. Culms 14–37 cm tall. Leaves of reproductive shoots with widest blade per plant 2.6–4.0 mm wide, green. Vegetative shoots 23–45 cm tall, (0.8–)1.4–1.6 times as tall as culms. In-

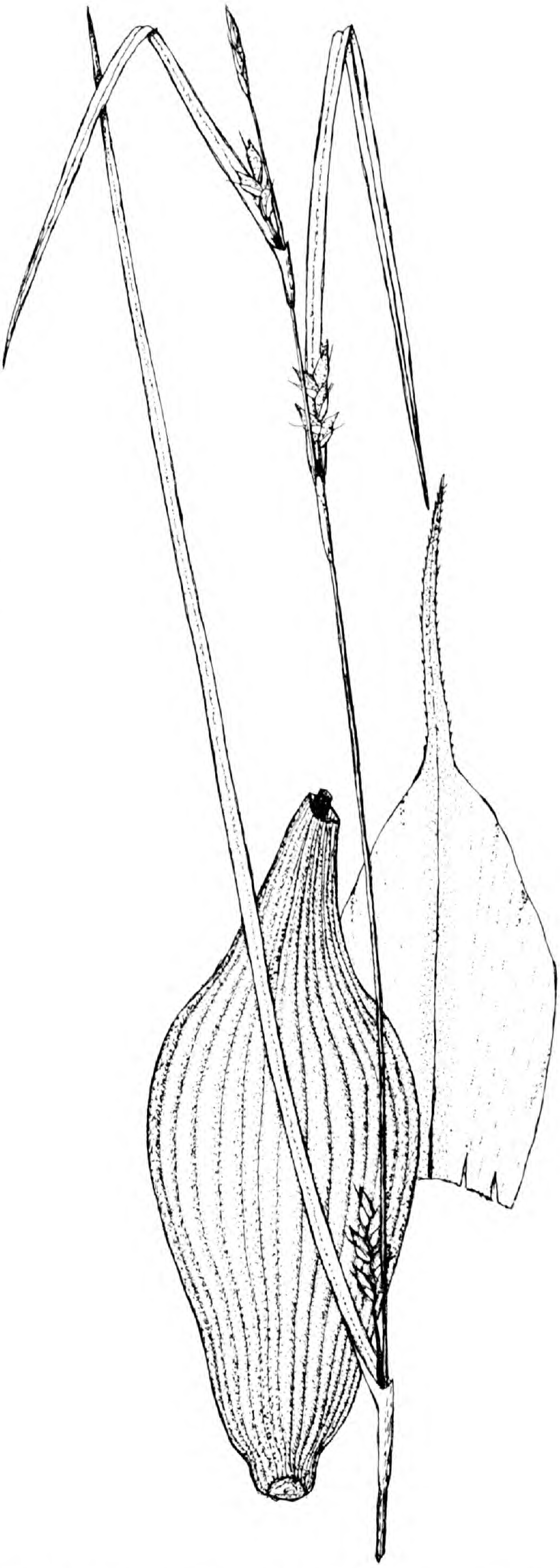

Figure 2. *Carex calcifugens* Naczi. Distal portion of culm (× 0.9); lateral view of perigynium and pistillate scale (both × 17.5).

fructescences 19–34 cm long, (88–)94–99% of culm height, with the spikes separate or the distal-most 2 to 3 spikes overlapping, the internode between the distal lateral spikes (1.0–)2.6–12 cm long, the longest (per plant) internode between the distal lateral spikes 5.2–12 cm long; proximal bract blades uniformly green, hyaline band of adaxial face of sheath with apex truncate or concave; bract blade of distal-most lateral spike exceeding terminal spike, longest (per plant) bract blade of distal-most lateral spike 6.1–15 cm long. Spikes 4 to 5; terminal spike 8–35 × 1.4–2.5 mm, the longest per plant 14–35 mm long, exceeding distal-most lateral spike, on peduncle 3.1–54(–73) mm long, the longest peduncle per plant 17–54(–73) mm long; lateral spikes 11–17 × 4.5–8.5 mm, entirely pistillate, 2- to 8-flowered, the longest per plant 5- to 8-flowered, the perigynia distichously imbricate, the internode between the proximal-most scales in the proximal-most spike 3.0–4.3 mm long, perigynia overlapping, with ratio of length of longest lateral spike per plant (in mm):number of perigynia = 2.2–2.4. Staminate scales 4.3–5.8 × 1.4–1.9 mm, usually acute but occasionally obtuse, awnless. Pistillate scales 3.6–5.7 mm long, 1.8–2.1(–2.4) mm wide; body (2.2–)2.5–3.0 mm long, with midrib prolonged as awn 1.0–3.2 mm long. Perigynia (3.7–)3.9–5.0 mm long, 1.6–2.0(–2.1) mm wide, 2.1–2.5(–2.7) times as long as wide, 1.5–2.0 times as long as achene bodies, ascending, obtusely triangular in cross section, nerves deeply impressed and 48 to 63, obovate or narrowly obovate in outline, gradually tapered from widest point to base, abruptly tapered from widest point to straight or slightly excurved beak; beaks (0.4–)0.6–1.0 mm long, 8.3–21% of perigynium length, vertical or bent 10–30° from vertical. Achenes 2.6–3.4 × 1.4–1.9 mm, faces tightly enveloped by perigynia, proximally abruptly contracted to stipe, distally abruptly contracted to minute beak; stipe 0.2–0.5(–0.7) mm long, vertical; body 2.0–2.6 mm long; beak (0.10–)0.20–0.30 mm long, vertical.

Carex calcifugens is morphologically most similar to *C. edwardsiana* and *C. oligocarpa*. All three of these species have a densely caespitose habit, the widest leaf blade per plant 1.8–4.0 mm wide, the longest pistillate spike 4- to 8(10)-flowered, perigynia usually 2.1–2.6 times as long as wide, perigynium bodies abruptly contracted to beaks (0.4–)0.5–1.0 mm long, and perigynia 1.5–2.0 times as long as the achene bodies. As indicated in the key, *C. calcifugens* shares several features with *C. edwardsiana* that distinguish both of these species from *C. oligocarpa*: the infructescence with the proximal-most spike usually at the base of the plant, vegetative shoots usually greatly exceeding culms, and hyaline bands of sheaths of proximal-most bracts apically truncate or concave. *Carex calcifugens* differs from *C. edwardsiana* in having the purple-red coloration of the shoot bases less extensive, longer bodies of the pistillate scales, and longer achene beaks.

Carex calcifugens ranges from eastern North Carolina south to northern Florida, strictly on the Coastal Plain. It is rare and very local. The type and paratypes are all the specimens examined of *C. calcifugens*. The total number of documented populations is about 18. Most populations seen consisted of fewer than 20 individuals. At the type locality, however, the plants were relatively numerous. The plants usually occur on slopes above streams in mesic deciduous forests with diverse herbaceous and woody angiosperm communities. Specimen labels indicate *C. oligocarpa* also occurs in maritime woodlands. Frequent vascular plant associates of *C. calcifugens* are *Aesculus pavia* L., *Carex abscondita* Mackenzie, *C. striatula* Michaux, *Cercis canadensis*, *Cornus florida* L., *Fagus grandifolia* Ehrhart, *Hexastylis arifolia*, *Polystichum acrostichoides* (Michaux) Schott, and *Sanguinaria canadensis* L. The substrates for four studied populations are well-drained sandy loams, loamy sands, and sands. Analyses of the soils in the immediate vicinity of the roots of *C. calcifugens* at these sites reveal low levels of calcium (calcium concentration at four sites = 473–920 ppm). Since several of the populations occur over shell mounds and deposits of fossil shells, it is likely the paucity of calcium is due to leaching. The epithet "*calcifugens*" ("calcium-fleeing") is fitting for this new species because of its affinity for calcium-poor soils, in contrast to its close relatives *C. oligocarpa* and *C. edwardsiana*, which are calciphiles (calcium concentration at eight sites of *C. oligocarpa* = 840–5937 ppm, calcium concentration at four sites of *C. edwardsiana* = 5937–6190 ppm, Naczi, unpublished data).

Paratypes. U.S.A. **Florida:** Leon Co., near Tallahassee, 8 Apr. 1910, *Harper 65* (GH, MIN, NY); ca. 2 mi. ESE of Tallahassee, 26 Apr. 1925, *Harper 30* (BH, GH, ILL, NY, PH, US); Liberty Co., Allen [Alum] Bluff of Apalachicola River, 11 Apr. 1931, *Palmer 38537* (GH, MO, NY); ca. 6 mi. NE of Bristol, 11 May 1989, *Orzell & Bridges 9716* (DOV, MICH), 1 Apr. 1990, *Orzell & Bridges 13061* (DOV, MICH), 14 Apr. 1990, *Orzell & Bridges 13155* (DOV, MICH). **Georgia:** Baker Co., E side of Ichauwaynochaway Creek, Ichauway Plantation, 11 Apr. 1986, *Gholson 11599* (FLAS, herb. Bryson); Burke Co., E of McBean, Shell Bluff Landing, 10 Apr. 1938, *Clausen & Trapido 3389* (BH, CU, OKL), 10 Apr. 1938, *Pyron & McVaugh 2502* (FSU, GA); 7 mi. NE of Shell Bluff, near

Savannah River, 18 May 1989, *Naczi 2191* (DOV, GA, MICH, MO, NY, VDB, herb. Bryson), 5 June 1990, *Naczi 2532* (MICH), 25 May 1999, *Morris 4525 & Patrick* (DOV, herb. Bryson); ca. 3 mi. E of Waynesboro, along Brier Creek, 18 May 1989, *Naczi 2195* (DOV); Early Co., N of Blakely, Colomokee Mounds State Park, 4 Apr. 1948, *Thorne 7971 & Muenscher* (CU, GA, GEO, GH); Effingham Co., N of Clyo, along the Savannah River, 21 Apr. 1962, *Ahles 56549 et al.* (NCU), 2 May 1991, *Naczi 2833* (DOV). **North Carolina:** Brunswick Co., Smith Island, May 1894, *Ashe s.n.* (NCU); Carteret Co., near Lenoxville, 11 Apr. 1898, *Ashe s.n.* (FSU, MICH, NCU); near Shackleford Pt., 11 Apr. 1898, *Ashe s.n.* (NCU); 1.2 km from the W end of Shackleford Island, 20 May 1990, *Peet 6794 & Larke* (NCU); Dare Co., near Cape Hatteras, 16 June 1898, *Ashe s.n.* (NCU); Buxton Woods, 23 May 1954, *Radford 8116* (NCU). **South Carolina:** Aiken Co., Savannah River Site, Compartment 48, Stand 37, 13 May 1993, *Stanford 152* (USCH); Savannah River Site, slope of Upper Three Runs Creek, 10 June 1994, *Hyatt 6085* (DOV, MICH); Savannah River Plant, compartment 31, near Tyler Rd., along Tinker Creek, 28 Apr. 2000, *Pittman 04280007 & Darr 313* (DOV, MO, USCH, herb. Bryson); Allendale Co., Savannah River Operations Area of the Atomic Energy Commission, 6 Apr. 1953, *Batson & Kelley s.n.* (USCH); Barnwell Co., Savannah River Plant, along Lower Three Runs Creek, 28 Apr. 2000, *Pittman 04280031 & Darr 337* (DOV, USCH); Charleston Co., Edisto State Park, 9 Apr. 1994, *Pittman 04099405* (MICH, USCH); Dorchester Co., SW of Summerville, near Ashley River, 27 May 1957, *Ahles 26411 & Haesloop* (NCU), 19 Apr. 1962, *Radford 44505* (FSU, GA, GH, NCU, NY, VDB), 25 May 1988, *Naczi 1970* (DOV, FLAS, MICH, MO, NY, USCH, VDB, WIN, herb. Bryson), 6 June 1990, *Naczi 2534* (MICH); Orangeburg Co., S end of Santee State Park, 19 May 1997, *Pittman 05199703* (DOV, MICH, USCH).

Carex paeninsulae Naczi, E. L. Bridges & Orzell, sp. nov. TYPE: U.S.A. Florida: Clay Co., ca. 1 mi. N of Green Cove Springs, Magnolia Springs, 0.4 mi. N of rte. 17, W of Haven Avenue and S of stream, 20 Apr. 1991, *R. F. C. Naczi 2770* (holotype, DOV; isotypes, FLAS, FSU, GA, GH, MICH, MO, NY, VDB, WIN, herb. Bryson). Figure 3.

Carex grisea var. *angustifolia* Boott, Illustr. Genus *Carex* 34. 1858. TYPE: U.S.A. Florida: [no additional locality data], [no date], *Chapman s.n.* (lectotype, designated here, K; isolectotype, K).

A ceteris speciebus *Carici oligocarpae* affinibus rhizomatibus longioribus differt.

Perennial, loosely caespitose. Rhizomes 7–58 mm long between shoots or branches of the rhizomes. Shoot bases purple-red to 4.8–11.4 cm high. Culms 8.9–39 cm tall. Leaves of reproductive shoots with widest blade per plant 3.0–4.6 mm wide, green. Vegetative shoots 33–59 cm tall, 1.4–2.2 times as tall as culms. Infructescences 8.1–29 cm long, 73–95% of culm height, with the distal-most 2 to 3 spikes overlapping or rarely all spikes separate, the internode between the distal lateral spikes 0.4–7.4(–9.8) cm long, the longest (per plant) internode between the distal lateral spikes 0.9–7.4(–9.8) cm long; proximal bract blades uniformly green, hyaline band of adaxial face of sheath with apex truncate or concave; bract blade of distal-most lateral spike exceeding terminal spike, longest (per plant) bract blade of distal-most lateral spike 3.2–9.5 cm long. Spikes 4 to 6; terminal spike 14–38 × 1.2–2.1 mm, the longest per plant 17–38 mm long, exceeding distal-most lateral spike, on peduncle 3.0–32(–68) mm long, the longest peduncle per plant 8.7–32(–68) mm long; lateral spikes 7–20 × 3.5–4.8 mm, entirely pistillate, 2- to 12-flowered, the longest per plant (5)7- to 12-flowered, the perigynia distichously imbricate, the internode between the proximal-most scales in the proximal-most spike 2.4–3.5 mm long, perigynia overlapping, with ratio of length of longest lateral spike per plant (in mm) : number of perigynia = 1.8–2.5. Staminate scales 3.9–4.8 × 1.2–1.8 mm, acute, awnless or awned with awn up to 2.2 mm long. Pistillate scales 2.5–4.2 × 1.4–2.2 mm; body 1.5–2.4 mm long, with midrib prolonged as awn 0.4–2.4 mm long. Perigynia 4.1–4.7 × 1.4–1.6 mm, 2.7–3.1 times as long as wide, 1.8–1.9 times as long as achene bodies, ascending, obtusely triangular in cross section, nerves deeply impressed and 49 to 66, narrowly obovate in outline, gradually tapered from widest point to base, gradually tapered from widest point to apex, beakless or with straight beak; beaks 0–0.4 mm long, 0–10% of perigynium length, vertical. Achenes 2.9–3.4 × 1.3–1.4 mm, faces tightly enveloped by perigynia, proximally abruptly contracted to stipe, distally abruptly contracted to minute beak; stipe 0.5–0.6 mm long, vertical; body 2.2–2.6 mm long; beak 0.10–0.30 mm long, vertical.

Carex paeninsulae is unique in the *C. oligocarpa* complex in its loosely caespitose habit as a result of relatively long rhizomes (longer rhizomes 10–58 mm long between shoots or branches of the rhizome in *C. paeninsulae*). Other members of the complex are densely caespitose, with rhizomes short (0.2–8 mm long between shoots or branches of the rhizome). *Carex paeninsulae* differs from *C. oligocarpa* in having vegetative shoots greatly exceeding the culms (vegetative shoots 1.4–2.2 times as tall as culms in *C. paeninsulae* vs. 0.88–1.4 times as tall as culms in *C. oligocarpa*), hyaline bands of adaxial faces of sheaths of proximal-most bracts truncate or concave at their apices (convex and elongated 0.8–4.0 mm beyond the sheath apex in *C. oligocarpa*), and perigynia with a higher length : width ratio

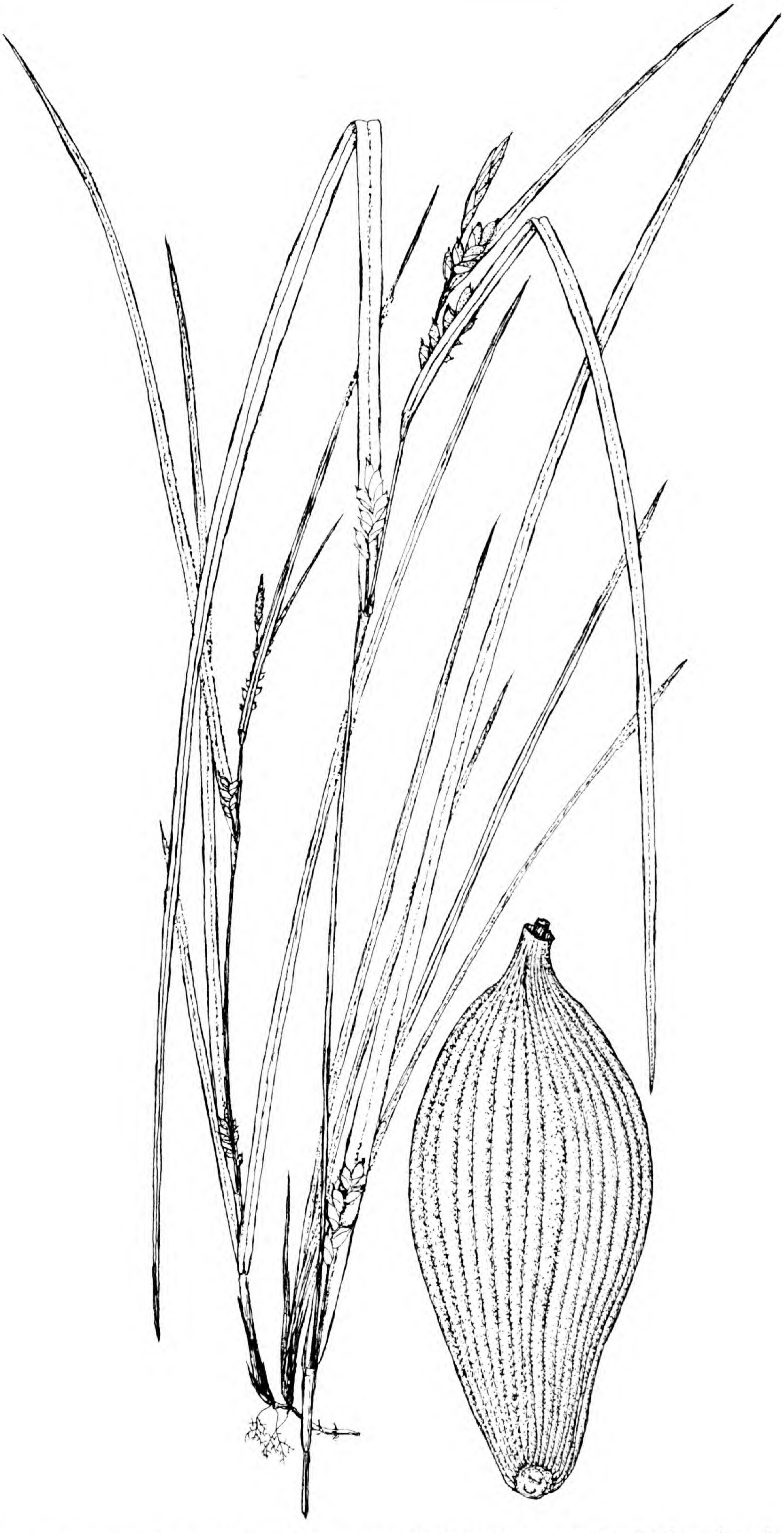

Figure 3. *Carex paeninsulae* Naczi, E. L. Bridges & Orzell. Habit (left; × 0.45); distal portion of culm (middle; × 0.9); and perigynium, lateral view (right; × 17.5).

(perigynia 2.7–3.1 times as long as wide in *C. paeninsulae* vs. 2.0–2.6 times as long as wide in *C. oligocarpa*). *Carex paeninsulae* is similar to *C. calcifugens* and *C. edwardsiana* in having the vegetative shoots exceeding the culms, but differs from those species in perigynia with a higher length : width ratio (perigynia 2.7–3.1 times as long as wide in *C. paeninsulae* versus 1.9–2.5[–2.7] times as long as wide in *C. calcifugens* and *C. edwardsiana*). In addition, *C. paeninsulae* has the purple-red coloration extending higher on the bases of the plants than in *C. calcifugens*: to 4.8–11.4 cm high in *C. paeninsulae* versus to 2.7–5.2(–5.6) cm high in *C. calcifugens*. Furthermore, *C. paeninsulae* has shorter bodies of the pistillate scales than *C. calcifugens*: 1.5–2.4 mm long in *C. paeninsulae* versus (2.2–) 2.5–3.0 mm long in *C. calcifugens*. Relative to *C. edwardsiana*, *C. paeninsulae* has longer achene beaks. In *C. paeninsulae*, these beaks are 0.10–0.30 mm long versus 0.05–0.10(–0.15) mm long in *C. edwardsiana*.

Carex paeninsulae occurs in the northern half of peninsular Florida, strictly on the Coastal Plain. It is rare and local, collected from only about 16 populations. The type and paratypes represent all the collections we have examined of this species. Plants grow in sandy loams in mesic deciduous forests in hardwood hammocks. Frequent vascular plant associates of *C. paeninsulae* include *Arisaema dracontium* (L.) Schott, *Carpinus caroliniana* Walter, *Liquidambar styraciflua* L., *Magnolia grandiflora* L., *Quercus virginiana* Miller, *Ruellia caroliniensis* (J. F. Gmelin) Steudel, *Sabal minor* (Jacquin) Persoon, and *S. palmetto* Schultes & Schultes. Because of its apparent restriction to the peninsula of Florida, "*paeninsulae*" is an appropriate epithet for this new species.

Edwin Bridges and Steve Orzell supplied numerous specimens and habitat notes to Robert Naczi for his description of *Carex paeninsulae*. In return, Naczi has complied with their request to be included as authors of the description.

Carex grisea var. *angustifolia*, as lectotypified here, is a synonym of *C. paeninsulae*. Though fragmentary, the lectotype possesses several features that are diagnostic of *C. paeninsulae*: a relatively long portion of a rhizome, a vegetative shoot that exceeds its associated culm, the longest peduncle of the terminal spike 24 mm long, the longest lateral spike with 8 perigynia, and perigynia with a length : width ratio of 2.8. Boott's syntypes of *Carex grisea* var. *angustifolia* are a mixture of *C. paeninsulae*, *C. bulbostylis*, and *C. corrugata* Fernald. For the lectotype, Naczi has chosen the specimen that best matches Boott's description (Boott, 1858: 35), especially ". . . perigyniis minus turgidis, apice saepe subrostellatis . . . ," which are more characteristic of *C. paeninsulae* than *C. bulbostylis* or *C. corrugata*. The lectotype is also the syntype that Boott illustrated for *C. grisea* var. *angustifolia* (Boott, 1858, pl. 87).

Paratypes. U.S.A. **Florida:** [county unknown], "Florida" [no additional data], 1859, *Chapman s.n.* (GH); [Bradford] Co., Mount Vernon, 1838, *Chapman 8* (NY); Clay Co., type locality, 5 May 1990, *Naczi 2373* (DOV, MICH); [Duval] Co., Island of Fort George, 1817, *Baldwin s.n.* (NY); St. Johns, [no date, but most likely 1817—see Darlington, 1843], *Baldwin s.n.* (PH); Gilchrist ["Levy" on label] Co., 1 mi. N of Trenton, 31 Mar. 1957, *Kral 4385* (FLAS, FSU, GH, MSC, VDB); Hernando Co., near Pineola, fern grottoes, 12 Apr. 1923, *Small 10835 & Mosier* (NY); Annutteliga Hammock, 26 Mar. 1958, *Cooley 5807 & Eaton* (FSU, GH, USF); Pineola Grotto, N of Brooksville near Istachatta, 8 Mar. 1977, *Wunderlin 5751* (USF); ca. 5 mi. N of Brooksville on rte. 41, 14 Apr. 1994, *Libby, Mears & Abbott s.n.* (DOV, MICH); ca. 6 air mi. NE of Brooksville, W side US 41, 12 Apr. 1994, *Orzell & Bridges 22634* (FTG, DOV, USF); Levy Co., Waccasassa Bay State Preserve, along boundary N of Turtle Creek, 12 Apr. 1996, *Abbott 8382* (DOV, FLAS); Marion Co., 4 mi. W of Anthony, 2 Apr. 1950, *Blake s.n. & Lewis* (FLAS); E side of Silver Springs, 13 Mar. 1976, *Kral 57220* (DOV, VDB); N side of US 27, ca. 1.6 mi. SE of junction with rte. 326 at Blichton, 28 Mar. 1993, *Orzell & Bridges 21348* (DOV), 8 May 1993, *Orzell & Bridges 21691* (FTG, DOV, MICH, US, USF); N side of US 27, ca. 1.8 mi. SE of junction with rte. 326 at Blichton, 28 Mar. 1993, *Orzell & Bridges 21352* (DOV, FTG, MICH, NY, US, USF, herb. Bryson); ca. 3.1 air mi. N of Flemington, 17 Apr. 1993, *Orzell & Bridges 21603* (US, FTG, DOV, MICH, USF); ca. 0.8 air mi. NNW of junction of rte. 318 and US 301 in Citra, 17 Apr. 1993, *Orzell & Bridges 21624* (FTG, DOV); 3.2 air mi. SW of Belleview, 18 Apr. 1993, *Orzell & Bridges 21626* (FLAS, FSU, FTG, DOV, MICH, NY, US, herb. Bryson); Seminole Co., near Oviedo, Black Hammock, 12 Apr. 1975, *Wunderlin 5456 & Poppleton* (USF); Sumter Co., ca. 2.2 mi. ENE of Linden, 15 Mar. 1992, *Orzell & Bridges 19167* (DOV, FLAS, FSU, FTG, GA, MICH, MO, NCU, NY, US, herb. Bryson); Suwannee Co., ca. 10.3 air mi. NW of Live Oak, on Suwannee River across from mouth of Alapaha River, 21 Mar. 1991, *Orzell & Bridges 16145* (FTG, MICH).

Carex thornei Naczi, sp. nov. TYPE: U.S.A. Alabama: Russell Co., 2.0 road mi. SW of Holy Trinity, along E side of rte. 165, along S side of Bluff Creek, 3 May 1996, *R. F. C. Naczi 5214* (holotype, DOV; isotypes, MICH, MO, NY, US, WIN, herb. Bryson). Figure 4.

A ceteris speciebus *Carici oligocarpae* affinibus laminis bractearum brevibus, pedunculo spicae terminalis longo, perigyniis (2.4–)2.5–3.1plo longioribus quam latioribus differt.

Perennial, densely caespitose. Rhizomes 0.8–6.4 mm long between shoots or branches of the rhi-

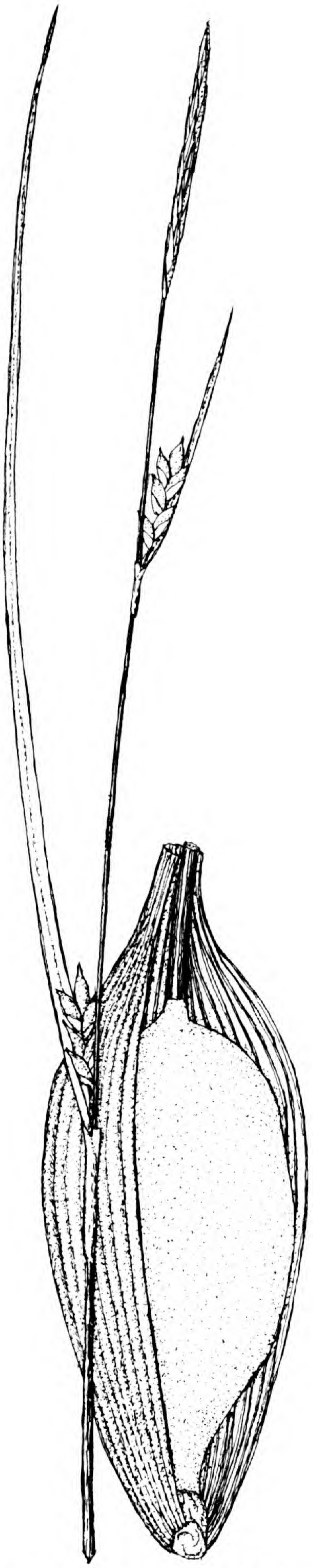

Figure 4. *Carex thornei* Naczi. Distal portion of culm (× 0.9); lateral view of perigynium in long section to reveal achene (× 17.5).

zomes. Shoot bases purple-red to 4.8–8.1 cm high. Culms 24–53 cm tall. Leaves of reproductive shoots with widest blade per plant 2.1–4.0 mm wide, green. Vegetative shoots 28–49 cm tall, 0.54–1.3 times as tall as culms. Infructescences 13–38 cm long, 77–96% of culm height, with the spikes usually separate or occasionally the distal-most 2(–3) spikes overlapping, the internode between the distal lateral spikes (1.6–)3.4–15.2 cm long, the longest (per plant) internode between the distal lateral spikes (5.3–)8.8–15.2 cm long; proximal bract blades uniformly green, hyaline band of adaxial face of sheath with apex usually truncate or concave but occasionally convex and elongated to 2.2(–5.0) mm from sheath apex; bract blade of distal-most lateral spike slightly exceeding terminal spike or exceeded by terminal spike, longest (per plant) bract blade of distal-most lateral spike 3.9–11 cm long. Spikes 4 to 5; terminal spike 16–36 × 1.9–2.5 mm, the longest per plant 17–36 mm long, exceeding distal-most lateral spike, on peduncle 3.4–89(–104) mm long, the longest peduncle per plant (22–)51–89(–104) mm long; lateral spikes 5–21 × 3.2–4.1 mm, entirely pistillate, 3- to 12-flowered, the longest per plant 6- to 12-flowered, the perigynia distichously imbricate, the internode between the proximal-most scales in the proximal-most spike 1.7–2.9 mm long, perigynia overlapping, with ratio of length of longest lateral spike per plant (in mm) : number of perigynia = 1.8–2.1. Staminate scales 4.3–5.0 × 1.4–1.8 mm, usually acute but occasionally obtuse, awnless. Pistillate scales 3.0–4.6 × 1.6–2.0 mm; body 1.6–2.6 mm long, with midrib prolonged as awn 1.1–2.5 mm long. Perigynia 3.8–4.9 × 1.4–1.7 mm, (2.4–)2.5–3.1 times as long as wide, 1.7–2.0 times as long as achene bodies, ascending, obtusely triangular in cross section, nerves deeply impressed and 53 to 64, narrowly obovate or narrowly oblong in outline, gradually tapered from widest point to base, gradually tapered from widest point to apex, beakless or with straight beak; beaks 0–0.4 mm long, 0–11% of perigynium length, vertical. Achenes 2.6–3.5 × 1.3–1.6 mm, faces tightly enveloped by perigynia, proximally abruptly contracted to stipe, distally abruptly contracted to minute beak; stipe 0.2–0.6 mm long, vertical; body 2.1–2.7 mm long; beak 0.1–0.4(–0.5) mm long, vertical.

Carex thornei is unique in the *C. oligocarpa* complex in its combination of short bract blades (longest distal-most bract blade per plant 3.9–11 cm long), long peduncles of the terminal spikes (longest peduncle of terminal spike per plant [22–]51–89[–104] mm long), and high length : width ratio of perigynia (perigynia [2.4–]2.5–3.1 times as long as wide). Morphologically, it is most similar to *C. oligocarpa* and *C. planispicata. Carex thornei* differs from *C. oligocarpa* in having shorter bract blades (longest distal-most bract blade per plant [4.9–] 9.2–14 cm long in *C. oligocarpa*), longer peduncles of the terminal spikes (9.8–49[–104] mm long in *C. oligocarpa*), perigynia with a higher length: width ratio (perigynia 2.0–2.6 times as long as wide in *C. oligocarpa*), and perigynia beakless or indistinctly beaked with beaks to 0.4 mm long (*C. oligocarpa* has distinctly beaked perigynia with beaks [0.4–]0.5–1.0 mm long). From *C. planispicata, C. thornei* differs by having longer peduncles of the terminal spikes (longest peduncle of terminal spike per plant 2.4–49 mm long in *C. planispicata*), the perigynia shorter relative to the achene bodies (perigynia 1.7–2.0 times as long as achene bodies in *C. thornei* vs. [1.9–]2.0–2.3 times as long as the achene bodies in *C. planispicata*), and shorter achene beaks (0.1–0.4[–0.5] mm long in *C. thornei* vs. [0.3–]0.4–0.7 mm long in *C. planispicata*).

Carex thornei is a narrow endemic of the lower Chattahoochee River–lower Flint River–upper Apalachicola River drainage in the region near the junction of the borders of Alabama, Florida, and Georgia. It occurs on the Coastal Plain, from the Fall Line south to Liberty County, Florida, a distance of only about 225 km (140 mi.). Within this region, it is sometimes frequent, but local. The paratypes cited below represent most of the known populations of the species. *Carex thornei* occurs in mesic deciduous forests, usually on the upper portions of floodplains and adjacent slopes, in sandy loams. Frequent associates include *Carex abscondita, C. basiantha* Steudel, *Cercis canadensis, Fagus grandifolia,* and *Hexastylis arifolia.*

Carex thornei has an unusual pattern of endemism, but not unique. Other species of flowering plants that are endemic to the region of the lower Chattahoochee, lower Flint, and upper Apalachicola rivers include *Rhododendron prunifolium* (Small) Millais, *Torreya taxifolia* Arnott, and *Taxus floridana* Chapman.

Carex thornei is named for Robert F. Thorne. Long ago (Thorne, 1951), he suggested what was being called *C. oligocarpa* from southwestern Georgia likely represented a new taxon. Actually, each of the three vouchers he cited as "*C. oligocarpa*" is a different new species, *C. thornei* (*Thorne 3100 et al.*), *C. acidicola* (*Thorne 3866*), and *C. calcifugens* (*Thorne 7971 & Muenscher*). It is fitting to recognize the taxonomic acumen of one of the earliest collectors of this species by naming it for him.

Paratypes. U.S.A. **Alabama:** Henry Co., vicinity of Shorterville, along Chattahoochee River S from Farmers Landing, 16 Apr. 2000, *MacDonald 13815* (DOV); Lee Co., 1.5 mi. N of Smith's Station, 7 Apr. 1949, *Duncan 9205 & Smith* (GA); Russell Co., ca. 2.5 mi. NW of Cottonton, along Sand Branch, 3 May 1996, *Naczi 5201* (DOV, MICH); type locality, 24 May 1997, *Naczi 6170* (DOV, herb. Bryson). **Florida:** Gadsden Co., Chattahoochee, between Main Street & Morgan Avenue, 27 Apr. 1974, *Gholson 809* (FLAS); Apalachicola River, Flat Creek Boat Landing, 13 Apr. 1982, *Gholson 9533 & Manhart* (FLAS), 13 Apr. 1982, *Manhart 407 & Gholson* (DOV, MICH); Chattahoochee, along Apalachicola River on River Landing Rd., 8 May 1995, *MacDonald 8645* (DOV, MICH, VDB, herb. Bryson); W of Chattahoochee, overlooking Apalachicola River, S of hwy. 90, 6 Apr. 2000, *Bryson 17850 & Usnick* (DOV, MICH, MO, USCH, VDB, VPI, WIN, herb. Bryson); Liberty Co., Torreya State Park, along Apalachicola River, 8 Apr. 1972, *Godfrey 71328* (FSU). **Georgia:** Baker Co., W bank of Flint River, Ichauway Plantation, 4 Apr. 1986, *Gholson 11593* (FLAS); Chattahoochee Co., ca. 9 mi. W of Cusseta, along Oswichee Creek, 23 May 1997, *Naczi 6135* (DOV); ca. 10.5 mi. NW of Cusseta, along Upatoi Creek, 24 May 1997, *Naczi 6148* (DOV); Decatur Co., 1 mi. N of Chattahoochee (Florida), bluff along Flint River, 14 Apr. 1947, *Thorne 3100 et al.* (CU, GA, GEO, GH), 22 Mar. 1949, *Thorne 9080 & Muenscher* (GEO, MICH, MO, PENN, US); Lake Seminole, East Bank Public Use Area, 13 Apr. 1982, *Manhart 401* (DOV, GA, GH, MICH, MO, NCU, NY, TENN, USCH, VDB, WIN, herb. Bryson), 20 Apr. 1985, *Gholson 11283* (FLAS), 12 May 1986, *Naczi 1072 & Gholson* (DOV, MICH), 18 May 1995, *Naczi 4710* (DOV, MICH); Early Co., W of Saffold railroad station, 26 Mar. 1949, *Thorne 9207 & Muenscher* (F); ca. 1.5 air mi. NW of Hilton, along Chattahoochee River, 18 May 1995, *Naczi 4715* (DOV, MICH).

CAREX KRALIANA, A NEW SPECIES OF *CAREX* SECT. *LAXIFLORAE*

Carex sect. *Laxiflorae* is a group of about 25 species endemic to eastern North America, western North America, Central America, and Eurasia (Naczi, 1992). All but 2 of the 16 species that occur in the Western Hemisphere inhabit mesic deciduous forests of the southeastern United States, the center of diversity for the section.

Morphologic apomorphies that diagnose *Carex* sect. *Laxiflorae* are culms with acute angles and culms with epidermal cells conspicuously larger than underlying cells (Naczi, 1992). Additional morphologic features that characterize the species, but are probably not apomorphic of section *Laxiflorae,* include long-sheathing proximal bracts, usually unisexual spikes with only the terminal one staminate, glabrous perigynia that are obtusely triangular in cross section and have more or less entire orifices, and perigynia usually with 25 to 39 nerves (sclerenchyma traces) that are raised above the surface in living and dried material.

Past authors frequently placed members of *Carex* sect. *Laxiflorae* in the same section as members of *Carex* sect. *Careyanae* Tuckerman ex Kükenthal (e.g., Kükenthal, 1909; Mackenzie, 1935; Fernald, 1950; Bryson, 1980; Manhart, 1986; Gleason & Cronquist, 1991). Bryson (1980) and Manhart (1986), based on morphologic and biochemical evidence, respectively, found section *Laxiflorae* s.l. to consist of two subgroups that correspond to section *Careyanae* and section *Laxiflorae* s. str. Phylogenetic analysis of morphologic data reveals that *Carex* sect. *Laxiflorae* s. str. and section *Careyanae* are not each other's sister groups, however, and uniting them would create a biphyletic group (Naczi, 1992). Analyses of DNA sequences also support treating *Carex* sect. *Laxiflorae* and section *Careyanae* as separate sections (Starr et al., 1999). For these reasons, we circumscribe *Carex* sect. *Laxiflorae* in the strict sense to exclude members of section *Careyanae*.

In the course of their ongoing research on the systematics of *Carex* sect. *Laxiflorae*, Naczi and Bryson have detected a previously undescribed species in the section. This new species, here named *Carex kraliana*, is widespread and frequent throughout much of the southeastern United States. In the following key, *Carex kraliana* is distinguished from all other members of section *Laxiflorae* that occur in the Western Hemisphere.

KEY TO SPECIES OF *CAREX* SECT. *LAXIFLORAE* NATIVE TO THE WESTERN HEMISPHERE

Complete, ample specimens bearing mature perigynia are necessary for identification. Magnification of 10× and bright illumination should be used when examining shoot bases for presence or absence of purplish coloration, since the coloration is often limited to small areas at the very bases of the plants. When measuring perigynium width, care should be taken to measure a perigynium at its widest point, since one face of a perigynium is usually slightly wider than the other two. When measuring length of the peduncles of lateral spikes, include the portion of the peduncle enclosed in the bract sheath.

1a. Bract blades of distal lateral spikes lanceolate or narrowly lanceolate, wider than spikes and concealing them when viewed from abaxial surface, widest bract blade (per plant) of distal-most lateral spike (3.0–)3.2–8.3 mm wide.

2a. Widest leaf or bract blade 1.3–3.8(–5.0) cm wide; pistillate scales from proximal portions of spikes awnless (sometimes mucronate), with truncate bodies; perigynia (1.6–)1.7–1.9 mm wide . . . *C. albursina*

2b. Widest leaf or bract blade 0.5–1.1 cm wide; pistillate scales from proximal portions of spikes awned, with acute bodies; perigynia 1.3–1.7(–1.8) mm wide . . . . *C. kraliana* sp. nov.

1b. Bract blades of distal lateral spikes linear, narrower than spikes and not concealing them when viewed from abaxial surface, widest bract blade (per plant) of distal-most lateral spike 0.5–3.4 mm wide.

3a. Perigynia 8- to 18-nerved . . . . *C. leptonervia*

3b. Perigynia (22)25- to 32-nerved.

4a. Shoot bases purplish, with purplish coloration ranging from slight tingeing of brown background in basal 5 mm of shoots to strong staining that obscures brown background and extends 14 cm high.

5a. Perigynia 2.4–3.3 mm long.

6a. Perigynia closely overlapping, 1.8–2.7 times as long as wide, with beaks 0.2–0.8 mm long; internode between proximal-most scales in proximal-most spike 1.1–3.2(–4.8) mm long; longest lateral spike 11–21 mm long; angles of bract sheaths denticulate . . . . *C. gracilescens*

6b. Perigynia loosely overlapping or separate, 1.7–2.1 times as long as wide, with beaks 0.1–0.3 mm long; internode between proximal-most scales in proximal-most spike 3.3–14 mm long; longest lateral spike (15–)19–33 mm long; angles of bract sheaths entire or minutely papillate . . . . *C. ormostachya*

5b. Perigynia 3.4–4.5 mm long.

7a. Terminal spike exceeding bract blade of distal-most lateral spike, longest peduncle (per plant) of terminal spike (31–)46–157 mm long; vegetative shoots with widest leaf blade 1.9–2.8 times as wide as widest leaf or bract blade of reproductive shoots; blades of overwintered leaves (often dying or dead at time of collection and thus partially or completely brown) with abaxial surfaces densely and minutely papillate . . *C. purpurifera*

7b. Terminal spike usually exceeded by bract blade of distal-most lateral spike, longest peduncle (per plant) of terminal spike 12–32(–53) mm long; vegetative shoots with widest leaf blade 1.1–1.8(–2.4) times as wide as widest leaf or bract blade of reproductive shoots; blades of overwintered leaves (often dying or dead at time of collection and thus partially or completely brown) with abaxial surfaces smooth . . . . *C. manhartii*

4b. Shoot bases brownish or whitish, with purplish coloration completely absent.

8a. Perigynia closely overlapping, ratio of length of longest lateral spike (in mm): number of perigynia = 0.8–1.7.

9a. Perigynia 2.5–3.8(–4.1) mm long, 1.5–1.9(–2.2) times as long as achene bodies; perigynium beaks 0.2–0.6 mm long.

10a. Most culms with 2 distal lateral spikes overlapping (occasionally most culms with distal lateral spikes separate, and only rarely with 3 to 4 distal lateral spikes overlapping) . . . . *C. blanda*

10b. Most culms with 3 to 4 distal lateral spikes overlapping . . . . *C. congestiflora*

9b. Perigynia (3.3–)3.9–5.4 mm long, 1.9–2.3 times as long as achene bodies; perigynium beaks 0.5–1.7 mm long.

11a. Distal lateral spikes overlapping; terminal spike exceeded by distal-most lateral spike or the 2 spikes subequal in height; perigynia ascending; most culms with peduncle of proximal-most spike arising in distal half of culm . . . . . *C. crebriflora*

11b. Distal lateral spikes separate; terminal spike clearly exceeding distal-most lateral spike; perigynia spreading; most culms with peduncle of proximal-most spike arising in proximal third of culm.

12a. Densely caespitose, with short rhizomes . . . . *C. styloflexa*

12b. Loosely caespitose, with long rhizomes . . . . *C. chapmanii*

8b. Perigynia loosely overlapping or separate, ratio of length of longest lateral spike (in mm): number of perigynia = 1.8–3.4.

13a. Pistillate scales 1.9–2.3 mm wide . . . . *C. hendersonii*

13b. Pistillate scales 1.1–1.8 mm wide.

14a. Longer peduncles of proximal lateral spikes 4.6–14 times as long as spikes they subtend; perigynia spreading.

15a. Densely caespitose, with short rhizomes . . . . *C. styloflexa*

15b. Loosely caespitose, with long rhizomes . . . . *C. chapmanii*

14b. Longer peduncles of proximal lateral spikes 1.4–3.3(–5.3) times as long as spikes they subtend; perigynia ascending.

16a. Longest bract blade 5.0–6.7(–8.0) cm long; blades of overwintered leaves (often dying or dead at time of collection and thus partially or completely brown) with abaxial surfaces densely and minutely papillate . . . *C. radfordii*

16b. Longest bract blade (4.5–)6.5–15 cm long; blades of overwintered leaves (often dying or dead at time of collection and thus partially or completely brown) with abaxial surfaces smooth or rarely sparsely and minutely papillate.

17a. Achene body 1.8–2.2 mm long; perigynia (2.6–)3.2–4.1(–4.6) mm long; longest terminal spike 12–24(–34) mm long . . . . *C. laxiflora*

17b. Achene body 2.2–2.8 mm long; perigynia (3.4–)3.9–5.1 mm long; longest terminal spike 20–32(–36) mm long . . . . *C. striatula*

Carex kraliana Naczi & Bryson, sp. nov. TYPE: U.S.A. Mississippi: Winston Co., ca. 5 mi. NW of Louisville, W of Noxubee Crest Natural Area, T16N, R12E, NW1/4 of sect. 31, 11 Apr. 2000, *R. F. C. Naczi 8339, Bryson, Case, Smith, MacDonald & Goodlett* (holotype, DOV; isotypes, MICH, MO, NY, WIN, herb. Bryson). Figure 5.

A *Carice albursina* laminis foliorum angustioribus, squamis pistillatis acutis vel aristatis, perigyniis angustioribus differt; a ceteris speciebus sectionis *Laxiflorarum* laminis bractearum lanceolatis vel anguste lanceolatis, laminis bractearum latioribus differt.

Perennial, densely caespitose. Rhizomes 0.1–0.8 cm long between shoots or branches of the rhizomes. Shoot bases dark brown to light brown. Reproductive shoots erect to spreading; culms 9.2–56 cm tall. Leaves of reproductive shoots 2 to 4; blades 1.2–21 cm × 2.6–11 mm, the widest per plant 5.3–11 mm wide, dark green. Vegetative shoots 26–34 cm tall; leaves 4 to 6, similar to those of reproductive shoots except blades 0.9–32 cm long; pseudoculms 2.8–6.9 cm tall. Infructescences (1.6–)2.6–18(–27) cm long, 9.3–47(–77)% of culm height, with the distal-most 2 to 3 spikes overlapping, the internode between the distal lateral spikes 0.7–19 cm long, the internode between the proximal spike 2.8–19 cm long; proximal-most bract with blade 6.2–17 cm long and 19–61% of culm height; bract blade of distal-most lateral spike lanceolate or narrowly lanceolate, (1.9–)3.4–8.3 cm long, the widest per plant (3.0–)3.2–7.1 mm wide, wider than and concealing lateral spike when viewed from abaxial surface, much exceeding terminal spike. Spikes 2 to 4, erect; terminal spike 5.8–13(–18) mm long, the longest per plant 7.6–13(–18) mm long, 0.9–2.1 mm wide, the widest per plant 1.1–2.1 mm wide, entirely staminate, on peduncle 0.8–7.3(–27) mm long, usually exceeded by distal-most lateral spike but sometimes subequal to it; lateral spikes 5.3–18(–23) mm long, the longest per plant 12–18(–23) mm long, 3.7–4.6 mm wide, entirely pistillate, (4)6- to 16-flowered, the perigynia spirally imbricate, the internode between the proximal-most scales in proximal-most spike 1.1–3.2(–3.8) mm long, perigynia closely overlapping, with ratio of length of longest lateral spike per plant (in mm): number of perigynia = 0.97–1.6(–1.9). Staminate scales 1.9–3.8 × 0.8–1.5 mm, obtuse or acute, awnless. Pistillate scales 1.1–4.2 × 1.4–1.8

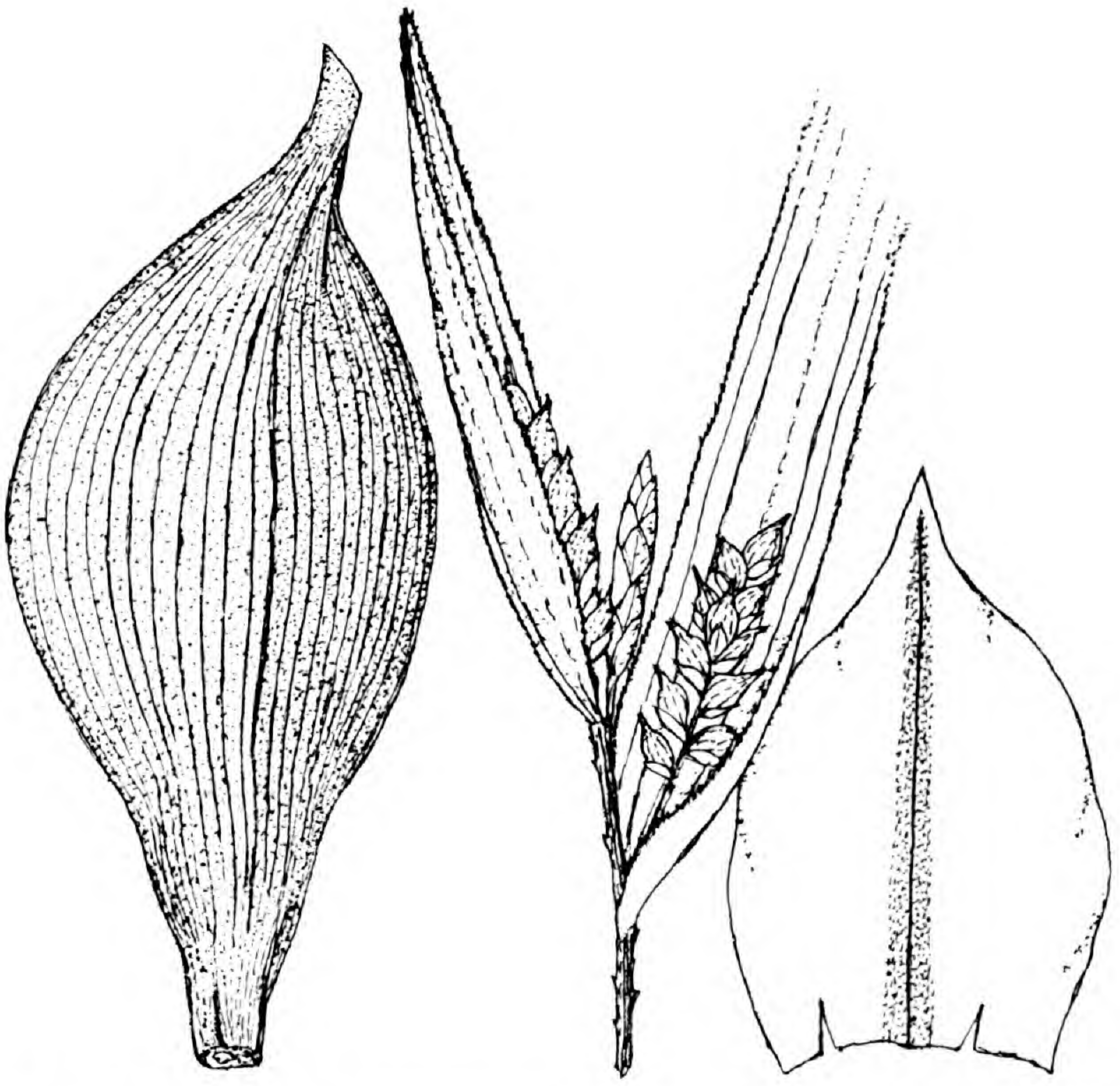

Figure 5. *Carex kraliana* Naczi & Bryson. Perigynium, lateral view (left; × 20); distal portion of culm (middle; × 2); and pistillate scale (right; × 20).

mm; body 1.1–2.2(–2.4) mm long, ovate, acute, usually awned when in proximal portions of spikes, usually awnless when in distal portions of spikes, margins usually whitish; awn 0–2.2 mm long. Perigynia 2.7–4.2(–5.0) mm long, 1.3–1.7(–1.8) mm wide, 1.8–2.4(–2.9) times as long as wide, 1.4–2.0 times as long as achene bodies, ascending, obtusely triangular in cross section, faces convex, nerves raised and 29 to 34, glabrous, yellow-green or pale green or yellow-brown, obovate in outline, apex excurved to beak, gradually tapered from widest point to narrow base, abruptly or gradually tapered from widest point to beak; beaks 0.2–0.6(–1.0) mm long, 9.0–21% of perigynium length, smooth, entire, deflected 30–45° from long axis of perigynium. Achenes 1.9–2.5(–2.9) mm long, 1.2–1.6(–1.7) mm wide, faces tightly enveloped by perigynia, obovoid or oblong, obtusely trigonous, faces flat or slightly convex, brown, basally abruptly contracted to stipe, apically abruptly contracted to minute beak; stipe 0.1–0.2 mm long, bent 10–30° from long axis of achene or vertical; body 1.8–2.2(–2.4) mm long; beak 0.1–0.2 mm long, bent (10–)45–60° from long axis of achene.

The most distinctive morphologic feature of *Carex kraliana* is its lanceolate or narrowly lanceolate, relatively wide bract blades. The width of the blades is greater than the width of the lateral spikes. The bract blades are quite spathe-like, since they obscure the lateral spikes when viewed from the abaxial surface of the bracts, and much exceed the spikes. Nearly all other members of *Carex* sect. *Laxiflorae* have linear bract blades that are narrower than or as wide as the lateral spikes. Only *C. albursina* Sheldon has wide and spathe-like bract blades similar to those of *C. kraliana*.

Carex kraliana differs from *C. albursina* in several ways. First, *C. kraliana* has narrower leaves than *C. albursina* (widest leaf blade per plant 5.3–11 mm wide for *C. kraliana* vs. 13–50 mm wide for *C. albursina*). Second, the pistillate scales of *C. kraliana* are acute to awned, but truncate and awnless in *C. albursina*. Third, the perigynia of *C. kraliana* are narrower than those of *C. albursina*. *Carex kraliana* has perigynia 1.3–1.7(–1.8) mm wide, while those of *C. albursina* are (1.6–)1.7–1.9 mm wide.

Carex kraliana is somewhat similar to several other species of section *Laxiflorae*, particularly *C. blanda* Dewey, *C. congestiflora* Reznicek & S. González, *C. crebriflora* Wiegand, *C. laxiflora* Lamarck, and *C. leptonervia* (Fernald) Fernald. These species share the following features with *C. kraliana*: brown shoot bases, the distal-most lateral spike often overlapping the terminal spike, and ascending, relatively short perigynia (perigynia often less than 4.3 mm long). Unlike *C. kraliana*, however, all these other species have linear and narrow bract blades. In *C. blanda*, *C. congestiflora*, *C. crebriflora*, *C. laxiflora*, and *C. leptonervia*, the widest (per plant) bract blade of the distal-most lateral spike is 0.9–3.2 mm wide (rarely up to 4.2 mm wide in *C. lax-*

iflora), whereas it is (3.0–)3.2–7.1 mm wide in *C. kraliana*.

Additional features distinguish *C. kraliana* from *C. blanda*, *C. congestiflora*, *C. crebriflora*, *C. laxiflora*, and *C. leptonervia*. *Carex kraliana* has the terminal spike exceeded by or subequal to the distal-most lateral spike, unlike *C. blanda*, which has the terminal spike usually clearly exceeding the distal-most lateral spike. *Carex kraliana* has the distal-most lateral spikes separate or no more than 2 of them overlapping, whereas *C. congestiflora* usually has the 3 or 4 distal-most lateral spikes overlapping. Also, *C. kraliana* has 1 to 3 lateral spikes versus 2 to 5 for *C. congestiflora*. Relative to *C. crebriflora*, *C. kraliana* has shorter pistillate scale bodies: 1.1–2.2(–2.4) mm long for *C. kraliana* versus (2.2–)2.5–3.5 mm long for *C. crebriflora*. Also, *C. kraliana* has narrower perigynia than *C. crebriflora*: 1.3–1.7(–1.8) mm wide for *C. kraliana* versus (1.6–)1.7–2.2 mm wide for *C. crebriflora*. *Carex kraliana* differs from *C. laxiflora* by its shorter terminal spikes: longest terminal spike per plant 7.6–13(–18) mm long in *C. kraliana* versus (12–)19–28(–34) mm long in *C. laxiflora*. In addition, *C. kraliana* has denser lateral spikes than *C. laxiflora*: internode between proximal-most scales of proximal-most spike 1.1–3.2(–3.8) mm long in *C. kraliana* versus 3.3–8.2 mm long in *C. laxiflora*. *Carex leptonervia* has 8- to 18-nerved perigynia (29- to 34-nerved in *C. kraliana*) and relatively loosely overlapping perigynia: internode between proximal-most scales of proximal-most spike 3.0–6.9 mm long in *C. leptonervia* versus 1.1–3.2 (–3.8) mm long in *C. kraliana*.

Probably because of its similarity to so many other species, *Carex kraliana* remained undescribed for so long. Older specimens of *C. kraliana* bear identifications most often of *C. blanda*, *C. crebriflora*, and *C. laxiflora* var. *serrulata* F. J. Hermann. Naczi and Bryson, too, had thought the name *C. laxiflora* var. *serrulata* applied to *C. kraliana* and annotated many specimens with this misidentification. Recent examination of the type of *C. laxiflora* var. *serrulata* (U.S.A. Indiana: Clark Co., ca. 1.5 mi. NW of Henryville, 25 May 1910, *Deam 6458*, holotype, GH; isotype, NY) reveals it is *C. laxiflora*, however, and not *C. kraliana*. Because of confusion of *C. laxiflora* var. *serrulata* with *C. kraliana*, reports of the former, particularly from the southeastern U.S. (e.g., Deam, 1940; Hermann, 1954, 1974; Braun, 1967; Hyatt, 1998; Reznicek & González-Elizondo, 1999), should be regarded as possibly *C. kraliana* and should be re-evaluated.

Plants of *C. kraliana* grow in mesic deciduous forests, usually in loams, sandy loams, and silt loams. Frequent associates of *C. kraliana* include *C. amphibola* Steudel, *C. basiantha*, *C. planispicata*, *C. rosea* Willdenow, *Hexastylis arifolia*, and *Podophyllum peltatum* L. *Carex kraliana* is frequent and widespread in the southeastern United States, ranging in several physiographic provinces from southern Maryland south to northern Florida and west to eastern Arkansas and eastern Texas. The paratypes are only a small fraction of the collections we have studied of *C. kraliana*.

Naczi and Bryson name this species for our friend and fellow student of Cyperaceae, Robert Kral, in recognition of his contributions to the knowledge of the flora of the southeastern United States, particularly its great diversity of sedges.

Paratypes. U.S.A. **Alabama:** Bibb Co., 6 mi. SE of Centreville, 1 May 1987, *Bryson 5606 & Kral* (herb. Bryson); Cleburne Co., ca. 10 mi. S of Borden Springs, 23 Apr. 1990, *Kral 77368* (VDB); Conecuh Co., ca. 1 mi. E of Jay Villa, 2 May 1996, *Naczi 5164* (DOV, MICH, MO, NY, WIN, herb. Bryson); Coosa Co., ca. 3.5 mi. SW of Unity, 14 Apr. 2000, *Naczi 8374 & Case* (DOV); Crenshaw Co., ca. 2 mi. S of Luverne, 17 Mar. 1993, *Naczi 2974 & Welpton* (DOV); DeKalb Co., ca. 0.5 mi. N of Portersville, 2 June 1997, *Naczi 6422* (DOV); Elmore Co., ca. 1.8 mi. SE of Titus, 23 Apr. 2002, *Naczi 9115* (DOV, MICH, VDB, WIN, herb. Bryson); Jackson Co., ca. 2.7 mi. N of center of Skyline, 22 Apr. 2002, *Naczi 9049* (DOV, VDB); Lawrence Co., ca. 8 mi. S of Mt. Hope, 21 May 1996, *Naczi 5403 & Bryson* (DOV, MICH, herb. Bryson); Lee Co., ca. 1.5 mi. N of Smiths Station, 24 Apr. 2002, *Naczi 9138* (DOV, VDB); Lowndes Co., 4.5 mi. E of Braggs, 6 Apr. 1993, *Kral 81989* (herb. Bryson); Madison Co., Huntsville, Monte Sano State Park, 6 May 1991, *Naczi 2878* (DOV, MICH); Marion Co., N side of Hamilton, 17 May 1973, *Kral 50065* (herb. Bryson); Russell Co., ca. 2.5 mi. NW of Cottonton, 3 May 1996, *Naczi 5189* (DOV, MICH, MO, NY, USCH, WIN, herb. Bryson); Tuscaloosa Co., near mouth of Hurricane Creek, 28 Mar. 1911, *Harper 141* (F, ILL); Winston Co., 5.5 mi. NE of Double Springs, 15 May 1992, *Bryson 11652* (DOV, herb. Bryson). **Arkansas:** Cross Co., W of Birdeye, along S side of rte. 42, 20 May 1990, *Naczi 2442* (DOV, herb. Bryson). **Florida:** Gadsden Co., S side of Chattahoochee, bluffs of Apalachicola River, 18 Mar. 1976, *Kral 57351* (DOV, MICH). **Georgia:** Early Co., W of Saffold railroad station, SW corner of county, 26 Mar. 1949, *Thorne 9208 & Muenscher* (MICH); Harris Co., ca. 6 mi. W of Mulberry Grove, along Mulberry Creek, 24 May 1997, *Naczi 6152* (DOV); Jasper Co., ca. 14 mi. SW of Monticello, ca. 0.8 mi. NE of Ocmulgee River crossing by rte. 83, 19 May 1997, *Naczi 6057* (DOV); Monroe Co., ca. 2.5 mi. SW of Russellville, 25 Apr. 2000, *Naczi 8397 & Ford* (DOV, herb. Bryson); Stephens Co., ca. 3 mi. N of Toccoa, 3 May 1991, *Naczi 2854* (DOV, herb. Bryson); Upson Co., ca. 1.4 mi. SSW of Roland, 25 Apr. 2002, *Naczi 9178* (DOV, VDB, herb. Bryson). **Indiana:** Crawford Co., 1.7 mi. E of Birdseye, 27 May 1990, *Naczi 2498* (DOV, herb. Bryson). **Kentucky:** Barren Co., ca. 3 mi. SSW of Haywood, Brigadoon State Nature Preserve, 14 June 1997, *Naczi 6459 & Heeg* (DOV); Clinton Co., ca. 3.3 mi. WNW of Albany, 23 May 1998, *Naczi 7187 & Ford* (DOV, MICH, herb. Bryson); Fulton Co., ca. 5 mi. SSW of Hickman, 27 June 1995, *Naczi 4853 & Reznicek* (DOV, MICH); Robertson Co., ca. 4 mi. SE of Piqua, 28 May 1998, *Naczi 7356 & Ford* (DOV); Rowan Co., ca. 7 mi. S of center of Morehead, 1 June 1996, *Naczi 5597 & Trauth* (DOV, KNK, MICH, herb. Bryson). **Louisiana:** Morehouse Parish, W of Jones, 30 Apr. 1992, *Thomas 128379, Bryson & Newton* (VDB). **Maryland:** Charles Co., Thomas Stone National Historic Site (W of Rose Hill Rd., 2 mi. S of Marshalls Corner), 31 May 2001, *Lea 2569* (DOV). **Mississippi:** Forrest Co., Ragland Hills, 11 Apr. 1991, *Bryson 10640 & Rosso* (DOV, herb. Bryson); Grenada Co., Camp McCain, 5 May 1995, *MacDonald 8593* (DOV, herb. Bryson); Holmes Co., 6.2 mi. E of Thornton, 14 Apr. 1992, *Bryson 11223 & Newton* (DOV, herb. Bryson); Marion Co., 17.5–18 mi. SSE of Columbia, 26 Apr. 1991, *Bryson 10725 et al.* (DOV, herb. Bryson); Panola Co., 1.0 mi. W of Pleasant Grove, 19 May 1990, *Naczi 2437* (DOV); Tishomingo Co., ca. 1.3 mi. S of Mingo, 17 May 1992, *Bryson 11704 & Warren* (DOV, herb. Bryson). **North Carolina:** Montgomery Co., NW of Uwharrie, along West Branch of McLeans Creek, 7 June 1990, *Naczi 2540* (DOV); Rockingham Co., ca. 7 km W of Price, along South Mayo River, 2 May 1994, *Wieboldt 8873* (DOV, VPI). **Ohio:** Lawrence Co., N side of Sharp's Creek Rd. (C-19), 2 mi. W of Symmes Creek, 22 May 1997, *McCormac 5796* (MICH). **South Carolina:** Edgefield Co., ca. 8 mi. SW of Edgefield, 2 Apr. 1997, *Nelson 18040* (DOV, USCH); Lancaster Co., ca. 2 mi. E of Taxahaw, 17 May 1996, *Naczi 5319* (DOV); York Co., ca. 4 mi. NW of Bethany, 17 May 1996, *Naczi 5304* (DOV). **Tennessee:** Dyer Co., ca. 6 mi. NW of Dyersburg, 27 June 1995, *Naczi 4844 & Reznicek* (DOV); Grundy Co., ca. 10 mi. SW of Altamont, 29 May 1990, *Naczi 2517, Kral & Raveill* (DOV); Henderson Co., ca. 11 mi. W of center of Lexington, Blue Goose, 26 June 1995, *Naczi 4798 & Reznicek* (DOV); Jefferson Co., Jefferson City, Apr. 1844, *Rugel s.n.* (MICH); Perry Co., by Blue Creek Rd., 4 mi. S of I-40, 14 May 1996, *Kral 85847* (DOV, MICH); Scott Co., ca. 1 mi. W of Fairview, 22 June 1993, *Naczi 3195 & Reznicek* (DOV, MICH). **Texas:** Marion Co., E of N arm of Caddo Lake, 29 Mar. 1987, *Orzell & Bridges 4940* (MICH); Sabine Co., ca. 4.5 mi. N of Milam, along upper reaches of Mason Creek, 12 Apr. 1988, *Orzell & Bridges 6180* (MICH); Tyler Co., above B. A. Steinhagen Lake, 4 Apr. 1989, *Orzell & Bridges 8991* (MICH). **Virginia:** Prince William Co., just NE of Prince William Forest Park, 21 May 1995, *Lea 959* (GMUF); Scott Co., ca. 6 mi. NE of Gate City, W of rte. 669 crossing of Copper Creek, 21 June 1993, *Naczi 3172, Reznicek & Wieboldt* (DOV, VPI); Southampton Co., NW of Courtland, near Davis School, along Nottoway River, 8 May 1940, *Fernald & Long 11784* (US); Sussex Co., 1.3 mi. NW of Fields Crossroads, 2 May 1997, *Fleming 12821* (GMUF); Westmoreland Co., Littlefields farm, end of SR 672, 22 June 1999, *Dodge 1483* (GMUF).

CAREX GHOLSONII, A NEW SPECIES OF *CAREX* SECT. *GRANULARES*

Carex sect. *Granulares* is a group of six species of North America and Central America (Naczi, 1992): *C. atractodes* F. J. Hermann, *C. crawei* Dewey, *C. granularis* Willdenow, *C. microdonta* Torrey & Hooker, *C. quichensis* F. J. Hermann, and *C. gholsonii*, described here. Four of these species (*C. crawei*, *C. gholsonii*, *C. granularis*, and *C. microdonta*) occur in the southeastern United States, the center of diversity of the section. *Carex atractodes* occurs in Mexico, and *C. quichensis* ranges in Guatemala. Members of this section inhabit mesic forests, moist meadows, moist prairies, and moist lake shores.

Three apomorphies diagnose *Carex* sect. *Granulares*: red-brown cells scattered in the epidermis of perigynia, 25 or more perigynia per well-developed lateral spike, and perigynia loosely enveloping the achenes (Naczi, 1992, 1997). Additional distinctive morphologic features that characterize the species, but are probably not apomorphic of *Carex* sect. *Granulares*, include long-sheathing proximal bracts, usually unisexual spikes with only the terminal one staminate, glabrous perigynia that are suborbicular or obtusely triangular in cross section and have more or less entire orifices, and perigynia usually with 25 to 39 nerves (sclerenchyma traces) that are raised above the surface in living and dried material.

Through their independent research on the systematics of *Carex* sect. *Granulares*, Naczi and Cochrane have discovered a previously undescribed species of the southeastern U.S. This new species, here named *C. gholsonii*, is infrequent to rare in its relatively small geographic range. In the following key, *C. gholsonii* is distinguished from other members of *Carex* sect. *Granulares*.

KEY TO *CAREX* SECT. *GRANULARES*

1a. Shoots scattered along long-creeping rhizomes; terminal spike and distal-most lateral spike (unless staminate) usually separate, longest (per plant) peduncle of terminal spike 2.2–15 cm long; proximal-most spike usually arising from proximal 30% of culm; perigynia with beaks 0.1–0.9 mm long.
  2a. Staminate scale bodies obtuse, awnless; widest leaf 1.8–2.8(–4.4) mm wide; perigynia 2.2–3.2 mm long, with beaks 0.1–0.3 mm long . . . . *C. crawei*
  2b. Staminate scale bodies acute, often awned; widest leaf 2.8–8.3 mm wide; perigynia 2.8–4.2 mm long, with beaks 0.3–0.9 mm long . . . . *C. microdonta*
1b. Shoots clumped on very short rhizomes; terminal spike and distal-most lateral spike usually imbricate, longest (per plant) peduncle of terminal spike 0.2–1.6(–14) cm long; proximal-most spike usually arising from distal 70% of culm; perigynia with beaks 0.1–0.3(–0.5) mm long.
  3a. Foliage usually glaucous; longest (per plant) bract blade of distal-most lateral spike 4.1–15.8 cm long; ligule of proximal-most bract (3.6–)4.0–26 mm long; perigynia 2.0–3.5(–3.9) mm long, 1.4–2.2(–2.4) times as long as wide; densely caespitose . . . . *C. granularis*
  3b. Foliage usually green; longest (per plant)

bract blade of distal-most lateral spike 1.6–4.6(–7.1) cm long; ligule of proximal-most bract 0.6–5.9(–6.5) mm long; perigynia 2.7–4.0 mm long, (1.6–)1.9–3.0 times as long as wide; loosely caespitose.

4a. Longest (per plant) terminal spike 8–19 mm long; longest (per plant) peduncle of terminal spike 0.4–3.0 mm long . . . . *C. atractodes*

4b. Longest (per plant) terminal spike (17–)19–38(–41) mm long; longest (per plant) peduncle of terminal spike 3.5–16(–140) mm long.

  5a. Widest leaf blade (5.7–)6.4–11.3 mm wide; widest (per plant) terminal spike (2.4–)2.6–3.4(–4.0) mm wide; perigynia 2.9–4.0 mm long . . . . *C. gholsonii* sp. nov.

  5b. Widest leaf blade 5.7–6.2 mm wide; widest (per plant) terminal spike 2.2–2.6 mm wide; perigynia 2.7–3.1 mm long . . . . . *C. quichensis*

Carex gholsonii Naczi & Cochrane, sp. nov. TYPE: U.S.A. Florida: Citrus Co., ca. 3 mi. S of city of Crystal River, along S side of rte. 494, 1.4 mi. W of rte. 98, 24 Apr. 1991, *R. F. C. Naczi 2787* (holotype, DOV; isotypes, FLAS, MICH, MO, NY, WIS, herb. Bryson). Figure 6.

A *Carice granulari* habitu laxe caespitoso, foliis viridibus, ligulis brevioribus, laminis bractearum brevioribus, perigyniis longioribus, perigyniis (1.6–)1.9–3.0plo longioribus quam latioribus differt; a *Carice atractode* spica terminali longiore, pedunculo longiori insidente differt; a *Carice quichensi* laminis foliorum latioribus, spica terminali latiore, perigyniis longioribus differt.

Perennial, loosely caespitose. Rhizomes 0.1–4 cm long between shoots or branches of the rhizomes. Shoot bases light brown to dark brown. Reproductive shoots erect to spreading; culms 20–75 cm tall. Leaves of reproductive shoots 1 to 5; blades 2.3–26 cm × 2.2–11.3 mm, the widest per plant (5.7–)6.4–11.3 mm wide, green. Vegetative shoots 18–51 cm tall; leaves 3 to 6, similar to those of reproductive shoots except blades 0.6–43 cm long; pseudoculms 3.1–9.0 cm tall. Infructescences 24–60 cm long, 51–93% of culm height, with the distal-most 2 to 3 spikes overlapping or rarely all spikes separate, the internode between the distal lateral spikes 0.9–17 cm long, the internode between the proximal spikes 5.9–31 cm long; proximal-most bract with blade 5.0–27 cm long and 17–89% of culm height, ligule 0.6–5.9(–6.5) mm long; bract blade of distal-most lateral spike linear, 0.9–4.6(–7.1) cm long, the longest per plant 1.6–4.6(–7.1) cm long, the widest per plant 1.2–2.4 mm wide, not concealing lateral spike when viewed from abaxial surface, greatly exceeded by terminal spike to slightly exceeding terminal spike. Spikes 4 to 6, erect; terminal spike 8.8–34(–41) mm long, the longest per plant (17–)19–34(–41) mm long, 1.7–4.0 mm wide, the widest per plant (2.4–)2.6–3.4(–4.0) mm wide, entirely staminate, overlapping and exceeding distal-most lateral spike or rarely separate from distal-most lateral spike; peduncle of terminal spike 1.4–16(–140) mm long, the longest per plant 3.5–16(–140) mm long; lateral spikes 5.3–25 × 4.2–6.6 mm, the longest per plant 14–25 mm long, entirely pistillate, 4- to 39-flowered, the perigynia spirally imbricate, the internode between the proximal-most scales in proximal-most spike 0.9–2.4 mm long, perigynia closely overlapping, with ratio of length of longest lateral spike per plant (in mm): number of perigynia = 0.58–1.1. Staminate scales 3.7–5.6 × 1.0–1.7 mm, usually acute but occasionally obtuse, awnless. Pistillate scales (2.0–)2.2–2.5(–3.1) mm long, 1.0–1.4 mm wide; body 1.4–2.2 mm long, ovate, acute and awnless or short-awned, margins whitish to ferruginous and often reddish-streaked and speckled; awn 0–1.0 mm long. Perigynia 2.9–4.0 mm long, 1.3–1.8(–2.1) mm wide, (1.6–)1.9–3.0 times as long as wide, 1.8–2.0 times as long as achene bodies, ascending, suborbicular to obtusely triangular in cross section (often flattened during specimen preparation), faces convex, nerves raised and 26 to 32, glabrous, olive to brownish green, narrowly ovate to ovate in outline, gradually tapered from widest point to broad base, abruptly tapered from widest point to excurved or straight beak; beaks 0.1–0.3 (–0.5) mm long, 3.0–17% of perigynium length, smooth, entire, bent 0–30° from long axis of perigynium. Achenes (1.9–)2.2–2.7 mm long, 1.2–1.6 mm wide, faces loosely enveloped by perigynia, obovoid, obtusely trigonous, faces slightly concave or flat, brown, basally abruptly contracted to stipe, apically abruptly contracted to minute beak; stipe 0.2–0.4 mm long, bent about 30° from long axis of achene; body 1.7–2.0 mm long; beak 0.1–0.5 mm long, bent (10–)30–90° from long axis of achene or rarely vertical.

With its caespitose habit, distal-most lateral spike usually overlapping the terminal spike, terminal spikes on relatively short peduncles, and relatively short-beaked perigynia, *Carex gholsonii* is most similar to *C. atractodes*, *C. granularis*, and *C. quichensis*. In fact, most specimens of *C. gholsonii* were originally identified as *C. granularis*. As indicated in the key, *C. gholsonii* differs from *C. granularis* by having a loosely caespitose habit, green foliage, shorter ligules, shorter bract blades, longer perigynia, and perigynia with a higher

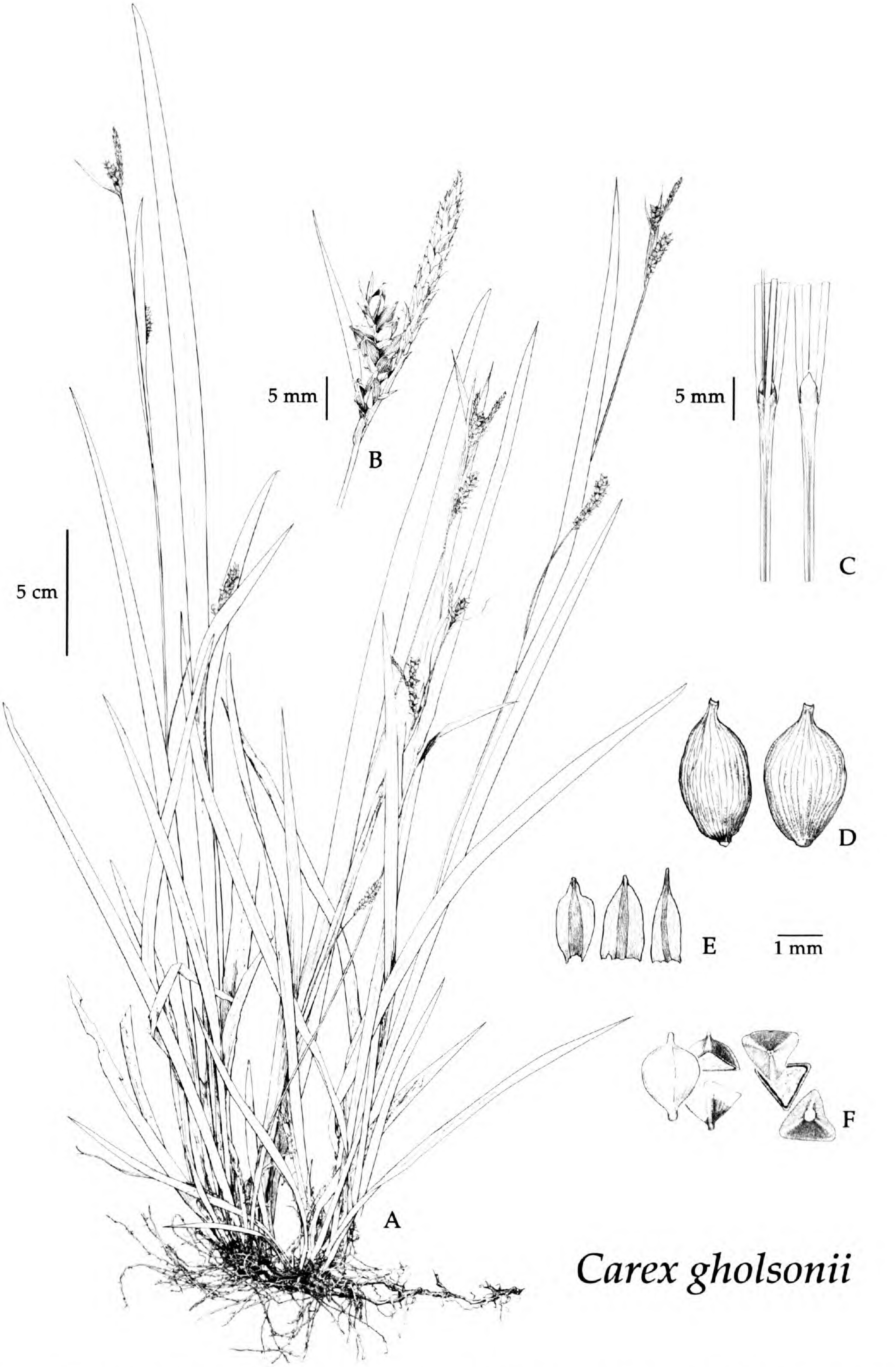

Figure 6. *Carex gholsonii* Naczi & Cochrane. —A. Habit. —B. Distal portion of culm. —C. Ligule of proximal-most bract, with (left) and without (right) included culm and peduncle of lateral spike. —D. Perigynium, lateral view (left) and adaxial view (right). —E. Pistillate scales. —F. Achene, whole (left), cross sectioned (middle), and showing apex, section, and base (right).

length : width ratio. Relative to *C. atractodes*, *C. gholsonii* has longer terminal spikes and longer peduncles of the terminal spikes. *Carex gholsonii* differs from *C. quichensis* by having wider leaf blades, wider terminal spikes, and longer perigynia.

The number and arrangement of chromosomes in two plants of *Carex gholsonii* at metaphase I are 16 II + 1 IV (methods as in Naczi, 1999b). One plant was from Nassau County, Florida (*Naczi 2742*, DOV, MICH; greenhouse-grown voucher originally from same population as *Naczi 2369*, cited below), and the second was from Wakulla County, Florida (*Naczi 2741*, DOV, MICH; greenhouse-grown voucher originally from same population as *Naczi 2383*, cited below). The chromosome number of *C. gholsonii* overlaps that of *C. granularis* (Naczi, 1999b). In addition, *C. granularis* frequently has 1 to 3 quadrivalents per cell at metaphase I, like *C. gholsonii*. The chromosome numbers of *C. atractodes* and *C. quichensis* are unknown.

Carex gholsonii ranges from southeastern North Carolina south to central peninsular Florida and west to southeasternmost Alabama. It occurs only on the Coastal Plain. It is quite rare in North Carolina, South Carolina, Georgia, and Alabama. Only in Florida is it relatively frequent, but even there it is local. The paratypes cited below are most of the specimens examined of *C. gholsonii*. No doubt its low frequency is due to its requirement for a specialized habitat, calcareous mucks and sandy loams. In these substrates, it grows along streams, in swampy forests, in hammocks, on floodplains, and in open, grassy areas such as roadsides. Frequent associates of *C. gholsonii* include *C. bromoides* Willdenow, *C. chapmanii* Steudel, *C. godfreyi* Naczi, *C. leptalea* Wahlenberg, *Rhynchospora miliacea* (Lamarck) A. Gray, *Ruellia caroliniensis*, *Sabal minor*, and *S. palmetto*.

Although *Carex granularis* is present in the southeastern United States, it is rare within the geographic range of *C. gholsonii*. No syntopic occurrences of these two species are known. *Carex gholsonii* is allopatric with the Central American *C. atractodes* and *C. quichensis*.

Naczi and Cochrane name this species for Angus K. Gholson, Jr., in gratitude for his assistance with fieldwork (including showing Naczi the first plants he saw of *C. gholsonii*), loans of specimens, and avid documentation of the flora of the southeastern United States. It is particularly appropriate that this species be named for Gholson since in the field it so often accompanies *C. godfreyi*, the namesake of Mr. Gholson's longtime friend and field companion.

Paratypes. U.S.A. **Alabama:** Houston Co., ca. 2 mi. S of Columbia, near George Andrews Lock & Dam, 3 May 1997, *MacDonald 10309* (DOV, FSU, MICH, UNA, VDB, WIS, herb. Bryson). **Florida:** [no locality beyond state], 1842–1849, *Rugel 289* (US); [Alachua] Co., Gainesville, 12 Apr. 1897, *Crawford s.n.* (PH); Brevard Co., Merritt Island National Wildlife Refuge, ca. 3 mi. N of Vehicle Assembly Bldg., 16 Apr. 1994, *Hyatt 5862* (DOV, MICH); Citrus Co., Chassahowitzka, along Chassahowitzka River just W of county park, 24 Apr. 1991, *Naczi 2792* (DOV, MICH); Columbia Co., 3 mi. W of Lula, 2 May 1965, *McDaniel 6085* (FLAS, FSU, MO, NY); Dixie Co., ca. 2.5 mi. NE of Jena, 24 Apr. 1991, *Naczi 2794* (DOV, FLAS, GA, GH, MICH, MO, NCU, NY, USCH, VDB, VPI, WIN, WIS, herb. Bryson); Gadsden Co., Chattahoochee, Lincoln Drive, 18 Apr. 1974, *Gholson 1030* (FLAS); Hillsborough Co., along Hillsborough River, next to Morris Bridge Rd., 19 Apr. 1978, *Arcuri 754 & Wunderlin* (USF); Jefferson Co., W of Aucilla River, along S side of rte. 98, 13 May 1986, *Naczi 1106 & Godfrey* (DOV); Lake Co., Astor Park, 0.2 mi. E of rtes. 40 & 445A junction, 22 Apr. 1991, *Naczi 2782* (DOV, FLAS, FSU, GH, MICH, MO, NY, TENN, UNA, USCH, VDB, herb. Bryson); Leon Co., W of Tallahassee, near Ocklockonee River, 5 Apr. 1925, *Small 11669 & Wherry* (NY); ca. 0.5 mi. S of Ocklockonee, 12 Apr. 1925, *Harper 16* (GH, NY, PH, US); ca. 6 mi. W of Tallahassee, 5 May 1960, *Godfrey 59510* (FLAS, FSU, NCU, NY, SMU, US, USF); Levy Co., ca. 1.2 mi. W of Otter Creek, along rte. 24, 9 Apr. 1977, *Gholson 6081 & Godfrey* (FLAS); Waccasassa Bay State Preserve, near Jack's Creek, 4 Mar. 1997, *Abbott 10029* (FLAS, DOV); Nassau Co., 1.8 mi. N of Callahan, along E side of rte. 1, 4 May 1990, *Naczi 2369* (DOV, MICH); Polk Co., E of rte. 60 crossing of Alafia River, 26 Mar. 1961, *Lakela 23960* (FLAS, GH, MIN, US, USF); St. Johns Co., N edge of St. Augustine, between rte. 1 and railroad, 15 Apr. 1982, *Correll 53634 & Popenoe* (NY); Taylor Co., ca. 2 mi. W of Hampton Springs, near Fenholloway River, low hammock, 29 Mar. 1910, *Harper 62* (CM, GH, NY); vicinity of Aucilla River, along rte. 98, 21 Apr. 1979, *Gholson 7661 & Godfrey* (FLAS); Volusia Co., Daytona, 14 Mar. 1904, *Deam 1805* (MICH); High Trail fish camp, 11 Apr. 1978, *Thorne s.n.* (USF); Wakulla Co., St. Marks Wildlife Refuge, 24 Apr. 1971, *Godfrey 70197* (FSU, GH, KNK, MSC, NY, PH, USF); ca. 0.7 mi. N of Newport, just S of Newport Spring, 6 May 1990, *Naczi 2383* (DOV, MICH). **Georgia:** Early Co., along Kirkland Creek, near Howard's Mill, 11 Apr. 1938, *Harper 3632* (F, GH, MICH, MO, NY, PH, US); Jefferson Co., ca. 10 mi. SE of Louisville, 8 Apr. 1904, *Harper 2104* (F, GH, MO, NY, US); Lee Co., Fowlton Creek near Armena, 20 Mar. 1949, *Thorne 9026 & Muenscher* (GA). **North Carolina:** Jones Co., 6.5 mi. E of Pollocksville, Island Creek, 20 Apr. 1952, *Godfrey 52245 & Radford* (NY, TENN); New Hanover Co., Wilmington, Delgado, 21 Apr. 1923, *Churchill 132* (GH); Pender Co., 7–13 June 1899, *Ashe s.n.* (NCU); ca. 11.5 mi. NNW of Holly Ridge, ca. 0.3 mi. W of Onslow Co. line, 20 May 1992, *Reznicek 8943 & Reznicek* (DOV, MICH); ca. 1 mi. W of Onslow Co. line, 20 May 1992, *Reznicek 8952 & Reznicek* (MICH). **South Carolina:** Aiken Co., Savannah River Site, along Tinker Creek above confluence with Upper Three Runs, 17 May 1993, *Antieau 185* (USCH); Allendale Co., Watchcall Creek, W side of SC 3, 13 Apr. 1996, *Nelson 17099 & Pittman* (DOV, MICH, USCH, VDB); Horry Co., 3 mi. N of Conway, 21 Apr. 1932, *Weatherby 16431 & Griscom* (NY); Orangeburg Co., Santee State Park, near Chapel Hill Baptist Church NE of rte. 6, 14 June 1988, *Hill 19574* (CLEMS, MICH).

CAREX INFIRMINERVIA, A NEW SPECIES OF *CAREX* SECT. *DEWEYANAE*

Carex sect. *Deweyanae* is a group of six to eight species of North America and eastern Asia. Most of the species occur in western North America, where as many as five species are sympatric in portions of British Columbia, Montana, and Washington. Members of *Carex* sect. *Deweyanae* usually inhabit mesic to wet-mesic woodlands.

Plants belonging to *Carex* sect. *Deweyanae* are lax sedges with setaceous proximal bracts, spikes that are usually gynecandrous or pistillate, distigmatic pistillate flowers, and spongy-based, beaked, thick-margined, non-puncticulate perigynia. The section contains *C. bolanderi* Olney, *C. bromoides* Willdenow subsp. *bromoides*, *C. bromoides* subsp. *montana* Naczi, *C. deweyana* Schweinitz var. *deweyana*, *C. deweyana* var. *collectanea* Fernald, *C. leptopoda* Mackenzie, *C. senanensis* Ohwi, and *C. infirminervia*, described here. Reznicek and Ball (1980) referred *C. laeviculmis* Meinshausen to section *Deweyanae*. It and the very similar (possibly conspecific) *C. kreczetoviczii* T. V. Egorova may belong to another section since they have shorter spikes, perigynia with lower length : width ratios, shorter perigynium beaks, and perigynia that are more spreading than is typical for section *Deweyanae*. All of the members of *Carex* sect. *Deweyanae* are native to North America, except *C. kreczetoviczii* (northeastern Russia) and *C. senanensis* (Japan).

Taxonomy within *Carex* sect. *Deweyanae* is controversial, particularly for *C. deweyana* and its western North American allies. In this group, some authors recognize as many as three species, *C. bolanderi*, *C. deweyana*, and *C. leptopoda* (Mackenzie, 1931; Hermann, 1970; Scoggan, 1978). Most recent authors, however, lump the three species, recognizing only *C. deweyana* with no infraspecific taxa (e.g., Hitchcock et al., 1969; Cronquist et al., 1977; Taylor, 1983; Klinka et al., 1989; Hurd et al., 1998). A few authors follow an intermediate course, treating *C. leptopoda* as *C. deweyana* subsp. *leptopoda* (Mackenzie) Calder & R. L. Taylor (Calder & Taylor, 1965, 1968; Mastrogiuseppe, 1993).

Detection of a new species of *Carex* sect. *Deweyanae* from western North America results from ongoing revisionary studies of the section by Naczi. Past failure to recognize this new species probably contributed to confusion among the species in the section. The new species, here named *C. infirminervia*, is distinguished from other members of the section in the following key.

KEY TO *CAREX* SECT. *DEWEYANAE*

This key works best with complete and ample specimens bearing mature perigynia; immature or incomplete specimens are difficult or impossible to identify. Since perigynia from the midregion of the spikes are most characteristic of the taxa, these perigynia should be studied in preference to perigynia from the proximal or distal portions of spikes.

1a. Longest (per plant) proximal spike 5.5–9.8 mm long; perigynium beaks 0.4–1.1(–1.3) mm long (beaks measured from achene apex to perigynium apex); widest leaf blade 1.3–2.0(–2.3) mm wide.

2a. Infructescences (16–)28–58(–87) mm long . . . . *C. laeviculmis*

2b. Infructescences 15–25 mm long . . . . *C. kreczetoviczii*

1b. Longest (per plant) proximal spike 8.7–27 mm long; perigynium beaks 0.9–2.8 mm long (beaks measured from achene apex to perigynium apex); widest leaf blade 1.3–5.9 mm wide.

3a. Perigynia (3.3–)4.1–6.7 times as long as wide, abaxially with (3)4 to 8 complete nerves (those that extend unbroken from perigynium base to base of perigynium beak); achenes 1.9–2.9 times as long as wide; widest leaf blade 1.3–4.4 mm wide.

4a. Culms 0.5–1.1 mm wide at mid-height; widest leaf blade 1.3–2.9(–3.1) mm wide; perigynium beaks 30–42% of perigynium length . . . . *C. bromoides* subsp. *bromoides*

4b. Culms 1.0–1.6 mm wide at mid-height; widest leaf blade (2.3–)2.8–4.4 mm wide; perigynium beaks 36–48% of perigynium length . . . . *C. bromoides* subsp. *montana*

3b. Perigynia 2.3–3.9(–4.2) times as long as wide, abaxially with 0 to 7 complete nerves (those that extend unbroken from perigynium base to base of perigynium beak); achenes 1.2–1.8 times as long as wide; widest leaf blade (2.2–)2.4–5.9 mm wide.

5a. Ligule of distal leaf on culm 0.9–2.2 mm long; pistillate scale bodies 2.8–4.2 mm long; achenes (1.8–)1.9–2.2 mm long; longest infructescence with 2 to 5 spikes; longest proximal spike with 5–12 perigynia (including undeveloped or aborted ones).

6a. Longest infructescence 35–56 mm long, longest internode between proximal spikes (11–)13–34 mm; longest proximal bract 15–49 mm long . . . . *C. deweyana* var. *deweyana*

6b. Longest infructescence 12–32 mm long, longest internode between proximal spikes 6–10 mm; longest proximal bract 9–12(–18) mm long . . . . *C. deweyana* var. *collectanea*

5b. Ligule of distal leaf on culm (2.1–)3.1–8.1 mm long; pistillate scale bodies 2.1–3.3(–3.8) mm long; achenes 1.4–1.9(–2.2) mm long; longest infructescence with (4)5 to 9 spikes; longest proximal spike with (9)12 to 37 perigynia (including undeveloped or aborted ones).

7a. Perigynium beaks 0.9–1.5(–1.7) mm long, 28–38% of perigynium length; pistillate scale bodies 2.1–2.9(–3.1) mm long . . . . *C. leptopoda*

7b. Perigynium beaks (1.4–)1.6–2.7 mm long, 38–50% of perigynium length; pistillate scale bodies (2.3–)2.7–3.8 mm long.

  8a. Perigynium apices with teeth 0–0.2(–0.4) mm long, teeth 0–8% of perigynium length (avoid perigynia with teeth lengthened by tearing of sinus between teeth); longest infructescence with (4)5 to 6(7) spikes; culm at mid-height papillose (best seen with 20× magnification on young culms) . . . . *C. infirminervia* sp. nov.

  8b. Perigynium apices with teeth (0.2–)0.3–0.6(–1.0) mm long, teeth (6–)9–20% of perigynium length (avoid perigynia with teeth lengthened by tearing of sinus between teeth); longest infructescence with (5)6 to 9 spikes; culm at mid-height smooth, serrulate, or scabridulous (check with 20× magnification).

    9a. Perigynia abaxially with (2)3 to 7 complete nerves; perigynium margins denticulate for 34–51% of perigynium length . . . . *C. bolanderi*

    9b. Perigynia abaxially with 0 to 2(3) complete nerves; perigynium margins denticulate for 49–64% of perigynium length . . . . *C. senanensis*

Carex infirminervia Naczi, sp. nov. TYPE: [Canada. British Columbia]: Nelson, Silver King Mine Rd., roadside at about 5000 ft., 31 July 1943, *J. W. Eastham 10949* (holotype, UBC; isotype, DAO). Figure 7.

A *Carice bolandero* et *Carice senanensi* culmis papillosis, infructescentiis spicis paucioribus instructis, apicibus perigyniorum edentatis vel brevidentatis differt.

Perennial, densely caespitose. Culms 10–83 cm tall, 0.8–1.3 mm wide at mid-height, covered with minute papillae at mid-height. Leaves with blades 1.4–3.8 mm wide, the widest blades 2.3–3.8 mm wide; ligules of distal leaves on culm (2.1–)2.6–6.8 mm long. Infructescences 27–68 mm long, with the proximal-most 2 spikes overlapping or separate, internode between proximal-most spikes 7.3–28 mm long; proximal-most bract 11–61 mm long. Spikes (4)5 to 6(7), usually gynecandrous but also sometimes pistillate or staminate; terminal spike 9.6–16 × 3.4–6.2 mm, usually with 1 to 3 staminate and 14 to 21 pistillate flowers, sessile or on peduncle up to 1.8 mm long; proximal-most spike 9.7–18 × 3.7–6.6 mm, the longest per plant 12–18 mm long, usually with 1 to 3 staminate and 11 to 22 pistillate flowers, the longest per plant with 12 to 22 pistillate flowers. Pistillate scales 2.9–4.4 mm long, acuminate to short-awned with awn up to 1.1 mm long; bodies 2.9–3.8 × 1.4–1.8 mm, whitish to castaneous except for green midrib. Staminate scales 3.1–4.3 × 1.0–1.5 mm, acute to short-awned, margins whitish to castaneous. Perigynia 3.7–5.3 mm long, 1.1–1.3(–1.4) mm wide, erect to appressed-erect, narrowly lanceolate in outline, 3.2–3.9(–4.2) times as long as wide, green to brown, unnerved adaxially, unnerved or weakly 1- to 3(4)-nerved abaxially, gradually narrowed to a beak; beaks 1.5–2.2 mm long, 39–49% of total perigynium length, denticulate on margins for distal 49–60% of length of perigynium, the apex toothless or bidentulate with teeth 0.1–0.2(–0.4) mm long, teeth 0–8% of perigynium length. Achenes 1.6–2.2 × 1.1–1.3 mm, 1.5–1.8 times as long as wide. Stigmas 1.8–2.5 mm long. Anthers 1.3–1.8 mm long.

Figure 7. *Carex infirminervia* Naczi. Perigynium, abaxial view (× 20).

Carex infirminervia most closely resembles *C. bolanderi* and *C. senanensis*. *Carex infirminervia* possesses relatively long ligules (≥ 2.1 mm long), relatively long bodies of the pistillate scales (≥ 2.9 mm long), perigynia 3.2–3.9(–4.2) times as long as wide, and perigynium beaks occupying a relatively high percentage of the perigynium length (≥ 39%). Only *C. bolanderi* and *C. senanensis* also have this combination of features; other species in section *Deweyanae* have shorter ligules (*C. deweyana*), shorter pistillate scale bodies (*C. leptopoda*), perigynia with either a lower (*C. leptopoda*) or a higher (*C. bromoides*) length : width ratio, and perigynium beaks occupying a lower percentage of the perigynium length (*C. deweyana, C. leptopoda*).

Carex infirminervia differs from both *C. bolanderi* and *C. senanensis* in at least three ways. First, at mid-height, the culms of *C. infirminervia* are covered with minute papillae (best seen with 20× magnification), whereas those of *C. bolanderi* and *C. senanensis* are smooth, serrulate, or scabridulous. The papillae on culms of *C. infirminervia* have their long axes perpendicular to the culm surface, unlike the serrulations and minute, antrorse teeth that are sometimes present in the mid-region of the culms of *C. bolanderi* and *C. senanensis*. The papillae are delicate, and many wear off the culms with age. By the time most perigynia have shed from a culm of *C. infirminervia*, the papillae may be patchily distributed or nearly absent. Thus, when studying the morphology of culms of *C. bolanderi, C. infirminervia*, and *C. senanensis*, one should examine more than one culm per specimen and include young culms in this examination. Within *Carex* sect. *Deweyanae*, papillose culms are not unique to *C. infirminervia*. Regularly, *C. leptopoda* has papillose culms, and *C. deweyana* occasionally has them. However, within the group of *C. bolanderi, C. infirminervia*, and *C. senanensis*, papillose culms are restricted to *C. infirminervia*.

A second feature that distinguishes *C. infirminervia* from *C. bolanderi* and *C. senanensis* is its fewer spikes per infructescence. The longest infructescence per plant in *C. infirminervia* bears (4)5 to 6(7) spikes, whereas *C. bolanderi* has (5)6 to 9 spikes and *C. senanensis* has 7 to 9 spikes. A third diagnostic feature of *C. infirminervia* is the toothless or relatively short-toothed perigynium apex. Whereas apices of perigynia of *C. infirminervia* have teeth 0–0.2(–0.4) mm long, those of *C. bolanderi* and *C. senanensis* bear teeth (0.2–)0.3–0.6(–1.0) mm long.

Additional features distinguish *C. infirminervia* and *C. bolanderi*. The perigynium margins of *C. infirminervia* are denticulate for the distal 49–60% of the perigynium length, whereas in *C. bolanderi*, the margins are denticulate for 34–51% of the perigynium length. Also, abaxial surfaces of perigynia of *C. infirminervia* usually have fewer and fainter nerves than those of *C. bolanderi*. In *C. infirminervia*, 0 to 3(4) fine nerves extend unbroken from the perigynium base to the base of the perigynium beak, whereas perigynia of *C. bolanderi* have (2)3 to 7 nerves, which are usually relatively thick. The epithet "infirminervia" ("weak-nerved") is appropriate for the new species since its relatively few and faint perigynium nerves distinguish it from *C. bolanderi*, the species to which it is morphologically and geographically most similar.

Carex infirminervia ranges from southwestern Alberta and central British Columbia south to northern Colorado and west to central California. Portions of the geographic range of *Carex infirminervia* overlap parts of the ranges of *C. deweyana* and *C. leptopoda*. *Carex infirminervia* is allopatric with the eastern North American *C. bromoides* and the Japanese *C. senanensis*. *Carex infirminervia* is sympatric with *C. bolanderi* over much of the ranges of the two species. Herbarium specimens document at least two locations for syntopy of *C. infirminervia* and *C. bolanderi*: one in British Columbia (Nelson, Six Mile Lakes, common on plateau, 4500 ft., 27 June 1940, *Eastham 7578* [UBC]—*C. infirminervia*, and *Eastham 7577* [UBC]—*C. bolanderi*) and the other in California (El Dorado Co., Strawberry Creek, 5900 ft., 20 July 1897, *Brainerd 179* [VT]—*C. infirminervia*, and *Brainerd 180* [VT]—*C. bolanderi*). In both cases, the collectors apparently noticed a difference between the two species, since they assigned different collection numbers to the specimens of each. Co-occurrence of *C. infirminervia* and *C. bolanderi*, with both apparently maintaining their distinctions, is further evidence in support of their status as two species.

Though widespread, *C. infirminervia* is infrequent and its populations are scattered. Judging from herbarium labels, it usually occurs in woodlands and their edges, often on slopes above streams. A few collectors have indicated *C. infirminervia* also grows in more open habitats, such as grassy slopes and roadsides. Perhaps these open habitats are near woodlands.

Most collections of *C. infirminervia* bear original identifications of *C. bolanderi, C. leptopoda*, or *C. deweyana*. *Carex infirminervia* shares some features with *C. bolanderi* (discussed above), *C. deweyana* (e.g., relatively long pistillate scale bodies, perigynium apex toothless or short-toothed, few and faint perigynium nerves), and *C. leptopoda* (e.g., relatively long ligules, perigynium apex toothless or short-toothed, few and faint perigynium nerves). Such shared characteristics probably account for much of the conflicting classification within the section. Recognition of the diagnostic features of *C. infirminervia* permits precise circumscription of it and similar species, with resultant clarification of the taxonomy of section *Deweyanae*.

Paratypes. CANADA. **Alberta:** Lake Louise, 22 July 1904, *Macoun 64142* (GH, NY); Carbondale River, 16 July 1944, *Cormack 328* (ALTA, US); Waterton Lakes National Park, above Waterton Lake, 13 July 1953, *Breitung 15880* (NY, US); Waterton Lakes National Park, E shore of Cameron Lake, 1 Aug. 1956, *Hermann 13049* (ALTA, US). **British Columbia:** Selkirk Mountains, Glacier, 4300 ft., 10 Aug. 1897, *Brainerd s.n.* (VT); Selkirk Mountains, Glacier–Avalanche Mountain, 23 July 1908, *Butters 398 & Holway* (GH, RM); Nelson, Six Mile Lakes, 27 June 1940, *Eastham 7578* (UBC); ca. 11 mi. W of Revelstoke, near Victor Lake, 3 July 1941, *Hitchcock 7547 & Martin* (WTU); Rossland, Little Sheep Creek Trail, 5 July 1942, *Eastham 9978* (UBC); Fernie, Fairy Creek, 5 July 1947, *Eastham 15652* (DAO, UBC); ca. 9 mi. NE of Nelson, Sitcum Creek Delta, 19 June 1953, *Calder 9385 & Savile* (DAO, UBC, UC); NNE of Naramata, 1.5 road mi. SW of Chute Lake, 8 July 1953, *Calder 10242 & Savile* (DAO, DS); Manning Park, 12 mi. NW of ranger station, along Hope–Princeton Hwy., 3100 ft., 16 July 1953, *Calder 10606 & Savile* (DAO); just NW of Azouzetta Lake, Pine Pass, along Hart Hwy., 2900 ft., 13 July 1960, *Calder 26902 & Kukkonen* (DAO); Galena, at Hill Creek, 21 June 1962, *Taylor & Szczawinski 513* (UBC); Azouzetta Lake, Hart Hwy., 650 m, 5 July 1963, *Taylor & Szczawinski 636* (UBC); 20 km NE of Vernon, Silver Star Mountain, 5 July 1982, *Botham 2948* (DAO, MICH), *Botham 2962* (DAO, MICH); ca. 8 km E of Yahk, provincial rest area on N side of hwy. 3, 27 June 2000, *Ford 00125 & Saarela* (WIN); Manning Provincial Park, trail between Strike and Flash Lake, 29 June 2000, *Ford 00139 & Saarela* (DOV, WIN). U.S.A. **California:** El Dorado Co., Strawberry Creek, 5900 ft., 20 July 1897, *Brainerd 179* (VT); Lake Tahoe, Emerald Bay, 21 July 1941, *Rose 41334* (CAS); Fresno Co., 2 mi. N of General Grant, National Park Headquarters, 29 June 1940, *Rose 40686* (CAS); Glenn Co., Canyon of Snow Basin Creek, 5 Aug. 1943, *Howell 19106* (CAS, US); Humboldt Co., Trinity Summit, lower end of Brett Hole, 23 July 1935, *Tracy 14162* (CAS, DS, NCU, UC); Mariposa Co., Lake Tenaya Trail, 14 Aug. 1894, *Congdon s.n.* (DS); Nevada Co., between Donner Pass and West Lake, 23 July 1943, *Howell 18721* (CAS); Placer Co., Lake Tahoe, Chambers Lodge, 25 July 1944, *Rose 44245* (CAS); Plumas Co., 8 mi. SW of Johnsville, McRae Meadows, 28 June 1951, *Rose 51029* (COLO); Lassen Volcanic National Park, Boiling Springs Lake, 20 July 1960, *Howell 35759* (CAS); Siskiyou Co., Spirit Lake, Marble Mountains, 3 Aug. 1939, *Howell 14989* (CAS, UC); SE end of Long Gulch Lake, Klamath National Forest, T39N, R9W, SE1/4 sect. 32, 12 Aug. 1987, *Tallent 901* (MICH); Trinity Co., N Fork Coffee Creek, Trinity River, 19 Aug. 1916, *Goldsmith 19a* (JEPS); [Tuolumne] Co. [originally labeled as El Dorado Co.], Jones Hill, 1879, *Shockley 605* (JEPS). **Colorado:** Boulder Co., Marysville, E of Eldora, N-facing slope Tennessee Mountain, Shickley property, 23 July 1971, *Colson 71-23* (COLO); Gunnison Co., Gunnison National Forest, West Elk Wilderness, along Cascade Creek, 0.25 mi. upstream from Coal Creek confluence, 7200 ft., 19 July 1994, *Rondeau 94-203 & DeCoursey* (COLO); Routt Co., Routt National Forest, lower Silver Creek, ca. 8100 ft., 13 Aug. 1993, *Duff 435 & Kettler* (COLO). **Idaho:** Bonner Co., 20 mi. N of Sandpoint, 3.5 mi. NE of Jeru Peak, Homstead Creek Watershed, Selkirk Mts., 14 Aug. 1969, *Stickney 1954* (RM); Elmore Co., ca. 6 mi. from Atlanta on road to Featherville, 22 July 1944, *Hitchcock 10203 & Muhlick* (CAS, GH, NY, RM, UC, US, WTU); Latah Co., NE of Moscow, Thatuna Hills, 12 July 1939, *Baker 1428* (WTU); Valley Co., 3 mi. NW of Payette Lake, 25 June 1946, *Hitchcock 13949 & Muhlick* (CAS, MO, NY, RM, UC, UTC, WTU); 12 mi. N of McCall, Brush Creek Rd., Payette National Forest, 13 Aug. 1971, *Lewis 2144* (UTC); upper six mile creek, Middle Fork Payette, Boise National Forest, 14 July 1972, *Lewis 2451* (UTC). **Montana:** [Flathead] Co., Nyack, 5 Aug. 1894, *Williams 466* (US); Flathead Co., Upper Whitefish Lake, above campground, Whitefish Range, 2 July 1972, *Lackschewitz 3718* (RM); Glacier Co., Glacier National Park, along trail from Many Glacier Hotel to Swiftcurrent Pass, 19 July 1919, *Standley 16011* (US); Ravalli Co., 10 mi. S of Alta, head of Beaver Creek, 2 July 1946, *Hitchcock 14362 & Muhlick* (CAS, NY, WTU). **Nevada:** Washoe Co., Carson Range, Little Valley, 26 July 1975, *Tiehm 1640* (NY, RENO). **Oregon:** Baker Co., 18 mi. above Richland, Eagle Creek, 28 June 1938, *Peck 19969* (CAS, WILLU); [Hood River] Co., Mount Hood, near White River, 23 July 1928, *Thompson 5006* (MO, WTU); Klamath Co., Crater Lake National Park, Vidae Ridge, 15 Aug. 1950, *Baker 7244* (CAS); N end of Lake of Woods, *Peck 16589* (WILLU); Lane Co., Lookout Ridge, along Lookout Ridge Rd., Andrews Exp. Area, 25 July 1968, *Franklin 772* (OSC, RM); Morrow Co., Umatilla National Forest, Alder Creek, along FS Road 21, 10 July 1993, *Wilson 6153 et al.* (MICH); [Umatilla] Co., Laka, Blue Mountains, 12 June 1886, *Henderson 1784* (GH); Wallowa Co., Eagle Cap Wilderness, S of S end of road in Lostine Canyon, 8 Aug. 1994, *Wilson 7392 et al.* (MICH). **Utah:** [Salt Lake] Co., Alta, Wasatch Mountains, 8 Aug. 1879, *Jones 1218* (MICH, NY, UTC); Salt Lake Co., Little Cottonwood Canyon, White Pine Fork Trail, 13 Aug. 1983, *Arnow 6149* (NY). **Washington:** Asotin Co., SW of Anatone, head of Cottonwood Creek, T7N, R44E, sect. 6, 9 July 1949, *Cronquist 5944 & Jones* (COLO, GH, MICH, NY, UC, US, UTC, WTU); [Chelan] Co., Stehekin, June 1902, *Griffiths 198 & Cotton* (GH); Cascade Tunnel, 14 July 1911, *Jones s.n.* (DS); Stevens Pass, June 1928, *Grant s.n.* (RM); Chelan Co., Stehekin River, below Cottonwood Camp, 31 Aug. 1956, *Raven 10300* (CAS); Columbia Co., Blue Mountains, 11 Aug. 1897, *Horner R485B524* (GH); Pierce Co., Mount Rainier National Park, trail to Glacier Basin, White River Campground, 2 Aug. 1977, *Colson 77-60* (COLO); Whatcom Co., S of Colonial Campground, Thunder Creek Trail, 14 June 1991, *Castaner 10723* (DOV). **Wyoming:** Lincoln Co., Skull Creek at junction of Little Greys River, 28 June 1980, *Tuhy 66* (NY); Park Co., ca. 1.5 mi. N of rtes. 14, 16, and 20, along Grinnell Creek Trail, 9 Aug. 1980, *Evert 2343* (COLO, NY, RM); along Mormon Creek, ca. 2–3 mi. N of Hwy. 14, 19 July 1985, *Evert 8535* (NY); Teton Co., 13 mi. E of Driggs, Idaho, 2 mi. E of Treasure Mountain Scout Camp, Teton Forest Camp, 16 July 1956, *Anderson 507* (NY, UTC).

A New Combination for a Variety of *Carex digitalis* (*Carex* sect. *Careyanae*)

Carex digitalis Willdenow is widespread in forests of eastern North America and common throughout most of its range. Fernald (1950) recognized two non-autonymic varieties for this species, *C. digitalis* var. *asymmetrica* Fernald and *C. digitalis* var. *macropoda* Fernald. In the forthcoming treatment of *Carex* sect. *Careyanae* for the *Flora of North America*, Bryson and Naczi (in press) recognize three varieties for *C. digitalis*, using the same circumscriptions as Fernald. However, the nomenclature of one of these varieties must change. Over half a century prior to Fernald, Bailey (1889) described *C. laxiculmis* var. *floridana*, which is the same taxon as *C. digitalis* var. *asymmetrica*. In order to use Bailey's prior epithet and align it with *C. digitalis*, it must be transferred, as follows.

Carex digitalis var. **floridana** (L. H. Bailey) Naczi & Bryson, comb. nov. Basionym: *Carex laxiculmis* var. *floridana* L. H. Bailey, Mem. Torrey Bot. Club 1: 47. 1889. TYPE: U.S.A. Florida: [no additional locality information, no date], *Chapman s.n.* (lectotype, designated here, BH).

Carex digitalis var. *asymmetrica* Fernald, Rhodora 43: 544. 1941. Syn. nov. TYPE: U.S.A. Virginia: Southampton Co., NW of Applewhite Church, near Three Creek, 8 May 1940, *Fernald & Long 11791* (holotype, GH; isotypes, GH, PH).

Carex digitalis var. *floridana* is diagnosed by relatively long perigynia (3.2–4.2 mm long) with conspicuously excurved apices. Specimens of the two other varieties, *C. digitalis* var. *digitalis* and *C. digitalis* var. *macropoda*, have perigynia 2.4–3.4 mm long with barely excurved apices. Examination of the types of *C. digitalis* var. *asymmetrica* and *C. laxiculmis* var. *floridana* reveal that both have long perigynia with excurved apices. In addition, Naczi and Bryson discern no taxonomic differences between these type specimens. Hence, we conclude they are the same taxon.

Bailey cited two syntypes for his *C. laxiculmis* var. *floridana*, *Chapman s.n.* and *Curtiss s.n.*, both from Florida. We choose the Chapman specimen as the lectotype because it more closely matches the description, and it bears mature and ample perigynia, whereas the other specimen (*Curtiss s.n.*) has immature and few perigynia.

Plants of *C. digitalis* var. *floridana* inhabit mesic, well-drained (usually sandy) soils of deciduous and deciduous-pine forests from southern Maryland south and west to eastern Texas, mostly on the Coastal Plain.

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Mikania oreophila (Asteraceae, Eupatorieae), a New Species from Southern Brazil

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ABSTRACT. *Mikania oreophila*, a new species of Asteraceae (Eupatorieae) from the southern Brazilian highlands, is described and illustrated. The new species is related to *M. paranensis*, from which it differs by the thinly chartaceous and somewhat basally attenuate leaves and subinvolucral bracts placed at the base of the peduncles.

RESUMEN. Se describe e ilustra *Mikania oreophila*, una nueva especie de Asteraceae (Eupatorieae) de las montañas del sur de Brasil. La nueva especie está emparentada con *M. paranensis*, de la cual se diferencia por sus hojas finamente cartáceas y algo atenuadas en la base y por las brácteas subinvolucrales dispuestas en la base de los pedúnculos.

Key words: Asteraceae, Brazil, Eupatorieae, *Mikania*.

Mikania Willdenow is a genus in Asteraceae with about 430 species distributed mainly in the tropical regions, mostly in South America (Holmes, 1995). There are about 171 species recorded for Brazil (King & Robinson, 1987). As part of a study of the genus in southern Brazil, an undescribed species came to our attention and is described herein as new.

Mikania oreophila M. R. Ritter & Miotto, sp. nov. TYPE: Brazil. Rio Grande do Sul: São Francisco de Paula, Alpes de São Francisco, 18 Mar. 2000, *M. R. Ritter & S. L. de Carvalho Leite 1110* (holotype, ICN; isotypes, FLOR, MBM, MO). Figure 1.

Suffrutices volubiles, breviter puberuli vel pubescentes; folia opposita, sine stipulis, aliquando linea trichomatum interpetiolari, hastata, decurrentia, superficiebus ambabus cum trichomatibus et glandulis sparsis, trinervibus. Capituli pedunculati, pilosi, compositi in inflorescentiis paniculiformibus. Bractea subinvolucrata lineari-lanceolata posita in base pedunculi et rare paulo superiore. Bracteae involucratae elliptico-lanceolatae. Pappus cum circiter 40 setis. Cypselae glabrae.

Twining lianas; stems terete, fistulose with age, striate, puberulent to pubescent with simple pluricellular uniseriate trichomes up to 1.5 mm long. Leaves simple, opposite, petiolate, estipulate; petioles 1.3–2.5 cm long, occasionally with a row of trichomes between them; blade thinly chartaceous, triplinerved, (6)6.5–9 cm long, (2.5)3.5–6(6.3) cm wide, base attenuate, apex long-acuminate, margins with up to six pairs of teeth, ciliate, both surfaces with trichomes like those on the stems and sparse sessile glands, more densely pubescent abaxially, especially so on veins. Capitulescence terminal or axillary, paniculate, branches terete. Capitula up to 7.5 mm tall, peduncles 1–3.5 mm long, densely pubescent; subinvolucral bract linear-lanceolate, 1.5–2(2.5) mm long, 0.4–0.7 mm wide, located at the base of the peduncle or occasionally a little more distal in capitula borne on short peduncles, margins entire, ciliate, apex long-acuminate, abaxially puberulent, sometimes sparsely glandular; involucral bracts elliptic-lanceolate, (2.5)3–4 mm long, 0.8–1 mm wide, margins entire, apically acuminate, ciliate, pubescent to puberulent, sometimes glandular. Corollas discoid, tube ca. 0.5–0.8 mm long, limb ca. 1.8–2.5 mm long, lobes ca. 0.4–0.5 mm long, glandular. Cypselae brownish, 2.5–3.5 mm long, glabrous, weakly glandular. Pappus with ca. 40 bristles, 3–4 mm long, with short stiff cells, whitish, sometimes pink-tinged.

Habitat and distribution. *Mikania oreophila* thrives in borders of woods in the highlands from the State of Rio Grande do Sul to the Serra do Mar in Paraná, reaching elevations of up to 1300 m. It was also collected in the State of São Paulo at elevations of 750–870 m, but with typical climatic characteristics of the highland "campos," with humid woods with frequent fogs and lower night temperatures.

Phenology. Flowering and fruiting plants were collected from February to May.

Etymology. The epithet is derived from the Greek words oros (mountain) and philos (loving), in allusion to the montane habitat of the species.

Mikania oreophila is similar to *Mikania paranensis*, from which it is set apart by the pilose, thin-

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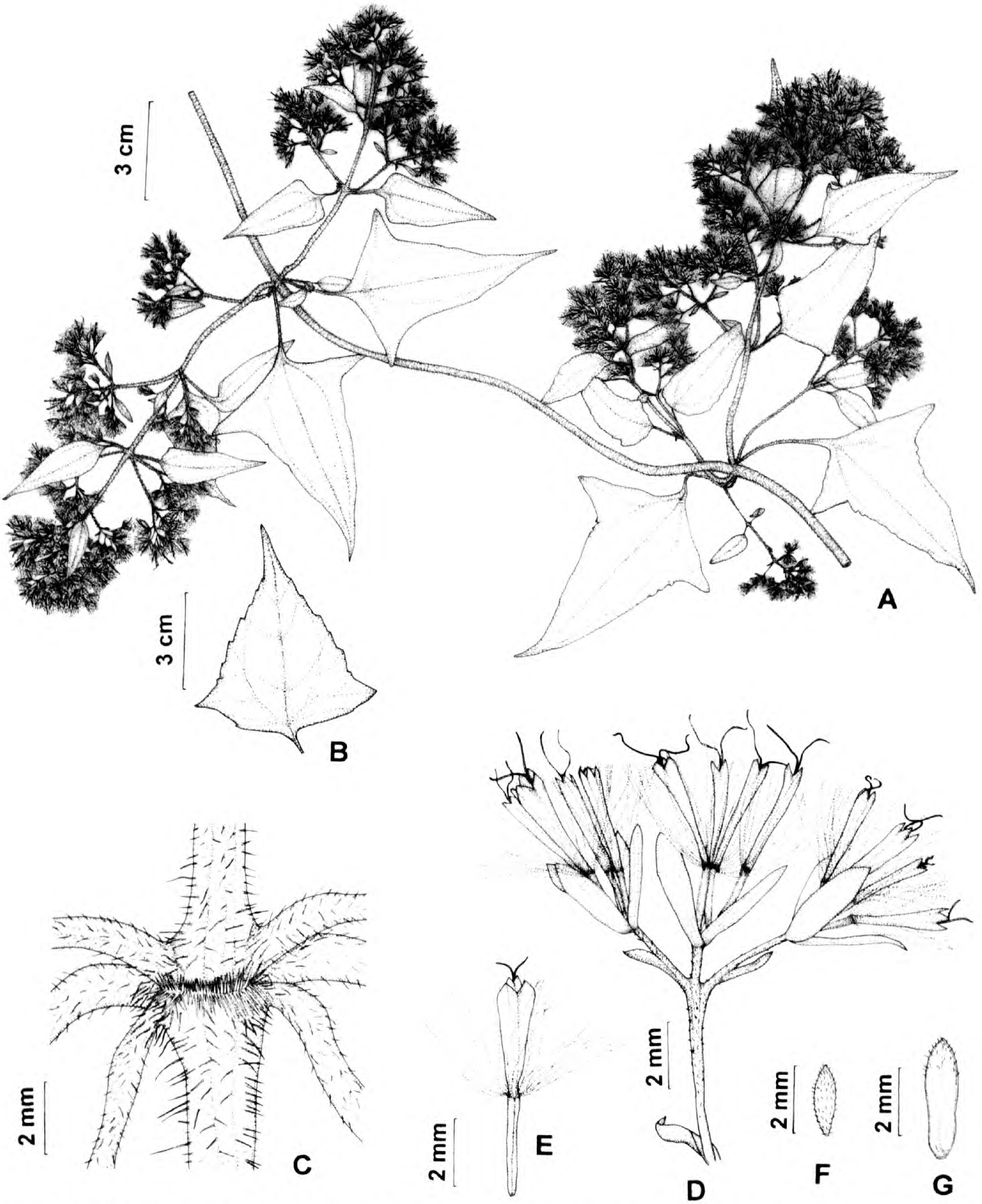

Figure 1. *Mikania oreophila* M. R. Ritter & Miotto. —A. Flowering branch. —B. Leaf. —C. Detail of stem node showing row of trichomes. —D. Capitula. —E. Floret. —F. Subinvolucral bract. —G. Involucral bract. (A, C–G: *M. R. Ritter & S. L. de Carvalho Leite 1110*, from holotype in ICN; B: *D. B. Falkenberg 7168*, from paratype in FLOR.)

ly chartaceous, and basally attenuate leaves, and by the subinvolucral bracts located at the base of the peduncles, or sometimes more distal, and the corolla tube uniformly widened from base to apex. In *M. paranensis* the leaves are glabrous, chartaceous to coriaceous, the blades are triangular and not basally attenuate, the subinvolucral bracts are placed at the base of the capitula, and the corolla is clearly divided into a narrow proximal half and a wider distal one. *Mikania oreophila* may also be confused with *M. chlorolepis* Baker, but in the latter species the leaves are longer, up to 16 cm long, and the subinvolucral bracts are located at the base of the capitula; moreover, *M. chlorolepis* is not known to occur in montane habitats in southern Brazil.

According to the sectional classification proposed by Holmes (1996), *Mikania oreophila* should be assigned to section *Summikania* due to its basal subinvolucral bracts, although the two species with which it is compared are better placed in section *Mikania* since they bear apical subinvolucral bracts; another character used by Holmes, the direction of the capitulescence maturation, could not be stated confidently in either species—indeed, in one specimen of *M. paranensis* where maturation was clearly verifiable (*Ritter 1003*, ICN 115651) it occurred racemosely, in a way contrary to the pattern of section *Mikania* and expected to be found in section *Summikania*. So, if further investigation proves such overlap of characters, it will be necessary to look for some additional ones to reinforce the useful sectional classification of Holmes.

Paratypes. BRAZIL. **Paraná:** Guaratuba, serra de Araçatuba, morro dos Perdidos, 18 Feb. 1998, *H. M. Fernandes & E. P. Santos 69* (ICN), 12 Mar. 1999, *L. C. Cândido & M. Hassegawa 12* (UPCB), 8 Apr. 2000, *E. Barbosa & O. S. Ribas 419* (MBM), 8 Apr. 2000, *E. Barbosa & O. S. Ribas 432* (MBM); Nova Galícia, 18 Feb. 1916, *P. Dusén 17701* (NY, S). **Rio Grande do Sul:** Cambará do Sul, em direção a São José dos Ausentes, a 19 km de entroncamento para Retiro, 9 May 2000, *M. R. Ritter 1162* (ICN); a 17 km de Fortaleza dos Aparados para Cambará do Sul, 23 Mar. 1999, *M. R. Ritter 1007* (ICN), *M. R. Ritter 1008* (ICN); fazenda Velha, Celulose Cambará, 5 Apr. 1994, *N. Silveira & C. Mansan 11924* (HAS, ICN); Ouro Verde, 10 Apr. 1995, *T. Lewinson, PIC 95176* (ICN). **Santa Catarina:** Urubici, alto da serra do Corvo Branco, acesso na SC 439, junto ao corte no morro, 24 Feb. 1995, *D. B. Falkenberg 7168* (FLOR); trilha para o topo da serra do Corvo Branco, no alto da SC 439, junto ao corte no morro, 28 Mar. 1995, *D. B. Falkenberg 7375* (FLOR). **São Paulo:** São Paulo, distrito de Marsilac, Parque Estadual da Serra do Mar, Núcleo Curucutu, 27 Mar. 1996, *R. J. F. Garcia, G. M. P. Ferreira & C. M. A. Pimentel 772* (PMSP, SPF).

Acknowledgments. We thank Márcia Vignoli da Silva for her accurate drawing of this new species, Marcos Sobral for stimulus and suggestions, Ely Fumagalli Horta for correcting the Latin diagnosis, and Nelson Ivo Matzenbacher for the valuable help with the English version. The curators of the cited herbaria are thanked for their help and availability.

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King, R. M. & H. Robinson. 1987. The Genera of the Eupatorieae (Asteraceae). Monogr. Syst. Bot. Missouri Bot. Gard. Vol. 22.

A New Species of *Faramea* (Rubiaceae) from Costa Rica

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ABSTRACT. *Faramea zamorensis*, a new species from Costa Rica, is described and illustrated. Its affinity to other species is discussed. The species is easily distinguished from congeners by its calyx lobes 5–7 mm long, its funnel-shaped corolla, and its costate hypanthium and fruits.

Key words: Costa Rica, *Faramea*, Rubiaceae.

Faramea Aublet is a large genus of about 130 species, ranging from Mexico, Central America, and the West Indies throughout tropical South America (Burger & Taylor, 1993). During a field study in the northern zone of Costa Rica, a new species having subsessile, funnel-shaped flowers was found and is described here. Including this new species, there are 17 species of *Faramea* reported for Costa Rica, mainly in lowland rainforests.

Faramea zamorensis Al. Rodríguez, sp. nov. TYPE: Costa Rica. Alajuela: San Carlos, Boca Tapada, Cuenca del Río San Carlos, Finca San Jorge, 10°43′20″N, 84°11′50″W, 100 m, 10 Feb. 1996, *Al. Rodríguez & A. Estrada 1067* (holotype, INB; isotypes, CR, MO). Figure 1.

Species facile distinguenda ob calyce lobulis 5–7 mm longis, corolla infundibuliformi, hypanthio costato a congeneris diversa.

Shrub 3 m tall, glabrous throughout; stem laterally flattened and remaining so with age. Leaves sessile or with petioles up to 1 mm long; blade elliptic to lance-elliptic, 10.5–18 × 3.3–8.5 cm, apex acuminate with slender tips 10–17 mm long, base cordate to subcordate, drying chartaceous, grayish green or blackish green above and below; secondary veins 10 to 16 per side, spreading widely, tertiary venation reticulated, thickened to slightly raised adaxially, slightly raised abaxially. Stipules interpetiolar, caducous, triangular, 5–11 mm long including arista, aristae 4–6 mm long. Flowers terminal, 2 or 3 per fascicle, peduncles 0–1.5 mm long, bracts ca. 7 mm long, linear-lanceolate, easily deciduous; pedicels 1.6–2 mm long, ebracteate, hypanthium turbinate, ribbed, 9–11 mm long; calyx lobes 5–7 mm long, linear, glabrous. Corolla funnel-shaped, violet and drying blackish, glabrous externally, tube ca. 18 mm long, slightly widening at mouth, ca. 1 mm diam. near the base and 2–3 mm diam. in the wider part, 4-lobed, with lobes 6–7 mm long, linear-triangular, acute and ascending. Ovary unilocular. Fruits drupaceous, leathery exocarp, subglobose, ca. 18 mm diam., ribs prominent when dried, glabrous, maturing bluish black, drying grayish black or grayish yellow, with persistent calyx tube and lobes, tube ca. 10 mm long and 3–4 mm diam.; seed 1 per fruit, globose, ca. 8 mm diam.

Table 1. Comparison of some characters of *Faramea zamorensis*, *F. correae*, *F. sanblasensis*, and *F. permagnifolia*.

	F. zamorensis	*F. correae*	*F. sanblasensis*	*F. permagnifolia*
Petiole (mm)	0–1	0	0 or subsessile	1–5
Leaf base	subcordate-cordate	rounded-subcordate	rounded-subcordate	rounded-truncate
Inflorescence	2 or 3 fasciculate flowers, terminal	2 or 8 fasciculate flowers, terminal	many flowers in a congested cyme, terminal	3 or 6 fasciculate flowers, terminal
Hypanthium	ribbed	terete	terete	terete
Calyx lobes	5–7 mm	truncate	truncate	truncate-denticulate
Corolla	funnel-shaped	salver-shaped	salver-shape	salver-shaped
Lobe	ascending	divergent	divergent	divergent
Fruit	ribbed	terete	terete	terete
Distribution	northern Costa Rica and southern Nicaragua	central Panama	eastern Panama	southern Costa Rica

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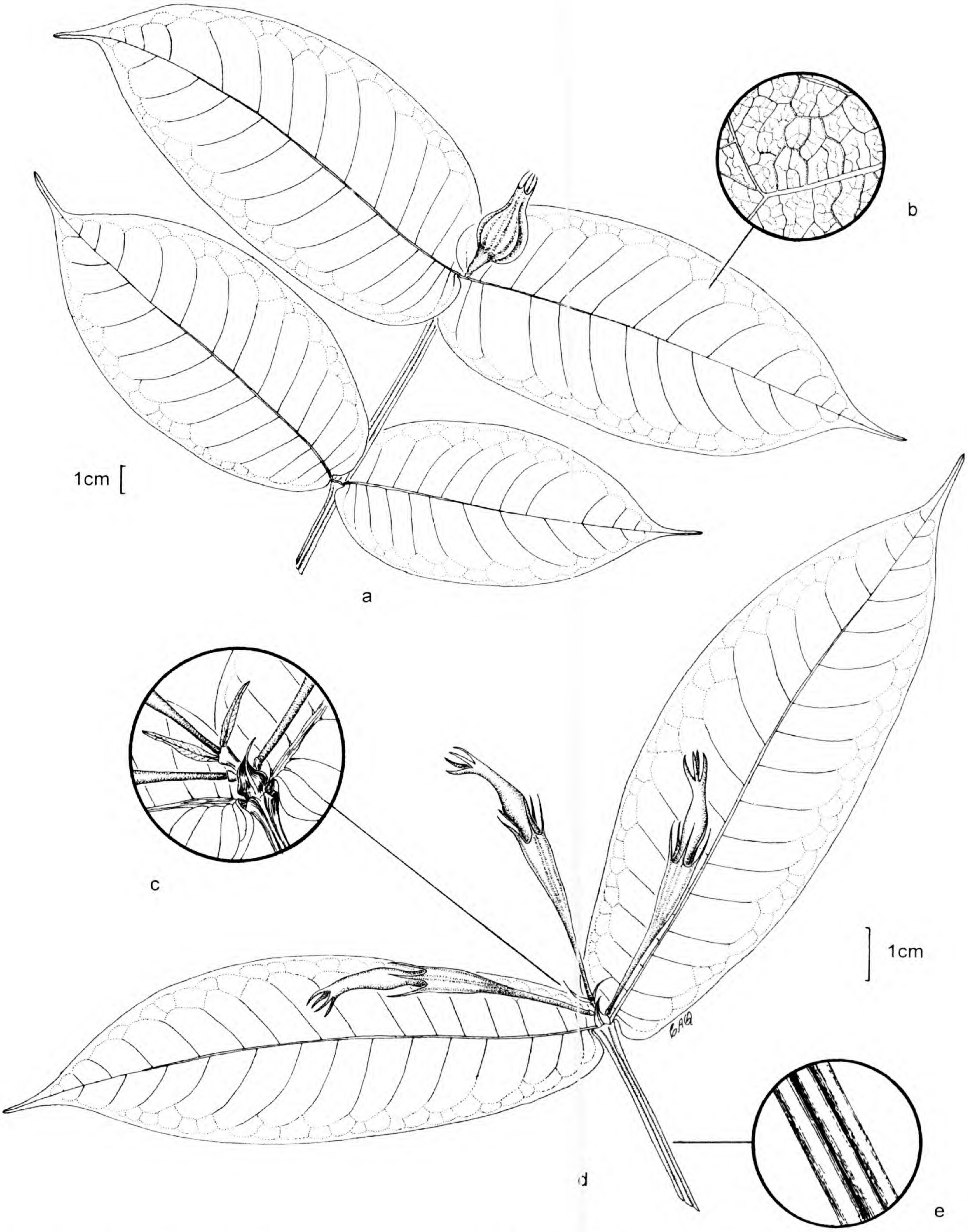

Figure 1. *Faramea zamorensis* Al. Rodríguez (*Rodríguez & Estrada 1067*). —a. Leaves and fruit. —b. Abaxial view of leaf showing tertiary venation. —c. Stipule. —d. Leaves and flowers. —e. Stem.

Phenology. Flowering in January and February; collected in fruit in both months.

Distribution. Known from wet forest in northern Costa Rica and in southern Nicaragua at 1–100 m.

Faramea zamorensis has the narrowly triangular, aristate stipules, unilocular ovary, and one-seeded fruit of most *Faramea* species. It is distinguished by its subsessile leaves, which are cordate or subcordate at the base, subsessile fasciculate flowers with a ribbed hypanthium, calyx lobes 5–7 mm long, funnel-shaped corolla, and ribbed fruit. Because of the slightly petiolate to sessile, basally cordate to subcordate leaves and congested inflorescences, this species is similar to *F. correae* C. M. Taylor, *F. sanblasensis* C. M. Taylor, and *F. permagnifolia* Dwyer ex C. M. Taylor. From all those it differs by its much longer calyx lobes, funnel-shaped rather than salverform corolla with ascending rather than divergent lobes, and the ribbed rather than terete hypanthium and fruit (see Table 1).

The specific epithet honors Nelson Zamora, a Costa Rican botanist and colleague, who also collected this species, and whose extensive work has greatly advanced the knowledge of the country's flora.

Paratype. COSTA RICA. **Alajuela:** San Carlos, Boca Tapada, Cuenca del Río San Carlos, Finca San Jorge, 50 m, 2 Jan. 1997, *Zamora 2549* (CR, INB, MO).

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Sladenia integrifolia (Sladeniaceae), a New Species from China

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ABSTRACT. A new species of *Sladenia* (Sladeniaceae) from China, *Sladenia integrifolia* Y. M. Shui, is described and illustrated. The relationship to and characters distinguishing the new species from *Sladenia celastrifolia* Kurz are discussed. The systematic position of the genus is also reviewed.

Key words: China, *Sladenia*, Sladeniaceae.

Between 15 and 26 October 1999, the authors made an expedition to the Xilongshan range of Jingping County, southeastern Yunnan, China, adjacent to southwestern Vietnam. During the expedition, the specimen *Zhou Zhe-Kun et al. EXLS-0039* (fr) was identified as *Sladenia celastrifolia* Kurz. However, further study showed that the entire margin of the leaves differed from the serrated margin of those of *Sladenia celastrifolia.* On 15 May 2001, another specimen, *Mo Ming-Zhong, Mao Rong-Hua & Yu Zhi-Yong 05* (fl), was collected, and more differences were found. As a result, a new species of *Sladenia* Kurz (Sladeniaceae) is here described.

Sladenia integrifolia Y. M. Shui, sp. nov. TYPE: China. Yunnan: Jinping Co., Zhemi community, Citongba to Liangzi, second dry evergreen forests, 1100–1300 m, 15 May 2001 (fl), *Mo Ming-Zhong, Mao Rong-Hua & Yu Zhi-Yong 05* (holotype, KUN 0735701; isotypes, MO, PE). Figure 1.

Species *Sladeniae celastrifoliae* similis, sed foliis integris, floribus lateralibus pedicellis 2.5–4 mm longis, sepalis late ovatis, 2.0 mm longis, 1.5 mm latis, filamentis base non connatis, fructibus 3 mm longis et crustaceis, costis non conspicuis, differt.

Evergreen trees, 13–15 m tall; branchlets green, terete, turgid, glabrous throughout; buds broadly ovate, glabrous. Leaves spiral, papery, glabrous, ovate or lanceolate, 5–11 cm long, 2.5–4.0 cm wide, adaxially deep green, abaxially greenish; base broadly cuneate, slightly decurrent on the petiole; margin entire, apex acuminate or caudate, with obtuse tip; midrib shallowly canaliculate on adaxial surface, raised on abaxial, lateral veins in 7 to 9 pairs, raised on both surfaces, secondary nerves sparse, slightly prominent on both surfaces; petiole 0.7–0.9 cm long, glabrous. Dichotomous cymes axillary, usually 4- or 5-forked, congested, with 14 to 17 flowers; peduncle glabrous, 0.4–0.8 cm; terminal flowers with pedicels 0.2–0.3 mm long, lateral flowers with pedicels 2.5–4.0 mm long; bracts narrowly ovate, ca. 2 mm long; bracteoles ovate, ca. 0.8 mm long, glabrous, caducous. Sepals broadly ovate, imbricate, ca. 2 mm long, 1.5 mm wide, obtuse at apex, with ciliate margin, not sprawling-reverse in fruit. Corolla white, urnshaped, glabrous, ca. 3 mm long, ca. 3 mm diam. at base, 5-fid at apex; corolla tube 0.7–0.8 mm long; lobes 5, involute, concave, oblong, 2.2–2.3 mm long, 1.5–1.7 mm wide. Stamens 8 to 10, inserted at base of corolla; filaments free, ca. 0.8 mm long, ca. 0.4 mm wide, acute at apex; anthers inflexed, ovate, ca. 0.8 mm long, apex 2-dehiscent with 2 hairs, base sagittate with 2 hairs on each side; ovary 3-locular, conoid, ca. 2 mm long, ca. 0.9 mm diam. at base, glabrous, apex continuous with style, tip 3-fid. Fruit ovoid, crustaceous, slightly striate, ca. 3 mm long, 1.0–1.1 mm diam. Seeds trigonal, winged, ca. 1.5 mm long, ca. 0.3 cm wide.

Habitat. In secondary evergreen forests, 1000–1300 m.

Phenology. Flowering March to June; fruiting July to December.

Distribution. China (SE Yunnan Province).

The flower and fruit characteristics of *Zhou Zhe-Kun et al. EXLS-0039* clearly belong to those of the genus *Sladenia*, as elaborated on by Ming (1997). However, the entire leaves show that it is not identical to *Sladenia celastrifolia.* The new species further differs from *Sladenia celastrifolia* in its glabrous twig, broadly ovate sepals, 2.5–4.0 mm long

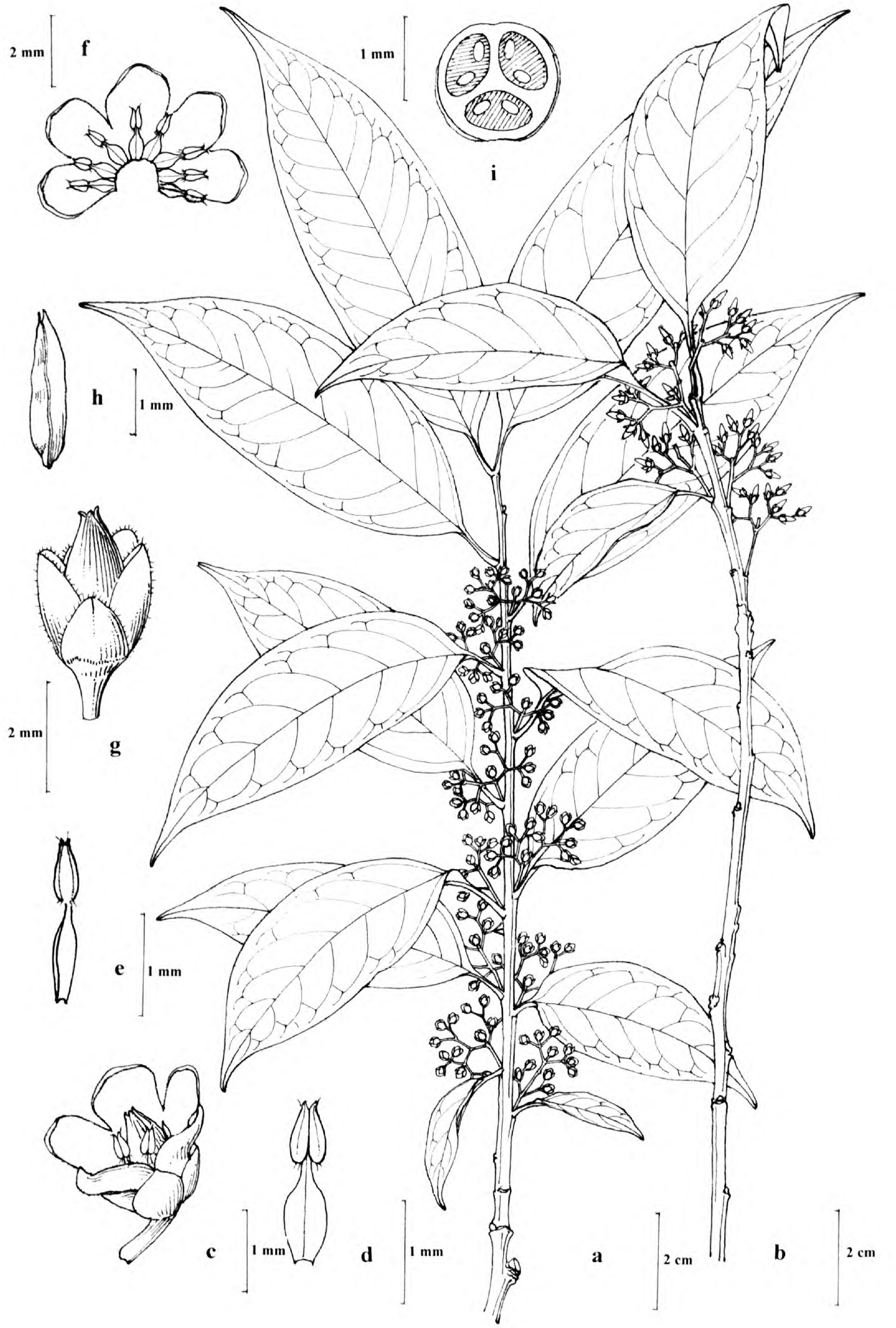
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Table 1. Differences between *Sladenia celastrifolia* and *S. integrifolia*.

Characteristics	*Sladenia integrifolia* Y. M. Shui	*Sladenia celastrifolia* Kurz
Leaf margin	entire	serrate, rarely entire
Lateral pedicel	2.5–4 mm	7–10 mm
Cymes	4- or 5-forked, congested	2- or 3-forked, spananthus
Sepal	broadly ovate; not erect in mature fruit; 2.0 mm long, 1.5 mm wide	oblong; sprawling-reverse in mature fruit; 5–6 mm long, 2–3 mm wide
Corolla	2.9–3.1 mm long, connate at base	5.3–6.4 mm long, almost distinct at base
Corolla tube	0.7–0.8 mm long, ca. ¼ as long as corolla	0.3–0.4 mm long, ca. 1/17 as long as corolla
Corolla lobe	broadly oblong; 2.2–2.3 mm long, 1.5–1.7 mm wide	oblong; 5–6 mm long, 2–3 mm wide
Filament	0.8 mm long, 0.4 mm wide, distinct at base	1.5 mm long, 1 mm wide, connate at most weakly
Stamens	8 to 10	10 to 13
Anther	ovate, 0.8 mm long	sagittate, 2 mm long
Ovary	conoid, obtuse at apex	pyramidal, acuminate at apex
Fruit	ovoid, slightly striate, crustaceous; 3 mm long, 1.0–1.1 mm diam.	bottle-shaped, ribbed, woody; 7–8 mm long, 3–4 mm diam.
Seed	1.5 mm long, 0.3 cm wide	3 mm long, 1 mm wide

lateral pedicels, and 3 mm long, slightly striate fruits (Table 1).

The formerly monotypic genus *Sladenia* is allied with Dilleniaceae (Gilg, 1893), Linaceae (Haller, 1923), Sladeniaceae (Airy Shaw, 1964), Actinidiaceae (Gilg & Werdermann, 1925; Hutchinson, 1969), and Theaceae (Kurz, 1873; Keng, 1962; Cronquist, 1981; Takhtajan, 1996; Thorne, 2000). Airy Shaw (1964) considered it to be a monotypic family, Sladeniaceae. In *Sladenia* the basic number of chromosomes (Li, 2002), the character of wood anatomy (Deng & Baas, 1990, 1991), the apical pore of the anthers (Kobuski, 1951; Keng, 1962), palynology (Wei et al., 1997), and embryology (Li et al., 2002) are all considerably different from the family Theaceae. Molecular DNA allies *Sladenia* with the East African *Ficalhoa* Hiern, the two forming the sister taxon to Ternstroemiaceae (Anderberg et al., 2002). It is thus reasonable that the group is considered to be a monotypic family. Currently, materials of testa anatomy and chemistry are poorly known. A detailed systematic study of the characteristics and relationships in light of the new species will be significant to understanding the position of the genus *Sladenia* in angiosperms.

Paratypes. CHINA. **Yunnan:** Jinping Co., Zhemi community, Citongba to Liangzi, in secondary evergreen forests, 1290 m, 17 Oct. 1999 (fr), *Zhou Zhe-Kun, Fei Yong, Shui Yu-Min, Zhang Guang-Jie & Yang Jian-Kun EXLS-0039* (KUN, MO, PE), 25 June 2001 (fl), *Hu Yun-Qan & Deng Ling 22* (KUN), 1 July 2001 (yng. fr), *Li Lu et Kong Dong-Rui 2001-7-1* (KUN, MO, PE).

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Figure 1. *Sladenia integrifolia* Y. M. Shui. —a. Habit (in flower). —b. Habit (in fruit). —c. Flower. —d. Adaxial view of stamen. —e. Lateral view of stamen. —f. Opened corolla and stamens. —g. Fruit with persistent calyx. —h. Seed. —i. Transverse section of fruit. a, c–f from the holotype (*Mo Ming-Zhong, Mao Rong-Hua & Yu Zhi-Yong 05*); b, g–i from a paratype (*Zhou Zhe-Kun, Fei Yong, Shui Yu- Min, Zhang Guang-Jie & Yang Jian-Kun EXLS-0039*). Drawn by Wu Xi-lin.

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Drosera peruensis (Droseraceae), a New Species from Peru

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ABSTRACT. During a revision of the genus *Drosera* for *Flora Neotropica*, a new species was found. *Drosera peruensis* is described as new from Peru for the neotropics and is placed in *D.* subg. *Drosera* in section *Drosera*. It is characterized by the presence of elongated stems, leaves that become patent when old, obovate-oblong blades with distinct petioles, filamentous trichomes on the abaxial leaf surface, and inflorescence with filamentous trichomes.

Key words: *Drosera*, Droseraceae, Peru.

Drosera peruensis T. Silva & M. D. Correa, sp. nov. TYPE: Peru. Pasco: Oxapampa, Cordillera Yanachaga, Cerro Pajonal, "chacos" 12 km SE of Oxapampa, 75°20′W, 20°35′S, 2700–2800 m, valley of Rio Yamaquizu, above Chacos to a microwave construction site, a footpath toward a crest behind the site toward a small lagoon, 7 Oct. 1982, *R. B. Foster 9066* (holotype, PMA; isotypes, F, MO). Figures 1, 2.

Herba 4–11.5 cm alta. Caules elongati, 2–4 cm longi. Folia rosulata, vinacea, matura pendentia, laminae oblongae, 4–7 mm longae, ad 1 mm latae. Inflorescentiae 1–2, vinaceae, 4–7 cm longae, flores 2–4; ovaria 3-carpellaria, styli 3, profunde 2-partiti; stigmata 6, clavata. Fructus capsularis, valvis 3; semina oblonga, reticulata.

Herb, 4–11.5 cm tall; stem 2–4 cm long. Leaves reddish, patent when old, 10–12 cm long, blades obovate-oblong, 4–7 × 1 mm, adaxial surface villous, glandular trichomes, abaxial surface densely villous, filamentous trichomes to 1 mm long, pale gold; petioles 6–7 × 1 mm, adaxial surface glabrous, abaxial surface villous, filamentous trichomes, 2–2.5 mm long, pale gold; stipules rectangular, membranaceous, ca. 7 mm long, laciniate, laciniae ca. 6 mm long. Inflorescences 1 or 2, red-tinged, flowers 2 or 4, 4–7 cm long, villous, with filamentous trichomes, peduncle 3.5–6 cm long, pedicel reddish. Flowers with reddish sepals, 4 × 1.5 mm, fused in lower ⅓, abaxial surface villous, with reddish filamentous trichomes to 1 mm long,

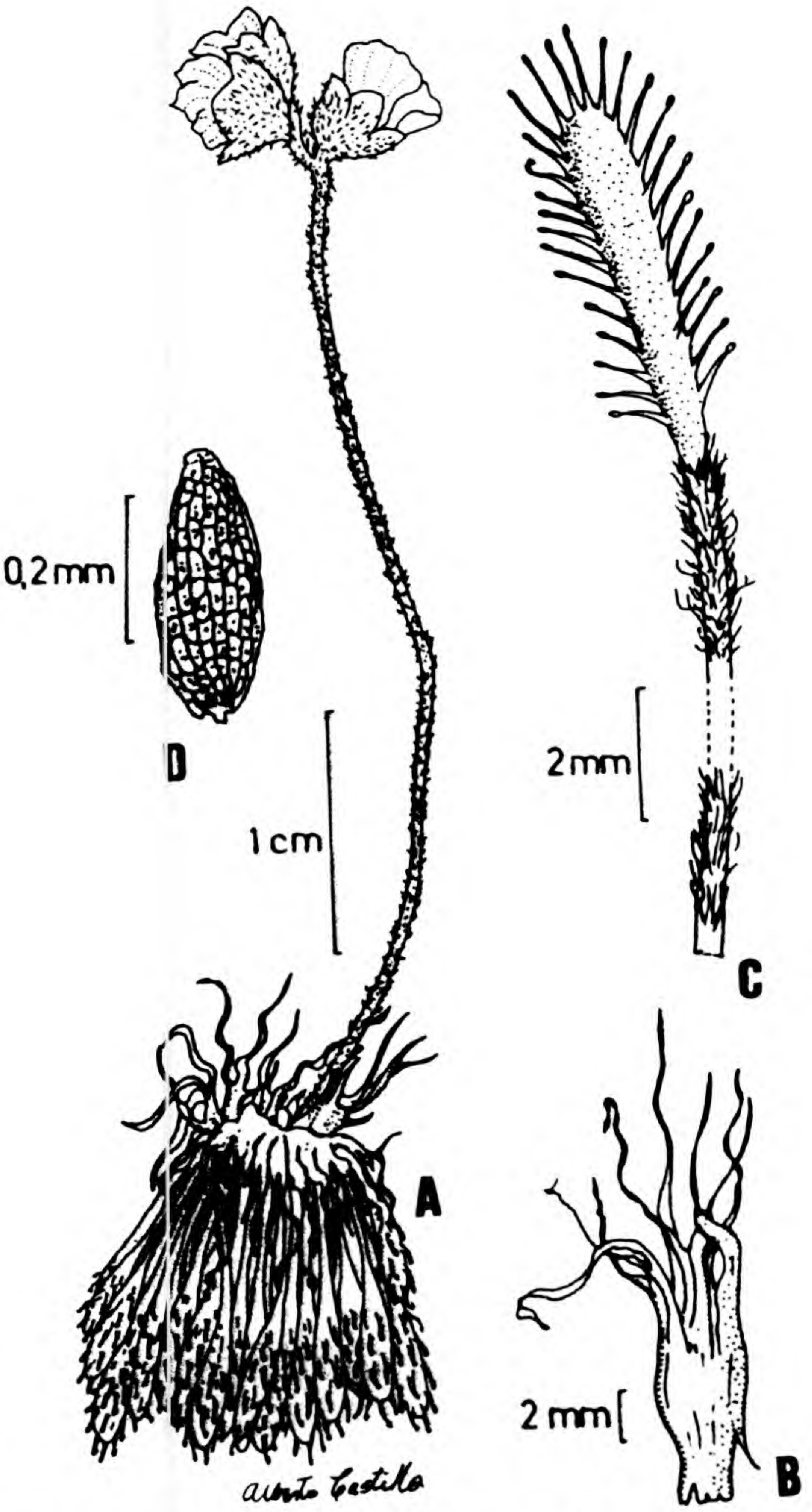

Figure 1. *Drosera peruensis* T. Silva & M. D. Correa. —A. Habit. —B. Stipule. —C. Leaf. —D. Seed. (*Foster 9066*, PMA.)

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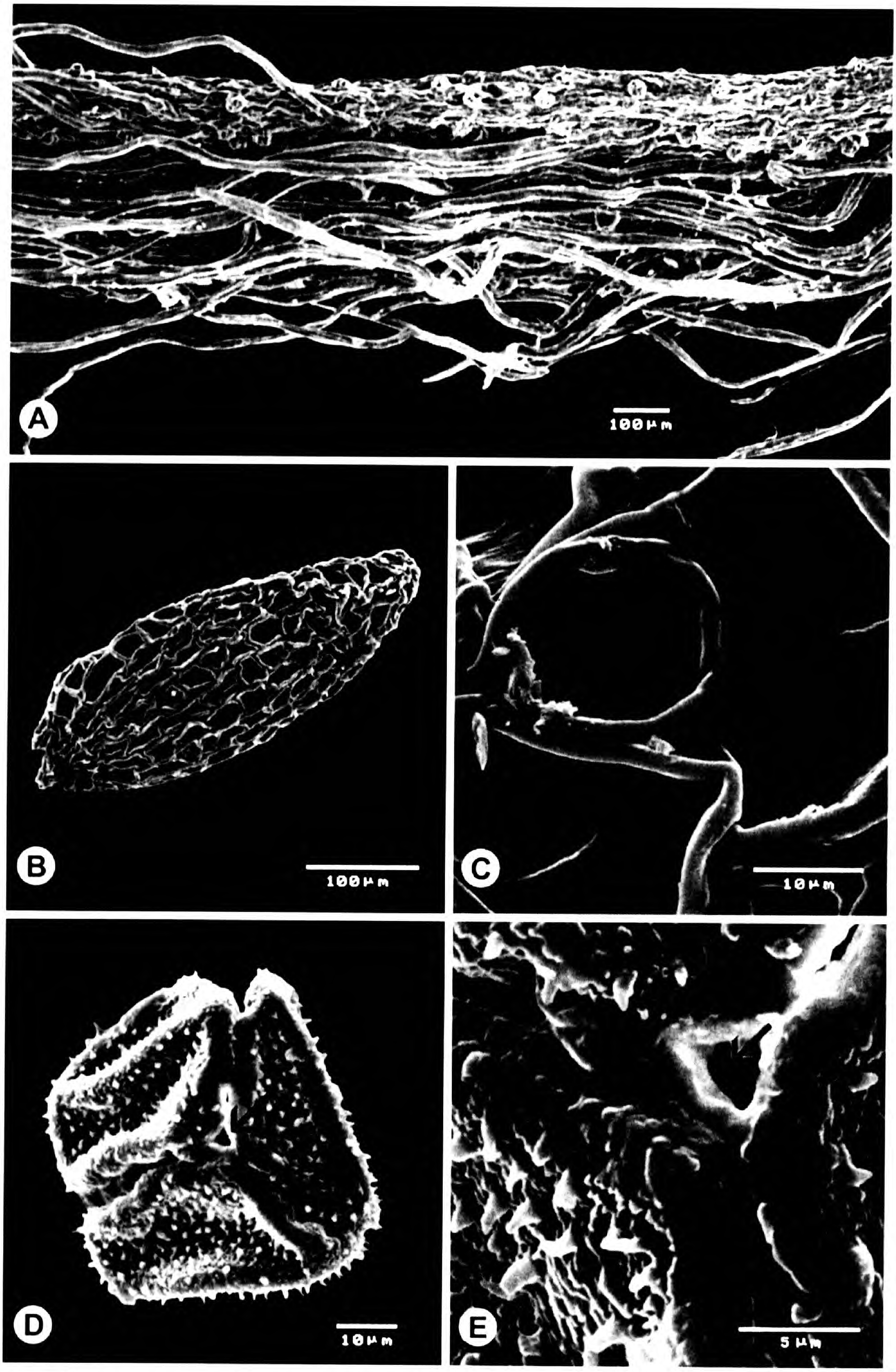

Figure 2. SEM photographs of *Drosera peruensis.* —A. Leaf, abaxial surface detail. —B Seed. —C. Seed, surface detail. —D. Pollen, proximal view. —E. Pollen, pore detail. (*Foster 9066*, PMA.)

lobes oblong; petals white or red; ovary 3-carpellate, styles 3 bipartite to the base, stigmas 6, clavate. Fruit a 3-valvate capsule; seed oblong, testa reticulate.

The genus *Drosera* L. is distributed throughout Australia, America, and Africa, with a few species in Asia and Europe. Twenty species are found in the neotropics, concentrated in northern South America (Venezuela, Guyana, Surinam, and French Guiana) and eastern Brazil. Two species are found in Peru: *D. chrysolepis* Taubert and *D. peruensis* T. Silva & M. D. Correa.

Drosera peruensis is distinguished from all other *Drosera* species by the presence of elongated stems, patent leaves when old, obovate-oblong blades with distinct petioles and densely covered by filamentous trichomes on the abaxial leaf surface, and the inflorescence with filamentous trichomes. The area where it was found was a shrubland on white sandstone, with spongy *Sphagnum* humus up to 2 m deep, except where burned. The species was colonizing a sandy wet landslide on a steep slope, forming small pillars with old leaves and stems. It is only known from the type collection.

Drosera peruensis is distinguished from *D. chrysolepis* by having leaves with oblong-obovate blades 4–7 mm long, a petiole 6–7 mm long, and rectangular stipules, whereas *D. chrysolepis* has narrowly oblong blades 1–3 mm long, a petiole 2–5 cm long, and triangular stipules. The blades of *Drosera peruensis* are similar in shape to the obovate-oblong ones in *D. arenicola* Steyermark. The new species has filamentous trichomes on the inflorescence, while *D. arenicola* has glandular trichomes.

Drosera peruensis is placed in *Drosera* subg. *Drosera* based on its subterraneous, non-tuberculate root system and in section *Drosera* because it is stipulated and has three styles divided to the base (Seine & Barthlott, 1994).

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Caobangia, a New Genus and Species of Polypodiaceae from Vietnam

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ABSTRACT. We describe and illustrate the monotypic new genus and species *Caobangia squamata* (Polypodiaceae), endemic to limestone ridges in northern Vietnam. *Caobangia* is superficially similar to the predominantly Neotropical genera *Microgramma* and *Pleopeltis*, but its affinities appear to be with *Lepidogrammitis*, comprising about eight species in China and southeastern Asia. *Caobangia* is characterized by long-creeping filiform rhizomes, clathrate rhizome scales, simple, monomorphic to subdimorphic, densely acicular-scaly blades, and a single row of sori on each side of the midrib.

Key words: *Caobangia*, Polypodiaceae, Vietnam.

Discovery of a new genus of ferns, based solely on previously undescribed species of an avowedly non-hybrid nature, is an uncommon event. Quite recently, a new genus and species (*Mankyua chejuense* B.-Y. Sun et al.) of the eusporangiate fern family Ophioglossaceae was described from Cheju Island, Korea (Sun et al., 2001), but previous to that, the last such new genera of which we are aware were the description of *Podosorus angustatus* Holttum (1966), Polypodiaceae, from the Philippines, *Cystoathyrium chinense* Ching (1966), Athyriaceae, from China, and *Nephopteris maxonii* Lellinger (1966), Pteridaceae, from Colombia.

Recent pteridophyte floras of areas within eastern Asia fail to provide clues as to the identity of our species, and one quickly comes to "blind alleys" in available keys. In the recent *Flora Malesiana* treatment for Polypodiaceae (Hovenkamp et al., 1998), our undescribed taxon will key to *Lemmaphyllum* s.l. (including *Lepidogrammitis*), in the sense that name is applied by Hovenkamp, but his description of *Lemmaphyllum* is at variance with *Caobangia* in several important respects (see discussion under the new genus below). In an effort to identify the plant we describe herein, we have consulted, without success, keys to genera and species from the following areas: Vietnam (Tardieu-Blot & Christensen, 1941; Pham-Hoàng, 1991, 1999); Thailand (Smitinand & Larsen, 1989); China (Lin, 2000); Malaysia (Holttum, 1954); Malesia (Hovenkamp et al., 1998); and Taiwan (Huang, 1994). We have also shown a specimen of the plant in question to knowledgeable colleagues in Asia (especially China and Japan), Europe, and North America, and no one has seen anything remotely resembling the plant described below. Without hesitation, therefore, we name this taxon as a new genus and species.

Caobangia A. R. Smith & X. C. Zhang, gen. nov. TYPE: *Caobangia squamata* A. R. Smith & X. C. Zhang. Figure 1.

A *Lepisoro* et *Lepidogrammitide* laminis dense squamatis, squamis fere laminis occultantibus, rubro-brunneis, plerumque 5–6 mm longis, base peltatis clathratis marginibus dentatis, apice acicularibus non-clathratis dentatis differt; a *Lemmaphyllo* s. str. sori rotundatis discretis ca. 2 mm diametro, laminis monomorphis vel subdimorphis squamis numerosis acicularibus differt.

Rhizomes long-creeping, filiform, sparingly branched, approximately terete, dorsiventral with two rows of dorsal fronds, rather sparsely set with roots, not ant-inhabited, densely scaly; scales lacking hairs at the bases (non-comose), acicular and nearly entire from peltately attached, clathrate, strongly and irregularly toothed bases. Fronds short-stipitate to nearly sessile; stipes scaly, lacking obvious articulation lines or swellings at bases; blades herbaceous to chartaceous, entire, elliptic to ovate, monomorphic to subdimorphic in size and shape, dark green-brown when dried, stellate hairs lacking, densely scaly on both sides with persistent red-brown, hairlike scales; blade scales with peltate, clathrate, laciniate-margined bases and very long, acicular, uniformly red-brown, non-clathrate,

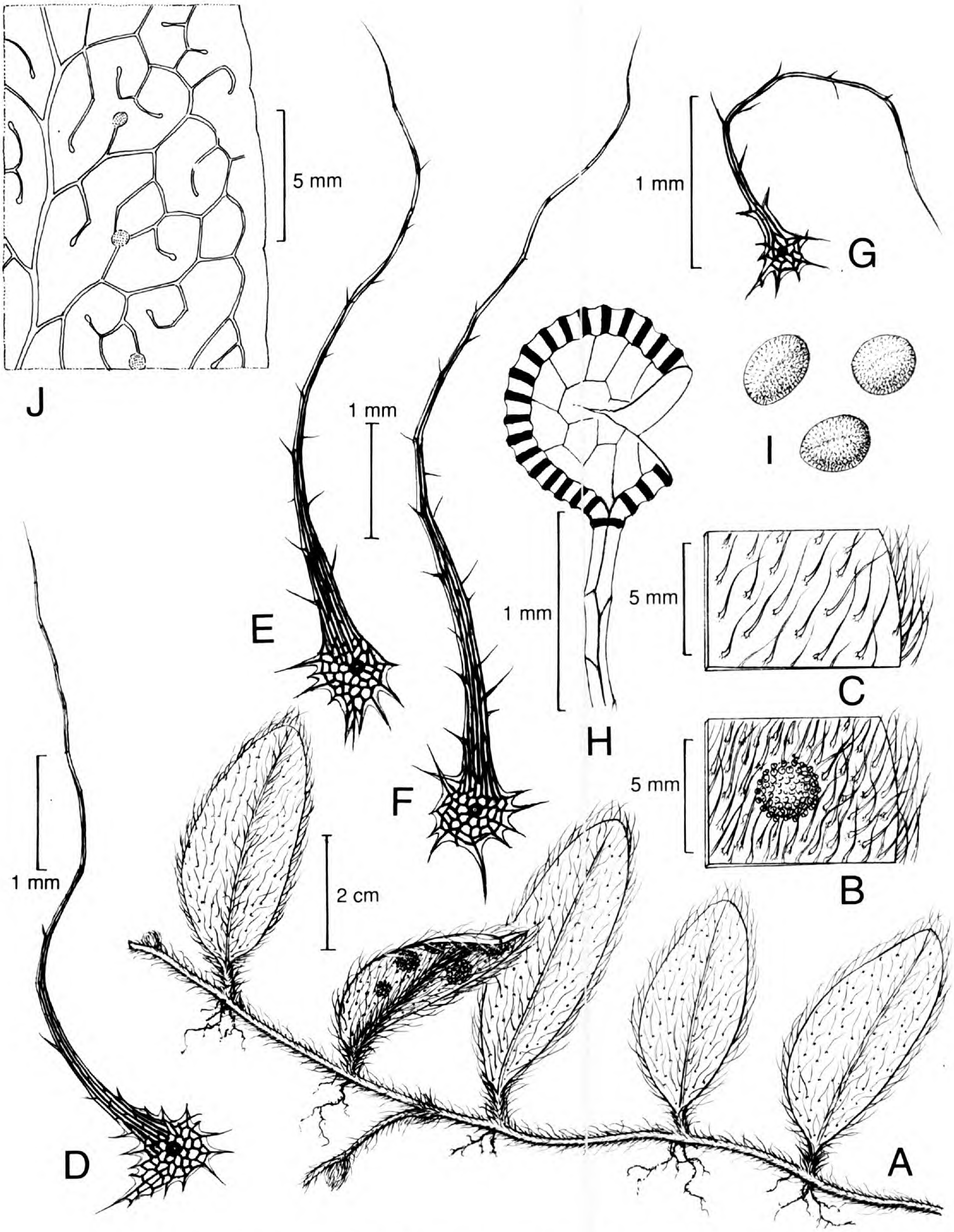

Figure 1. *Caobangia squamata* A. R. Smith & X. C. Zhang, based on *Loc et al. CBL 1698* (PE, UC). —A. Plant habit. —B. Abaxial blade surface, with sorus. —C. Adaxial blade surface. —D. Rhizome scale. —E. Scale from abaxial surface of blade. —F. Scale from adaxial surface of blade. —G. Scale near sorus. —H. Sporangium. —I. Spores. —J. Venation in a portion of fertile leaf, with scales removed; stippled areas indicate soral receptacles, with sporangia removed.

dentate to laciniate tips. Venation: midribs distinct, sclerenchymatous (darkened, but hidden by red-brown scales), main lateral veins indistinct or distinct only in the basal 1/5 or less in cleared fronds, 10–13 per side, anastomosing and forming irregular areoles (1 row of large areoles adjacent to midrib, 0–2 additional rows of smaller areoles toward margins), areoles with occasional free veinlets, these simple (unforked), almost always recurrent, immersed, not or only faintly visible adaxially, veins toward blade margins often ending freely, hydathodes lacking. Sori in single rows within the larger areoles, midway between midrib and each margin, round, not confluent, ± obscured by acicular scales. Sporangia stalked, lacking paraphyses, with 16 to 19 indurated annulus cells, mixed with acicular scales; spores monolete, whitish, papillate to rugose, fully mature spores not seen.

The name *Caobangia* is chosen to acknowledge the area where this most distinctive fern grows. It is the name of the province, as well as the name of the capital city of the province. "Cao," in Vietnamese, means high; "Bang" refers to a locality with more or less flat terrain. The province of Cao Bang is in a limestone area, carved with many often narrow valleys. The city of Cao Bang lies in the largest valley of this province, surrounded by high mountains. The Cao Bang limestone area is one of the richest areas for plant diversity in Vietnam, and many endemic or relatively restricted plants are known from the region (Averyanov, 1998; Loc et al., 1999a, 1999b; Hiep et al., 2000). Recent collections from this area from diverse families of ferns and seed plants have proven to be first records of species from Vietnam, e.g., *Cyrtomium hemionitis* H. Christ (Dryopteridaceae) (see ⟨http://mobot.mobot.org/W3T/Search/vast.html⟩), *Loxogramme grammitoides* (Baker) C. Christensen (Polypodiaceae), *Pteris actiniopteroides* C. Christensen (Pteridaceae), *Pseudotsuga brevifolia* W. C. Cheng & L. K. Fu (Pinaceae), *Campylotropis henryi* (Schindler) Schindler (Leguminosae), *Luculia yunnanensis* S. Y. Hu (Rubiaceae), *Myrsine kwangsiensis* (E. H. Walker) Pipoly & C. Chen (Myrsinaceae), *Paphiopedilum dianthum* T. Tang & F. T. Wang and *Paphiopedilum micranthum* T. Tang & F. T. Wang (Orchidaceae), and *Swertia nervosa* (Wallich ex G. Don) C. B. Clarke (Gentianaceae) (see Loc et al., 1999b, for more examples).

The habitat of *Caobangia* is on limestone ridges in closed tropical seasonal submontane conifer forest dominated by *Pseudotsuga brevifolia* W. C. Cheng & L. K. Fu mixed with *Pinus kwangtungensis* Chun ex Tsiang, sometimes with *Calocedrus macrolepis* Kurz and *Amentotaxus argotaenia* (Hance) Pilger. The common angiosperm found in the overstory is *Quercus*. In the understory (7–15 m tall) are the conifers *Nageia fleuryi* (Hickel) de Laubenfels, and *Podocarpus brevifolius* (Stapf) Foxworthy, and angiosperms *Platycarya strobilacea* Siebold & Zuccarini, *Pistacea weinmannifolia* J. Poisson ex Franchet, and species of *Acer, Carpinus, Elaeocarpus, Eriobotrya, Sorbus, Schefflera,* and *Ulmus.* Shrubs and herbs abound; among the latter are numerous species of Orchidaceae, terrestrial as well as epiphytic. Ferns and bryophytes are similarly abundant, both as lithophytes and epiphytes. The limestone ridges on which this forest community occurs are extremely eroded, composed of resistant, marble-like rock outcrops interspersed with thin soil pockets. The climate is tropical, with cool winters (5 months, from November to March, with mean monthly temperature below 17° Celsius) and summer rains. There is no dry period: all months have rainfall over 25 mm (see Van et al., 2000).

Affinities of this distinctive new genus are obscure, on initial inspection, other than being an undoubted member of the Polypodiaceae. Characteristics placing it firmly in Polypodiaceae include the long-creeping, sparingly branched, clathrate-scaly rhizomes; articulate fronds; simple blades; areolate venation with included recurrent veinlets; lack of hairs on the blades; round, dorsal, exindusiate sori; and monolete, bilateral whitish spores. Moreover, it grows on rocks, a habitat favored by many members of this family. Within Polypodiaceae, only *Platycerium* and *Pyrrosia* in the Paleotropics and subtropics bear such dense scales on the blade, and the scale type found in *Caobangia* (peltate-acicular and clathrate at the base) is strongly at variance with the stellate scales found in platycerioid genera. We suggest that *Caobangia* is probably a member of the lepisoroid clade, comprising the genera *Drymotaenium, Lepisorus, Lepidogrammitis, Lemmaphyllum,* and, more remotely, *Belvisia* (tribe Lepisoreae of Hennipman et al., 1990). From all of these, *Caobangia* differs in the densely scaly blades. Additionally, from *Lepisorus* it differs in lacking peltate scales from the receptacle. *Caobangia* is more distantly related to the microsoroid genera, which include *Microsorum, Leptochilus, Neocheiropteris, Colysis,* and *Phymatosorus* (Nooteboom, 1997, 1999), and it differs from these by the single regular row of sori between midrib and blade margin and the abundant peltate-acicular scales on the blades.

The closest living relative of *Caobangia* may be the genus *Lepidogrammitis* Ching, sometimes treated as a synonym of *Lemmaphyllum* (e.g., by Hennipman et al., 1990). *Lepidogrammitis* (Ching, 1940), which we prefer to recognize at generic rank, comprises perhaps eight species in China and southeastern Asia (Lin, 2000). It is characterized by long-creeping, filiform rhizomes, clathrate rhizome scales, fronds with simple, monomorphic to subdimorphic or dimorphic blades, and, on each fertile blade, a single row of sori on each side of the midrib. Most of the species are restricted to China. *Lepidogrammitis* differs from *Caobangia* in having the rhizome scales decidedly clathrate throughout their entire length (including tips), glabrous or nearly glabrous, subcoriaceous or fleshy blades, strongly articulate stipe bases, and presence of stalked peltate scales within the sori. The venation in at least some species of *Lepidogrammitis* (see, e.g., Lin, 2000, fig. 19.8, *Lepidogrammitis drymoglossoides* (Baker) Ching) is similar to that of *Caobangia* (Fig. 1J) except that in *Caobangia* there is a less continuous intramarginal union of the vein tips around the periphery of the blade, and veins of *Caobangia* often end freely near the margin.

If one compares *Lemmaphyllum* sensu Hovenkamp (in Hovenkamp et al., 1998) with *Caobangia*, one notes the following differences: rhizome scales peltately attached at the base (never basifixed, as described for some *Lemmaphyllum*), scales also acicular and essentially entire beyond the base (vs. dentate to lacerate in *Lemmaphyllum*); blades herbaceous to chartaceous, densely scaly on both surfaces (vs. more or less succulent and glabrous or essentially so in *Lemmaphyllum*); veins forming one large and an incomplete smaller second row of areoles between midrib and margin (vs. 2 or 3 rows of areoles in *Lemmaphyllum*; see, e.g., fig. 19.2 in Lin, 2000); and sori round (vs. round to elliptic to longitudinally coenosoriate in *Lemmaphyllum*), sori lacking round-peltate paraphyses (vs. paraphyses round-peltate in *Lemmaphyllum*). Fronds of *Lemmaphyllum* s. str. (2 or 3 species) are often strongly dimorphic, and the sori appear linear and subacrostichoid (confluent) at maturity. *Lemmaphyllum carnosum* (Hooker) C. Presl bears a few scattered scales on the lamina abaxially (e.g., *van der Werff et al. 14216*, UC, from Vietnam), but these are round-peltate to ovate, much less strikingly acicular than those in *Caobangia*, only about 1 mm long, and strongly clathrate throughout. *Lemmaphyllum accedens* (Blume) Donk, sometimes placed in the segregate genus *Weatherbya*, is widespread in Malesia to Polynesia and is yet more distantly related. Both *Lemmaphyllum* s. str. and *Lepidogrammitis* are relatively common epiphytes in low-elevation forests in southern China and southeast Asia.

There is no close relationship that we see to any known genus of New World Polypodiaceae. From *Pleopeltis*, perhaps the most superficially similar genus, *Caobangia* differs in having acicular scales from a peltate base on all parts of the blades (instead of round-peltate scales). The rhizome scales of *Caobangia* are non-comose and uniformly colored, contrasting with the comose, bicolored scales found in many species of *Pleopeltis*. *Microgramma*, also with simple blades, has non-clathrate rhizome scales lacking acicular tips; it is more remotely related, although still somewhat superficially similar. Unpublished molecular work by Haufler et al. place *Pleopeltis* and *Microgramma* solidly within a large clade of Neotropical Polypodiaceae, and separate from nearly all Old World genera of Polypodiaceae, which form their own large clade (Schneider et al., ms. in prep.).

Caobangia squamata A. R. Smith & X. C. Zhang, sp. nov. TYPE: Vietnam. Cao Bang: Ha Lang, Thang Loi, vicinity of Lung Sam village, 22°45′N, 106°42′E, 550–600 m, 24 Apr. 1999, *P. K. Loc, P. H. Hoang & L. Averyanov CBL 1698* (holotype, HN not seen; isotypes, LE not seen, KUN not seen, MO 5291090 not seen, PE, UC). Figure 1.

A *Lepidogrammitide rostrata* (Beddome) Ching laminis dense squamatis, squamis fere laminis occultantibus, rubro-brunneis, plerumque 5–6 mm longis, base peltatis clathratis, marginibus dentatis vel laciniatis, apice acicularibus dentatis non-clathratis differt.

Rhizomes ca. 1 mm diam., 2–4 cm between stipe bases, densely covered with numerous ascending and outwardly curved, overlapping scales; scales dark red-brown, ca. 5 mm long, peltate bases ca. 0. 4–1.2 mm wide (including teeth), also with a few short teeth to 0.2 mm long in proximal third of the long acicular scale tips, distal portion of scales uniseriate for 1–2 mm. Fronds to 7.5 × 1.8 cm; stipes mostly 1–10 mm long, with scales similar to those of blades; sterile blades ovate to broadly elliptic or short-oblong, often shorter and more rounded than the fertile at their bases but equaling the fertile in width (transitional shapes appear to occur), mostly ca. half the length of the fertile fronds or less, rounded at tips, densely covered (but some laminar tissue visible between overlapping scales) on both sides with persistent scales mostly 5–6 mm long, scales acicular from peltate, clathrate, dentate-margined or laciniate bases, the acicular tips uniformly red-brown and non-clathrate, bearing up to ca. 10 teeth per side, teeth up to 0.3 mm long, scales curved and ascending or spreading, extending up to 5 mm beyond blade margins. Sori up to ca. 9 on each side of midrib, up to 2 mm diam., difficult to see because of the dense overlayer of scales.

Plants rare, epipetric on vertical shaded limestone cliffs of northern exposure, in secondary wet evergreen broadleaved forest with remnants of primary elements on steep slopes and bluffs of karst remnant limestone ridge. The type was distributed under the name *Lepisorus*, and is the only known collection.

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A New Species of *Gonolobus* (Apocynaceae, Asclepiadoideae) from Mesoamerica

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ABSTRACT. *Gonolobus taylorianus*, a Mesoamerican endemic, is described and illustrated.

Key words: Apocynaceae, Asclepiadoideae, *Gonolobus*, Mesoamerica.

The genus *Gonolobus* Michaux has about 150 species ranging from temperate North America to temperate South America. The greatest diversity is found in southern Mexico and northern Central America. The genus is most clearly distinguished from the other genera of the Gonolobinae by an extra anther appendage that is always found on the distal dorsal edge of the anther and is usually fleshy, of a contrasting color, and more or less patent. Additionally, the corona is always a simple, entire or 5-lobed, fleshy ring at the junction of the corolla and the gynostegium, there is frequently a well-developed corolline annulus, the corolla lobes are frequently strongly overlapping and twisted in bud, the indumentum is usually comprised of hairs of one length, and the follicles usually have five complete wings.

This new species came to light in the process of preparing floristic accounts for *Flora de Nicaragua* and *Flora Mesoamericana*, and is here described.

Gonolobus taylorianus W. D. Stevens & Montiel, sp. nov. TYPE: Nicaragua. Matagalpa: along road from Muy Muy to Esquipulas, ca. 19 km W of Esquipulas, 12°42′N, 85°45′W, elev. 400 m, 30 July 1978, *W. D. Stevens 9563* (holotype, MO). Figure 1.

Gonolobus taylorianus W. D. Stevens & Montiel; ex affinitate *G. nigri* et specierum affinium floribus majoribus et indumento annuli limbique eodem distinguendus.

Vine, twining (to right), woody below, corky bark absent; latex white, roots fibrous; young stems pubescent at nodes and in 2 lines on internodes, indumentum mixed, long hairs multicellular, pale yellow, reflexed, 0.15–0.4 mm long, short hairs multicellular, capitate-glandular, pale brown, erect, 0.05–0.1 mm long; internodes 2–16 cm long. Leaves opposite, without pseudostipules, blades ovate to elliptic, 5.9–12.5 × 2.2–7.1 cm, apex acuminate to attenuate, base lobate, lobes divergent to convergent, sinus 0.3–1.7 cm deep, glabrous or with scattered long (0.3–0.7 mm) and/or glandular hairs, lateral veins pinnate, 4 to 6 pairs, middle veins 35–45° to midrib, colleters 2 or 4; petiole 2.2–7 cm long, glabrous or with mixed indumentum on adaxial side. Inflorescence extra-axillary, 1 per node, congested-racemiform, 4- to 18-flowered, with indumentum of stem or rarely glabrous, sessile or peduncle 1–6(–13) mm long, axis 1–10 mm long, pedicel 4–11 mm long, bracts 0.6–2.6 × 0.1–0.5 mm, linear; calyx tube 0.5–1.2 mm long, with 1 to 2 colleters per sinus, lobes lanceolate to deltate, with acute tips, reflexed, 2.3–6.2 × 1.3–2 mm, green, glabrous or with a few long hairs on margin and base of abaxial side; corolla rotate, aestivation imbricate and dextrorse, brown, green, or purple, tube 1.7–2.7 mm long, glabrous or with mixed indumentum outside, long hairs to 0.1 mm long, inside densely pubescent with glassy, erect or curly, unicellular hairs 0.1–0.3 mm long, faucal annulus tubular, 5-lobed, 0.5–1.1 mm tall at lobes, 0.3–0.6 mm tall between lobes, outside with same indumentum as adjacent corolla tube, corolla lobes deltate to lanceolate with acute tips, with conspicuous to inconspicuous auricles at base, 6.6–11.7 × 3.2–4.7 mm, reflexed, glabrous or with mixed indumentum outside, inside glabrous to densely pubescent with glassy, erect or curly, unicellular hairs 0.1–0.3 mm long; gynostegium with stipe 0.3–0.6 × 0.7–1 mm, 5-ribbed, corona ± hidden by faucal annulus, a 5-lobed disk, adnate to corolla and gynostegium stipe, 0.3–0.6 mm thick, 0.6–1.2 mm wide between lobes, 0.9–1.5 mm wide at lobes, yellow, anther appendages deflexed to nearly patent, spathulate, 0.8–1.3 mm long, 0.9–1.3 mm wide at tip, fleshy, smooth to papillate, orange, terminal appendages tightly appressed to margin of style apex, 0.2–0.5 × 1.7–2.1 mm, green, guide rails straight, parallel, 0.6–1.2 × 0.1–0.3 mm; corpusculum 0.2–0.28 × 0.07–0.13 mm, sagittate, pale brown to black, translators 0.25–0.33 × 0.1–0.18 mm, broadly winged, pollinia 0.8–1.03 × 0.37–0.53 mm, obovate to pyriform, somewhat asymmetrical, exca-

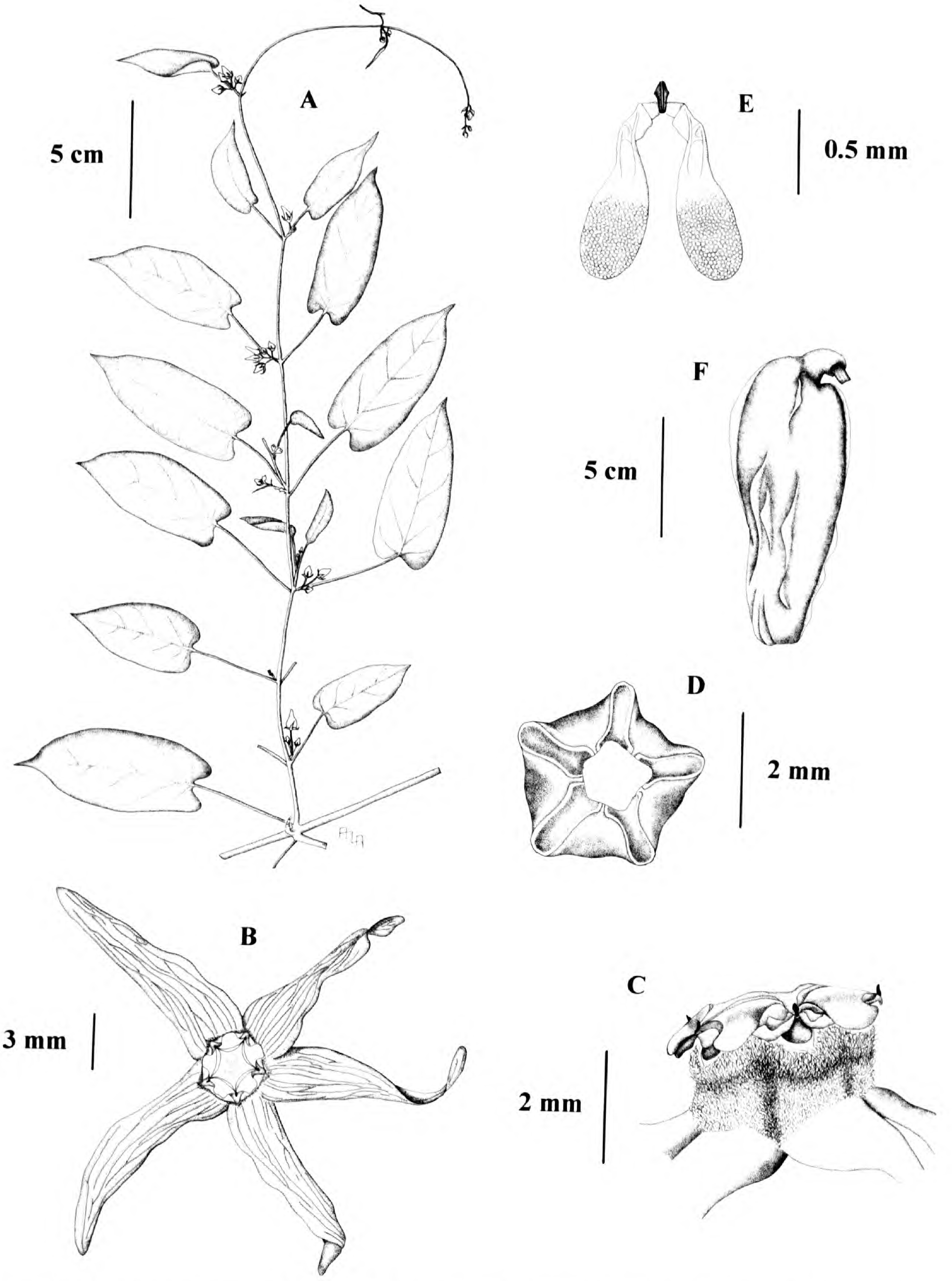

Figure 1. *Gonolobus taylorianus* W. D. Stevens & Montiel. —A. Flowering branch (*Saunders 872*). —B. Flower (*Stevens 9563*, type). —C. Flower, lateral view (*Stevens 9563*). —D. Corona, gynostegium removed (*Stevens 9563*). —E. Pollinarium (*Croat 42280*). —F. Follicle (*Moreno 15945*).

vated, sterile and translucid at attachment; style apex 2.4–3.4 mm wide, star-shaped, shallowly concave, smooth, red-brown. Follicles single, fusiform with narrow asymmetric base, 11–19 × 4.5–7 cm, glabrous, spongy, mottled white and pale green, smooth or irregularly winged (4 complete wings + 1 incomplete distal wing, 2 complete + 2 incomplete wings, or 1 to several incomplete wings), wings 2–8 mm wide; seeds obovate, 7–9.3 × 3.7–5.5 mm, flat, dark gray to gray-brown, verrucose-reticulate, margin 0.5–1 mm wide, irregularly crenulate on distal ¾–½, coma 2.5–5 cm long, white.

This species has most often been annotated as *Gonolobus salvinii* Hemsley, but also as *G. niger* (Cavanilles) R. Brown ex Schultes, *G. edulis* Hemsley, *G. fraternus* Schlechtendahl, *G. stenanthus* (Standley) Woodson, *G. roeanus* L. O. Williams, as well as a few generic misidentifications. One collection, *Standley 26259*, was even annotated as the type of a new species of *Gonolobus*, but the name was never published. The new species was described in the *Flora of Guatemala* (Standley & Williams, 1969) under the name *Gonolobus salvinii*, but examination of the type of that name reveals that it corresponds to a rare Guatemalan endemic, quite a different species that is described in that same publication under the name *G. longipetiolatus* Woodson. *Gonolobus longipetiolatus* will be considered a synonym of *G. salvinii*, while the more common and widespread species is here described. The new species *Gonolobus taylorianus* was treated as "*Gonolobus* sp. D" in *Flora de Nicaragua* (Stevens et al., 2001).

Gonolobus taylorianus is related to *G. niger*, but that species has long peduncles, much smaller flowers, purple-black corollas, a low faucal annulus that is, along with the rest of the corolla, completely glabrous, and larger follicles that are completely smooth or have only a few small fragments of wings, appearing to be prickles on the distal part of the follicle; *G. niger* ranges from northwestern Mexico to Guatemala. *Gonolobus roeanus* is also related and has brown corollas, but has smaller flowers and a low annulus that has only a terminal fringe of hairs, while the rest of the annulus and adaxial corolla surface is glabrous; *G. roeanus* seems to be known only from the flowering type collection from Guatemala. This small group of *Gonolobus*, which includes other undescribed species, is unusual in having a mixed indumentum and follicles that are not uniformly 5-winged. These characters suggest a relationship with *Matelea*, but the dorsal anther appendages are well developed and there is no doubt that the group is best accommodated within *Gonolobus*.

This new species is variable in a number of characters, especially corolla color (green, brown, or purple), flower size, although always much larger than the related species, distribution of the indumentum on the corolla (tending to be restricted to the annulus and limb on southern collections, but extending onto the lobes on the northern collections), the fruit wings (from smooth to various combinations of complete and incomplete wings), and in ecological requirements (moist, wet, or cloud forests between near sea level and 1300 m). *Gonolobus taylorianus* flowers mostly from July to September, and fruits mature from January to March. The unusual morphological variability is perhaps related to the fact that the species is often cultivated for its fruits. The developing fruits are eaten as a vegetable, raw when young, cooked when more mature, or boiled with sugar at any stage, and are available in markets in Guatemala and El Salvador during the fruiting season (Standley & Williams, 1969). "Cuchamper" is the most common local name for the species, and "Siguamper," "Chinchayote," and "Polla" are also recorded from herbarium labels. It seems to be primarily cultivated as a dooryard plant, but long cultivation and selection over a relatively broad geographic range could be accentuating the apparent variability of the species.

This species is named in honor of Jack Crawford Taylor (14 April 1922–), influential patron of the arts and sciences. It is most fitting that this new species, at once beautiful and useful, is named for a man whose dedication to preserving and understanding our environment is manifest.

Paratypes. GUATEMALA. **Jalapa:** along Hwy. 19 about 6.3 mi. SE of Jalapa, 16 July 1971, *Stevens 1247* (MO). **Guatemala:** camino a Humitos, Km 34 Amatitlán, 31 Aug. 1997, *MacVean & MacVean 7096* (MO, UVAL). **Santa Rosa:** Cerro Gordo, Sep. 1892, *Heyde & Lux ex Smith 4007* (MO). HONDURAS. **Colón:** base of Cerro Piedra Blanca, along Bonito Oriental–Limón road, ca. 5 km NE of Bonito Oriental, ca. 50 m SW of Río Piedra Blanca, 5 Feb. 1993, *Evans 1079* (MO); old road to Castilla, E of airport to Jericho, 12 Jan. 1981, *Saunders 872* (MO, NY). **Francisco Morazán:** Villa San Roque, 1 Aug. 1950, *Standley 26259* (MO); Sabana Grande, 9 Sep. 1945, *Valerio 3285* (MO); Quebrada La Orejona, NE de la UNAH, 17 Aug. 1978, *Zelaya 84* (MO). **Olancho:** márgenes del Río Talgua, 6 km SE de Catacamas, 16 Mar. 1987, *Ortega 203* (MO). EL SALVADOR. **La Libertad:** San Salvador, Jardín Botánico La Laguna, 3 Sep. 1984, *Berendsohn & Berendsohn 197* (MO); San Salvador, Jardín Botánico La Laguna, 20 Sep. 1988, *Villacorta 181* (MO); San Salvador, Jardín Botánico La Laguna, 25 July 1989, *Villacorta 343* (LAGU, MO); Mun. Antiguo Cuscutlán, laderas de La Laguna, casa W de vigilante, 28 Sep. 1989, *Villacorta et al. 458* (B, LAGU, MO). **La Paz:** Hacienda

Santa María, Canton La Lucha, Tecoluca, 13 Oct. 1988, *Berendsohn & R. Calderón 1187* (MO). **Santa Ana:** Santa Ana, 1928, *S. Calderón 2409* (MO); Santa Ana, 7 mi. NE of Metapán on road to Cerro Monte Cristo, 30 July 1977, *Croat 42280* (MO). **San Salvador:** San Bartolo, Ilopango, 12 Aug. 1973, *Flores 520* (MO). **Sonsonate:** Cantón La Calera, nacimiento del Río Grande de Sonsonate, 21 July 1989, *Villacorta et al. 324* (LAGU, MO). NICARAGUA. **Boaco:** summit and upper NW slope of Cerro Mombachito, 18 Jan. 1981, *Stevens 18969* (MO). **Chontales:** 2.8 km N of Cuapa, 21 Jan. 1978, *Stevens 6149* (MO). **Estelí:** Salto de Estanzuela, 13 Aug. 1976, *Hall 7687* (MO); 1 km al S de Santa Cruz, camino a Cuajiniquil, 6 Mar. 1982, *Moreno 15712* (MO); Hacienda Varela, 17 km de Estelí camino a El Sauce, 17 Sep. 1982, *Moreno 17411* (MO). **Granada:** NE del Volcán Mombacho, empalme de los caminos a Santa Isabel y a Cutirre, 16 Sep. 1980, *Moreno 2642* (MO); NE del Volcán Mombacho, Hacienda Las Delicias, 8–9 km sobre la carretera a Cutirre, 16 Sep. 1980, *Moreno 2693* (MO); Volcán Mombacho, empalme de los caminos a Las Delicias y a La Calera, 16 Sep. 1980, *Moreno 2700* (MO); Volcán Mombacho, La Esmeralda, 19 Mar. 1982, *Moreno 15945* (MO). **Madriz:** Cerro Volcán Somoto (Tepesomoto), lado Oeste, Finca San Martín, 25 Sep. 1980, *Moreno 2963* (MO). **Matagalpa:** Quebrada Malacal, Hacienda La Bonanza, 20 km de Matagalpa, 21 Jan. 1982, *Castro 2403A* (MO); along Hwy. 5, 24.6 km from Hwy. 3 intersection, 8.6 km SW of Río Tuma bridge, 26 Jan. 1982, *Stevens & Montiel 21438* (MO). **Rivas:** Isla Ometepe, Volcán Concepción, Los Hatillos, camino a Las Delicias, 9 Aug. 1984, *Robleto 990* (MO). **Zelaya:** between Cerro Saslaya and San José del Hormiguero, 13 Mar. 1978, *Stevens 7068* (MO); vicinity of Wani, Río Uli, 15 Mar. 1978, *Stevens 7271* (MO). COSTA RICA. **Guanacaste:** Santa Rosa National Park, 6 Jan. 1980, *Janzen 11873* (MO). **Puntarenas:** Curú, 2 Sep. 1995, *Sanders et al. 17751* (MO, UCR).

Acknowledgments. Michael Gilbert kindly loaned his expertise in the Asclepiadaceae in examining the type of *Gonolobus salvinii.* Alba Arbeláez prepared the drawing of this complicated species with her usual skills. Victoria Hollowell and Amy Pool suggested key improvements in the language.

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Rubiacearum Americanarum Magna Hama Pars IX. New Species and a New Combination in *Hippotis* and *Pentagonia* (Hippotideae) from Central and Western South America

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ABSTRACT. The following new species are described: *Hippotis stellata* C. M. Taylor & Rova, found from eastern Panama to northwestern Ecuador and distinguished by its closely grouped or possibly stellate trichomes; *Pentagonia angustifolia* C. M. Taylor, found in western Panama and formerly confused with *P. nuciformis* Dwyer; *P. dwyeriana* C. M. Taylor, found in western Panama and formerly confused with *P. macrophylla* Bentham; *Pentagonia monocaulis* C. M. Taylor, found in eastern Costa Rica and formerly confused with *P. donnell-smithii* (Standley) Standley; and *Pentagonia sanblasensis* C. M. Taylor, found in central Panama and also formerly confused with *P. macrophylla*. The new combination *H. panamensis* (Dwyer) C. M. Taylor is based on *Duroia panamensis* Dwyer, and a description is presented for this poorly known species, which is actually the most commonly collected species of *Hippotis* in Central America and adjacent northwestern Colombia.

Key words: Hippotideae, *Hippotis*, neotropics, *Pentagonia*, Rubiaceae.

The Neotropical genus *Hippotis* Ruiz & Pavón (Hippotideae; Robbrecht, 1993; Rova & Andersson, 1995) comprises about 11 species of shrubs and small trees found in wet lowland forests from Nicaragua to Bolivia. This genus is distinguished in the Rubiaceae by the combination of its lack of raphides; its interpetiolar stipules that are convolute or induplicate-valvate with the resulting structure often twisted again; its leaves with the higher order venation striolate or lineolate (i.e., very closely set and parallel within the areoles; Rova & Andersson, 1995); its axillary, usually solitary flowers; its well-developed calyx limbs that are spathaceous (i.e., completely fused in bud forming a closed structure that is split along one side or sometimes irregularly by the elongating corolla); its funnelform corollas with five valvate or reduplicate-valvate lobes; its baccate fleshy fruits with the large calyx limb usually persistent; and its seeds that are angled, generally smooth, and numerous on placentas that are axile at the base and parietal above (Rova & Andersson, 1995). The corollas are often rather zygomorphic with the tube broadly curved. *Hippotis* was last studied as a whole by Steyermark (1965); this work is now somewhat dated.

The Neotropical genus *Pentagonia* Bentham (Hippotideae; Robbrecht, 1993; Rova & Andersson, 1995) comprises about 25 to 30 species of shrubs and small trees found in wet lowland to premontane forests from Guatemala to Peru, in both primary and secondary vegetation. This genus is distinguished in the Rubiaceae by the combination of its fleshy, relatively large vegetative and reproductive structures; its lack of raphides; its interpetiolar convolute stipules; its leaves with the abaxial and often also the adaxial surfaces finely striate (described and illustrated in detail by Rova & Andersson, 1995); its axillary, cymose to subcapitate or glomerulate, sessile to usually shortly pedunculate inflorescences; its calyx limb that is usually five-lobed with the lobes often well developed and imbricated in bud, or alternatively this limb is sometimes spathaceous; its corollas with well-developed tubes and five valvate lobes; its five included stamens with the filaments pubescent on their bases its baccate, coriaceous to rather woody, usually lenticellate, generally subglobose fruits; and its seeds that are angled, smooth on the sides, and numerous on fleshy placentas that are axile at the base and parietal above (Rova & Andersson, 1995). Plants of *Pentagonia* usually contain generous amounts of mucilaginous latex or sap, which is visible in dried specimens as elastic filaments that stretch between broken edges of most tissues. The flowers are often slightly zygomorphic in their broadly curved tubes and the arrangement of their lobes and anthers, with the anthers usually grouped on the lower side of the flower and imbricated end-to-end because of the twisting and thus relative shortening of the filaments from the upper side of the flower.

Several morphological structures found in some species of *Pentagonia* are unusual in the Rubiaceae. The most striking of these is pinnatifid leaf shape (e.g., *P. tinajita* Seemann, *P. lobata* C. M. Taylor). Pinnatifid leaves may be lobed shallowly (e.g., some plants of *P. tinajita*) to essentially completely, with the blade tissue between the lobes sometimes reduced to a ridge of tissue along the costa (e.g., some plants of *P. alba* Dwyer and *P. pinnatifida* Seemann). Pinnatifid leaves are infrequent in the Rubiaceae, and are otherwise known in the neotropics only in occasional plants of some species of *Simira*. Pinnatifid *Pentagonia* species are most numerous in Panama and Costa Rica. Some species of *Pentagonia* have a "trash bucket" habit, with sessile or subsessile leaves that are rounded to auriculate at the base. These leaf bases form a cup or platform around the stem where leaf litter accumulates (e.g., *P. wendlandii* Hooker f.). Occasional herbarium specimens have small adventitious roots arising from the stems just above the nodes; these probably grew into the decaying accumulated litter. A number of species of *Pentagonia* are striking also in their unbranched or monocaulous habit (e.g., *P. macrophylla* Bentham). These plants may be as much as 3.5 m tall, and this monocaulous habit is loosely correlated with leaves that are relatively large. The leaves of these monocaulous species may be as much as 1.2 m long (e.g., *P. magnifica* K. Krause, *P. gigantifolia* Ducke). This aspect of the habit is here considered a generally consistent character for species of *Pentagonia*; some taxonomists have considered it variable within a species. Species of *Pentagonia* also show a notable variability in the development of their inflorescence bracts: in general, these are either relatively reduced to absent (to 1 mm long; e.g., *P. parvifolia* Steyermark), or quite well developed (5–30 mm long, e.g., *P. macrophylla, P. wendlandii*). Degree of development of the inflorescence bracts is also here considered a generally consistent character within species of *Pentagonia*.

Standley (1914b) presented a taxonomic history of this genus and noted that the name *Pentagonia* Bentham which was applied to these plants was illegitimate because it had been used twice previously, and that *Watsonamra* Kuntze was the first valid and legitimate name for them. At the same time Standley (1914a) published the genus name *Nothophlebia* Standley for a Costa Rican species that he distinguished from *Watsonamra* by its campanulate, only shallowly lobed calyx limb. Subsequently, the name *Pentagonia* Bentham was conserved for this group, and *Nothophlebia* was reduced to synonymy of *Pentagonia* (Burger & Taylor, 1993) as the relatively wide variation in this group's calyx morphology became evident. *Pentagonia* has not been studied as a whole since Standley's (1914b) article and is relatively poorly known. The large fleshy plants are difficult to prepare as good herbarium specimens. Most species of *Pentagonia* are locally uncommon in Central America and Colombia (pers. obs.; cf. Ernst, 1989). Little is known about population-level morphological variation, though study of this would be useful for the characters considered taxonomically informative (e.g., pubescence, corolla, and fruit sizes). Freeman and Stiles (1990), Stiles and Freeman (1993), and Janzen (1971) noted that *Pentagonia* flowers produce significant nectar, and in a lowland forest in Costa Rica are visited by hermit hummingbirds, large bees, and lepidopterans. The floral biology of *Pentagonia macrophylla* was studied by McDade (1986), who found the flowers to be protandrous, sequentially unisexual in function, and strongly synchronized among the plants of a single population.

The new species of *Hippotis* and *Pentagonia* described below were discovered during preparation of the Rubiaceae treatment for the *Flora Mesoamericana*.

New Species and a New Combination

Hippotis panamensis (Dwyer) C. M. Taylor, comb. nov. Basionym: *Duroia panamensis* Dwyer, Ann. Missouri Bot. Gard. 55: 138. 1968. TYPE: Panama. Bocas del Toro: Duwebdulup Peak, N of R. Terebé across from W. Huron (behind chief's house), 300–900 m, 13 Apr. 1968, *J. H. Kirkbride, Jr. & J. A. Duke 571* (holotype, MO-1968346; isotypes, MO-1968345, PMA).

Trees or treelets to 17 m tall; stems pilose to hirsute. *Leaves* elliptic to usually obovate, 12–35 × 5.5–18 cm, at apex acuminate, at base cuneate to subtruncate, drying papyraceous to chartaceous, on both surfaces pilose to hirsute; secondary veins 7 to 10 pairs, not looping to interconnect, without domatia; petioles 1–3.5 cm long; stipules elliptic to lanceolate, 1.5–3 cm long, obtuse to acute. *Flowers* solitary, ebracteate; peduncles 1–10 mm long; hypanthium ellipsoid, ca. 5 mm long, densely sericeous; calyx limb spathaceous, 2.5–4 cm long, hirsute, apex entire and acute to irregularly 2- or 3-lobed, lobes acute; *corolla* funnelform, white to cream, externally sericeous to hirsute, internally glabrous, tube 35–45 mm long, lobes 5, triangular, 5–8 mm long, acute to obtuse; anthers ca. 3 mm long, filaments hirsute at base; stigmas ca. 2 mm long. *Fruits* ellipsoid, 3–4 × 1–3 cm, hirsute to pilose; seeds ca. 2 mm long.

This species is found in wet forests at 0–900 m elevation from Nicaragua to northeastern Colombia; it has been collected with flowers most frequently in February and also in March, April, August through October, and December, and in fruit in February and April through October.

Dwyer (1980) described this species in *Duroia* Aublet probably based mainly on its general aspect, the hirsute to pilose pubescence of all its vegetative organs, its externally sericeous corollas, and its usually solitary, rather large (i.e., several cm in diameter), baccate fruits. However, his species clearly belongs instead to *Hippotis* as shown by its interpetiolar, induplicate-valvate stipules (vs. fully fused into a circumscissile calyptrate structure in *Duroia*), its lineolate higher-order leaf venation (vs. irregularly reticulated in *Duroia*), its bisexual flowers (vs. unisexual on dioecious plants in *Duroia*), its spathaceous calyx limb (vs. tubular and truncate to regularly lobed in *Duroia*), and its five corolla lobes (vs. six to nine in *Duroia*).

Dwyer (1980) treated this species together with the following, *Hippotis stellata*, under the name *Hippotis albiflora* H. Karsten. However, *H. albiflora* is a species restricted to Colombia and Venezuela (Steyermark, 1965). Because of this confusion and also the limited usefulness of the original description of *Duroia panamensis*, a complete description and a list of representative specimens are presented here. *Hippotis panamensis* is distinguished from the other species in this genus by the combination of its spreading pubescence on the vegetative organs and fruits, its stipules 1.5–3 cm long, its petioles 1–3.5 cm long, its solitary flowers with peduncles 1–10 mm long, its relatively long calyx limbs, and its relatively long white corollas. *Hippotis albiflora* differs in its appressed pubescence, its flowers 1 to 3 per leaf axil on pedicels 7–11 mm long, its calyx limbs 16–23 mm long, and its corollas 35–42 mm long.

Representative specimens. COLOMBIA. **Chocó:** Parque Nacional de Utría, en la falta de la serranía que bordea el Río San Pichí, *F. García C. & Agualimpia 470* (MO). COSTA RICA. **Cartago:** 24 km NE of Turrialba on highway to Limón, then E at Tres Equis on jeep road 1.5 km, *Liesner et al. 15379* (MO). **Heredia:** Finca La Selva, the OTS field station on the Rio Puerto Viejo just E of its junction with the Rio Sarapiquí, along W Boundary Trail, 2900 m line, *Grayum 2352* (MO). **Limón:** Cerro Coronel, E of Laguna Danto, *Stevens & Montiel 24363* (MO, PTBG). NICARAGUA. **Río San Juan:** sobre el Río Sábalo, *P. P. Moreno & Robleto 26007* (MO). **Zelaya:** along road to Colonia Yolaina, Colonia La Esperanza, etc. [sic], ca. 1.3 km SE of intersection with road between Nueva Guinea and Colonia Verdun, immediately upriver from bridge over Caño Sardina, *Stevens 6306* (MO). PANAMA. **Bocas del Toro:** near highway to Chiriquí Grande, 10 road-mi. from continental divide and about 2 road-mi. along road E of highway, *McPherson 11822* (MO).

Hippotis stellata C. M. Taylor & J. H. E. Rova, sp. nov. TYPE: Panama. Darién: Parque Nacional del Darién, ridge between N and S branches of Río Pucuro, in forest N of old village of Tacarcuna, ca. 18 km N of Pucuro, 8°05′N, 77°16′W, 600–800 m, 24 Oct. 1987, *B. Hammel, G. de Nevers, H. Cuadros & H. Herrera 16473* (holotype, PMA; isotypes, MO-3607390, PTBG-7273). Figure 1.

Haec species a congeneris foliis calyce fructuque pubescentia plerumque adpressa vestitis, limbo foliari subtus secus venationem tertiariam trichomatibus ramosis ex ramulo centrali elongato etiam ramulis basalibus brevibus numerosis constantibus induto, limbo calycino 30–40 mm longo atque corollae albae tubo ca. 50 mm longo ac lobulis 10–12 mm longis distinguitur.

Shrubs or small trees to 15 m tall; stems densely strigillose to sericeous. *Leaves* elliptic to obovate, 13–35 × 6–18 cm, at apex acuminate, at base obtuse to rounded, drying papyraceous to chartaceous, adaxially strigillose and scabridulous, abaxially strigillose and hirtellous with trichomes mixed simple and sessile-stellate; secondary veins 8 to 10 pairs, not to weakly looping to interconnect, without domatia or rarely with crypt-type domatia; petioles 1–3 cm long; stipules lanceolate-oblong, 9–16 mm long, obtuse. *Flowers* solitary; peduncles 4–6 mm long, densely strigillose to sericeous; hypanthium turbinate, 6–7 mm long, densely velutinous; calyx limb 30–40 mm long, densely strigillose, spathaceous and acute, irregularly and shortly 1- to 4-lobed; *corolla* funnelform, white, externally moderately to densely sericeous, internally glabrous, tube ca. 50 mm long, lobes ligulate, 10–12 mm long, obtuse to rounded; anthers and stigmas not seen. *Fruits* ellipsoid, ca. 3 × 2 cm, densely strigillose, brown.

Distribution, habitat, and phenology. In wet forest at 350–1500 m, eastern Panama through western coastal Colombia to northwestern Ecuador; collected with flowers in February, April, June, October, and November, with fruits in February, April, May, July, and September.

This new species is distinguished from other *Hippotis* by the unusual trichomes found on its leaf undersides, which are unlike the trichomes known from other *Hippotis* species: these are apparently stellate or multiradiate with one large central arm and 3 to 20 shorter arms arranged generally in a

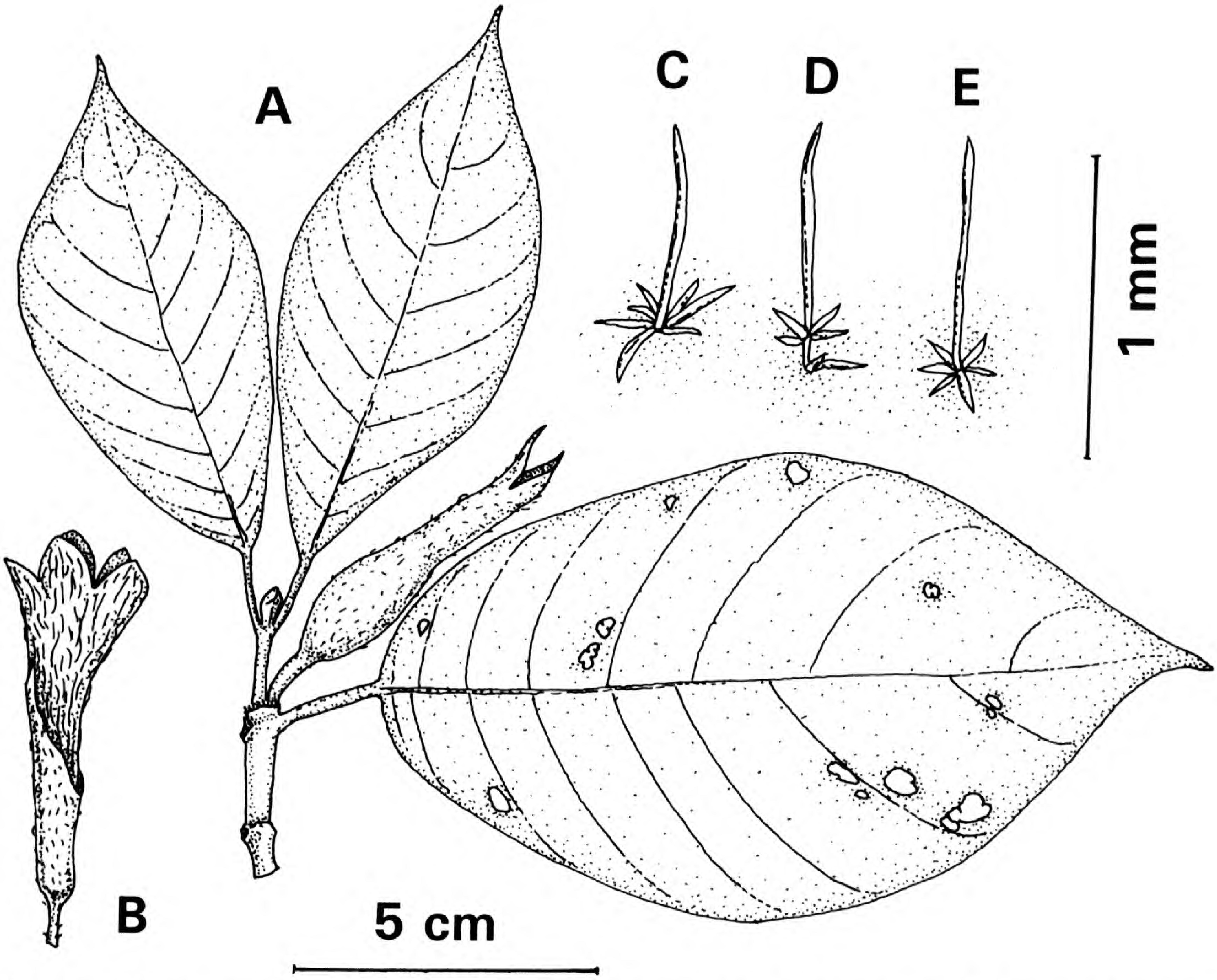

Figure 1. *Hippotis stellata* C. M. Taylor & Rova. —A. Fruiting branch. —B. Flower. —C, D, E. Branched trichomes from abaxial leaf surface. A, based on *Orozco et al. 2347*; B, C, D, E, based on *Hammel et al. 16473*. A, B to 5-cm scale; C, D, E to 1-mm scale.

basal rosette. Each of the arms is unicellular. The species epithet refers to these trichomes. Individual plants of some other species of *Hippotis* (e.g., *H. panamensis*) have a mixture of short and long trichomes on their leaf undersides, and these are occasionally grouped to almost fasciculate. It seems likely that the apparently stellate trichomes found in *H. stellata* are formed from the fusion among these grouped unequal trichomes rather than by branching of individual trichomes. Such stellate or closely grouped trichomes are otherwise unreported in Rubiaceae (Robbrecht, 1988).

This new species is also distinguished by its calyx limbs 30–40 mm long and its white corollas with tubes ca. 50 mm long and lobes 10–12 mm long. Dwyer (1980) included this species together with *Hippotis panamensis* in his circumscription of *H. albiflora*, as discussed above under *H. panamensis*. However, *H. albiflora* differs from this new species in its pedicels 7–11 mm long, its calyx limb 16–23 mm long, and its corollas 35–42 mm long. Also similar to *H. stellata* is *H. grandiflora* Steyermark from Pacific coastal Colombia; *H. grandiflora* differs from this new species in its stipules 30–35 mm long, its petioles 6–10 mm long, its bracteoles 30 × 10–15 mm long, its calyx limb with the tube 43–47 mm long and lobes 6–10 mm long, and its corolla ca. 80 mm long.

Paratypes. COLOMBIA. **Antioquia:** mpio. Frontino, correg. La Blanquita, region de Murrí, vía Nutibara–La Blanquita, 14.5 km O de Nutibara, 15–16 km del Alto de Cuevas–La Blanquita, *Callejas et al. 6762* (HUA, MO); Parque Nacional Natural "Las Orquídeas," Sector Venados, *Cogollo et al. 2865* (JAUM, MO); Murrí, La Blanquita, Río Murrí, hills above village, *Gentry et al. 75739* (MO); mpio. Cocorná, vereda La Piñuela, carretera a San Francisco, *Giraldo-Cañas 916* (HUA, MO); mpio. Frontino, vereda Venados, Parque Nacional Natural "Las Orquídeas," Quebrada Las Manzanares, *Pipoly et al. 18211* (JAUM, MO). **Chocó:** mpio. Nuquí, correg. Termales, Quebrada Piedra Piedra, *Acevedo-Rodríguez et al. 6783* (MO, US); NW of Alto Curiche, *Duke 11258* (MO). **Risaralda:** mpio. de Mistrató, correg. de Puerto de Oro, vereda Chirrinchá, Finca La Cilia, *C. I. Orozco et al. 2347* (COL, MO). ECUADOR. **Carchi:** cantón Tulcan, Reserva Etnica Awá, parroquia El Chical, Centro Gualpi Medio, Rio Cabumi, *A. Grijalva et al. 591* (MO); cantón Tulcan, around encampment in Gualpi Chico area of Awá Reservation, NW and SE, *Hoover et al. 3695* (MO); cantón Tulcan, Reserva Etnica Awá, parroquia El Chical, Centro San Marcos, *P. Méndez et al. 373* (MO); cantón Tulcan, Reserva Indígena Awá, comunidad San Marcos, 25 km al NW de El Chical, parroquia Maldonado, *D. Rubio et al. 1051* (MO). PANAMA. **San Blas:** Pemasky, Sendero Ina Igar, *R. Peralta 608* (MO).

Pentagonia angustifolia C. M. Taylor, sp. nov. TYPE: Panama. Veraguas: on Caribbean slope above Río Primero Brazo 5 mi. NW of Santa Fe, 700–1200 m, 18–19 Mar. 1973, *R. L. Liesner 993* (holotype, MO-2257090). Figure 2C.

Haec species a *Pentagonia nuciformi* habitu monocauli breviore, a *Pentagonia monocauli* foliis angustis 10–16 cm latis atque limbo calycino glabrescente 17–18 mm longo distinguitur.

Slender trees to 4 m tall, unbranched; stems glabrescent. *Leaves* entire, narrowly oblanceolate to narrowly ligulate or elliptic-oblong, 35–50 × 10–16 cm, at apex acute to acuminate, at base acute to attenuate or obtuse to rounded, drying chartaceous, adaxially glabrous, abaxially glabrescent or sometimes strigillose on principal veins; secondary veins 11 to 13 pairs; petioles 5–8.5 cm; stipules lanceolate to ovate, 2.5–4.8 cm long, acute to acuminate, smooth, abaxially and adaxially glabrous. *Inflorescences* congested-cymose, puberulous to glabrescent; peduncles 5–7 cm long; bracts reduced or absent; pedicels 2–3 mm long; *flowers* ca. 7, pedicellate; hypanthium turbinate, ca. 5 mm long, glabrescent; calyx limb 17–18 mm long, glabrescent, color not noted (probably green), lobed for ⅓–½, lobes 5, elliptic, ciliolate, obtuse to rounded, somewhat cucullate; *corolla* in bud tubular, color not noted, externally glabrescent, internally not seen, tube to 22 mm long, lobes 5, deltate, to 5 mm long, acute; anthers and stigmas not seen. *Fruits* several, subglobose, 25–30 mm diam., densely lenticellate, yellow, glabrescent; seeds not seen.

Habitat, distribution, and phenology. In wet forest at 450–1200 m in western Panama; collected in flower in March and August, in fruit in May and October.

This new species differs from *Pentagonia nuciformis* Dwyer by its relatively short monocaulous habit, its pedicellate flowers, and its longer calyx limbs; plants of *P. nuciformis* branch and frequently are up to 15 m tall, with sessile or subsessile flowers and calyx limbs 5–8 mm long. *Pentagonia angustifolia* is similar in habit to *P. monocaulis* (described below), but *P. monocaulis* can be quickly distinguished by its broader leaves, 26–36 cm wide. The specific epithet of this new species refers to its relatively narrow leaves. The flowers of the type collection may be mature, but more likely these are well-developed buds that partially and prematurely opened after collection.

Paratypes. PANAMA. **Veraguas:** valley of Río Dos Bocas along road between Escuela Agrícola Alto Piedra and Calovébora, 15.6 km NW of Santa Fe, *Croat 27561* (MO); Cerro Tute, W of Santa Fe, beyond Alto de Piedra, *McPherson 7187* (MO); NW of Santa Fe, 8.8 km from Escuela Agrícola Alto de Piedra, Pacific slope, *Mori & Kallunki 6784* (MO).

Pentagonia dwyeriana C. M. Taylor, sp. nov. TYPE: Panama. Coclé: hills above road 18 km past Sardinilla on way to Nombre de Dios (road not finished), 150–300 m, 2 Aug. 1974, *T. B. Croat 26123* (holotype, MO-2205421). Figure 2A, B.

Haec species a *Pentagonia macrophylla* bracteis acutis anguste triangularibus usque lingulatis distinguitur.

Small trees to 5 m tall, branching pattern not noted; stems densely pilosulous or hirtellous sometimes becoming glabrescent. *Leaves* entire, oblanceolate to narrowly elliptic-oblong, 35–65 × 12–25 cm, at apex acute to somewhat acuminate, at base obtuse to rounded, drying chartaceous, adaxially and abaxially moderately to densely pilosulous or hirtellous; secondary veins 13 to 18 pairs; petioles 6.5–10.5 cm long; stipules narrowly triangular, 32–40 mm long, acute, smooth, adaxially sericeous to glabrescent, abaxially densely sericeous. *Inflorescences* glomerate to congested-cymose, densely strigillose; peduncles 0–10 mm long; bracts narrowly triangular to lanceolate, 1.5–3 × 0.3–0.8 cm, acute to long-acute; *flowers* sessile or subsessile; hypanthium turbinate, ca. 6 mm long, densely sericeous; calyx limb ca. 15 mm long, densely strigillose to sericeous, lobed for ca. ½, perhaps yellow, lobes 5, elliptic to ovate, obtuse to rounded; *corolla* tubular, pale yellow, externally densely velutinous except glabrous in basal ¼–⅓, internally not seen, tube ca. 30 mm long, lobes 5, narrowly triangular to ligulate, ca. 6 mm long, acute; anthers and stigmas not seen. *Fruits* several, subglobose to ellipsoid, 2–3 × 2–2.5 cm, yellow, sparsely lenticellate, glabrescent, with bracts persisting and pink; seeds ca. 4 mm long.

Habitat, distribution, and phenology. In wet forest at 150–700 m in western Panama; collected in flower in August, in fruit in January and August.

This new species is similar to *Pentagonia macrophylla* Bentham, but it is easily separated from that by its narrower, acute inflorescence bracts.

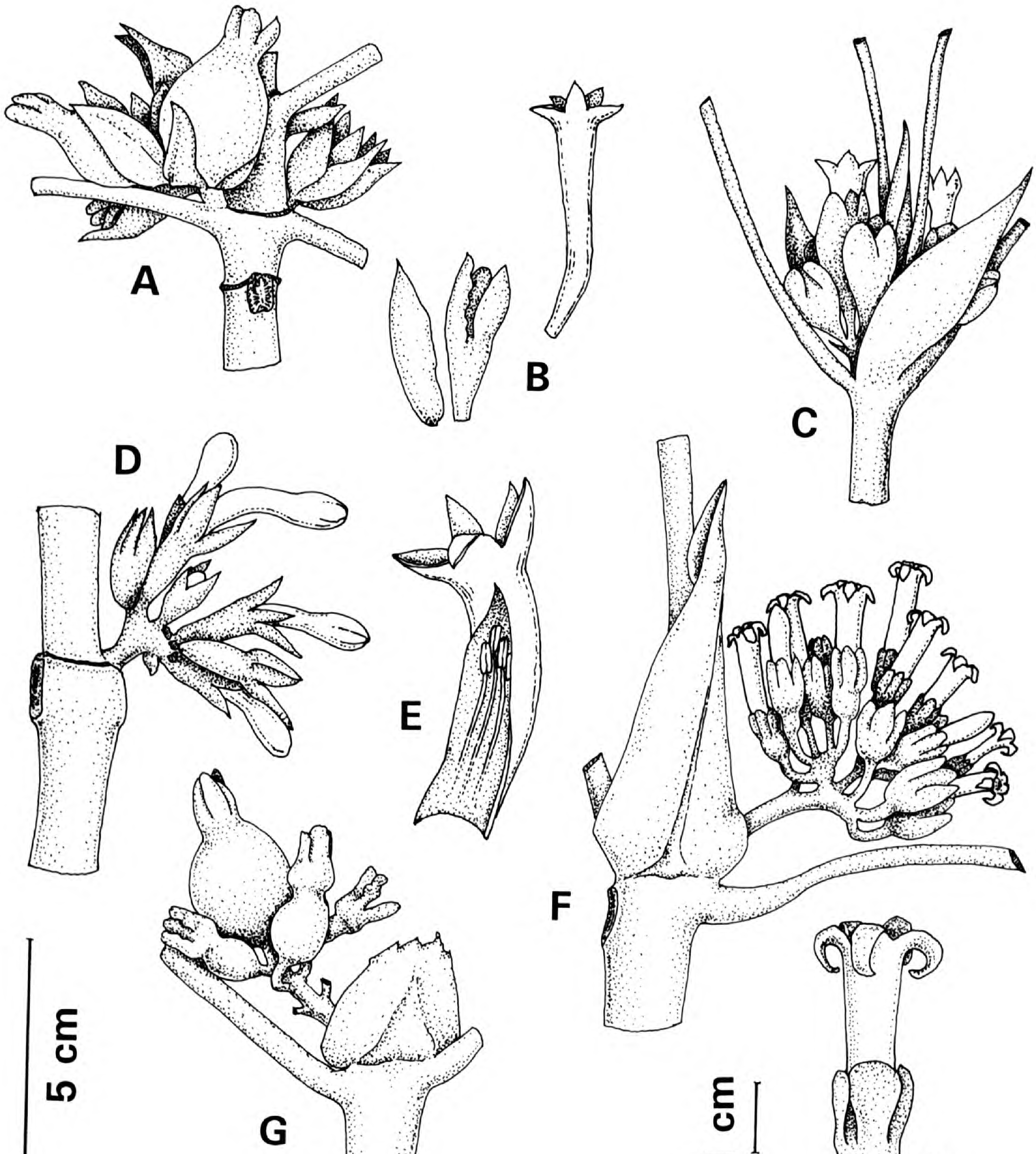

Figure 2. A, B. *Pentagonia dwyeriana* C. M. Taylor, based on *Croat 26123*. —A. Part of stem with infructescence. —B. Flower partly dissected with (left to right) bract, calyx, and corolla. —C. *Pentagonia angustifolia* C. M. Taylor, based on *Liesner 993*. D, E. *Pentagonia sanblasensis* C. M. Taylor, based on *Sytsma & Andersson 4500*. —D. Part of stem with inflorescence. —E. Corolla, partly dissected. F, G, H. *Pentagonia monocaulis* C. M. Taylor, based on *Croat 35720*. —F. Part of stem with infructescence and broken stipule. —G. Part of stem with inflorescence. —H. Flower. A, C, D, G to 5-cm scale; B, E, H to 1-cm scale.

Pentagonia macrophylla has obtuse to rounded bracts 6–15 mm wide, and also differs from this new species in its usually fewer secondary leaf veins (10 to 14 pairs) and its calyx limb lobed for ¾ or more of its length. The epithet of this new species commemorates John D. Dwyer, who prepared the Rubiaceae treatment for the *Flora of Panama* (Dwyer, 1980).

Paratypes. PANAMA. **Colón:** N of Diamante, ridge NW of abandoned mine on Quebrada de la Mina, *H. W. Churchill & de Nevers 4213* (MO), *4214* (MO, PMA).

Pentagonia monocaulis C. M. Taylor, sp. nov. TYPE: Costa Rica. Heredia: near Puerto Viejo along road near Río Sucio, 20 m, 27 May 1976, *T. B. Croat 35720* (holotype, MO-2381703). Figure 2F, G, H.

Haec species a *Pentagonia donnell-smithii* habitu simplici, limbo calycino dense strigilloso atque corolla cremosa luteave extus dense velutino-tomentulosa distinguitur.

Shrubs or small trees to 3.5 m tall, unbranched or perhaps sparsely branched; stems pilosulous or puberulous to glabrescent. *Leaves* entire, obovate to broadly elliptic, 30–63 × 26–36 cm, at apex acute to obtuse or somewhat acuminate, at base obtuse to rounded or truncate, drying chartaceous to subcoriaceous, adaxially glabrescent, abaxially strigillose to glabrescent on the lamina and moderately to densely strigillose on the principal veins; secondary veins 12 to 16 pairs; petioles 3–15 cm long; stipules ligulate to lanceolate, 3.5–7.5 cm long, acute, adaxially glabrous, abaxially moderately to densely strigillose to glabrescent. *Inflorescences* subcapitate to congested-cymose, strigillose to glabrescent; peduncles 0.5–2 cm long; axes conspicuously lenticellate; bracts none or reduced, up to 1 mm long, rounded; pedicels 0–3 mm long; *flowers* sessile to shortly pedicellate; hypanthium cylindrical to ellipsoid, 4–5 mm long, densely strigillose; calyx limb 10–15 mm long, densely strigillose, green, lobed for ⅓–½, lobes 5, elliptic to ligulate, obtuse to rounded, entire to sparsely ciliolate, frequently somewhat cucullate; *corolla* tubular, cream to usually yellow, externally densely velutinous-tomentulose except glabrous near base, internally glabrous except densely hirtellous just above stamen insertion, tube 28–34 mm long, lobes 5, narrowly triangular or lanceolate, 8–10 mm long, acute; anthers ca. 3.5 mm long, positioned variously ⅔ of length of corolla tube above base to just below corolla throat, filaments ca. 12 mm long, villous on bases; stigmas ca. 3.5 mm long, positioned near anthers. *Fruits* several, subglobose to ellipsoid, 20–25 mm diam., glabrescent, lenticellate, brown to orange; seeds ca. 23 mm long.

Habitat, distribution, and phenology. In wet forests at 0–900 m, Caribbean slopes of Costa Rica; collected in flower in January, March through July, and October, in fruit in January, July, September, and November.

This new species is similar to *Pentagonia donnell-smithii* (Standley) Standley (Burger & Taylor, 1993; Taylor, 2001); it differs from *P. donnell-smithii* in its low unbranched habit, its densely strigillose calyx limbs, and its externally densely velutinous-tomentulose, cream to yellow corollas. In contrast, *P. donnell-smithii* has a branched habit up to 15 m tall, glabrous calyx limbs, and externally glabrous, white to pink corollas. The specific epithet of *P. monocaulis* refers to its habit.

Paratypes. COSTA RICA. **Heredia:** Parque Nacional Braulio Carrillo, estación Magsasay, *G. Carballo 91* (INB, MO); cantón de Sarapiquí, Río Sarapiquí near Puerto Viejo, Estación Biológica La Selva, *A. Faivre 6* (INB, MO), *Gentry & Ortiz 78595* (MO), *L. J. Poveda 697* (MO), *D. Smith 538* (DUKE, MO); cantón de Sarapiquí, cuenca del Sarapiquí, La Virgen, margen del Río San Ramón, carreterea al Tirimbina, *A. Rodríguez & Fernández 1413* (INB, MO). **Limón:** cantón de Pococi, Refugio Nacional Barra del Colorado, Llanura de Tortuguero, Sardinas, *F. Araya et al. 236* (INB, MO); between Río Chirripocito and Río Sardina ("Sardinal"), *Grayum 9784* (CR, MO); Guapiles, on road from Guapiles to Río Chirripó, *Barringer & Gómez-Laurito 2369* (MO); hills 3.4 airline km S of Islas Buena Vista in the Río Colorado, 16 airline km SW of Barra del Colorado, *Davidse & Herrera 31280* (MO); path from Río Sucio to González farm, Braulio Carrillo, *L. D. Gómez et al. 22736* (MO); Cerro Coronel, E of Laguna Danto, *Stevens 23702* (MO); E of Río Zapote, *Stevens 23944* (MO), *24300* (MO), *Stevens et al. 24677* (MO); Barra del Colorado, N side, between town and ocean beach, *Stevens 24699* (MO). NICARAGUA. **Río San Juan:** entre el Pueblo de San Juan del Norte Nuevo y la casa de Ramón Castillo, viajando por el caño San Juanillo, *Rueda et al. 1862* (MO).

Pentagonia sanblasensis C. M. Taylor, sp. nov. TYPE: Panama. San Blas: El Llano–Cartí road, 12 mi. from PanAmerican Hwy., 350–400 m, 10 May 1981, *K. Sytsma & L. Andersson 4500* (holotype, MO-2929899). Figure 2D, E.

Haec species a congeneris pubescentia dense velutina, foliis satis amplis, inflorescentia subsessili glomerata, calycis limbo profunde lobato 12–20 mm longo ac lobulis acutis atque fructu luteo 22–25 mm in diametro distinguitur.

Small trees to 5 m tall, possibly monocaulous; stems glabrescent, a little to markedly quadrangular and sometimes strongly channeled on sides. *Leaves* narrowly elliptic-oblong to elliptic or oblanceolate, 30–82 × 12–32 cm, at apex obtuse to acute, at base obtuse to rounded or truncate, drying chartaceous to subcoriaceous, adaxially glabrescent, abaxially densely velutinous; secondary veins 12 to 21 pairs; petioles 3.5–9 cm long; stipules narrowly triangular to lanceolate, 1.5–5 cm long, acute, smooth or sometimes with midrib thickened, adaxially glabrous, abaxially densely strigillose. *Inflorescences* glomerate, velutinous or pilosulous to glabrescent; peduncles 0–8 mm long; bracts absent or minute; *flowers* sessile or subsessile; hypanthium turbinate, 5–6 mm long, densely velutinous; calyx limb ca. 12 mm long, densely velutinous, lobed for ¾ to nearly completely, green, lobes 5, lanceolate to ovate, acute; *corolla* tubular-funnelform, white to yellow, externally densely velutinous except glabrous in basal ⅓, internally glabrous except puberulous in basal ⅓, tube ca. 43 mm long, lobes 5, narrowly triangular, ca. 10 mm long, acute; anthers ca. 4 mm long, positioned ca. ⅔ of length of corolla tube above its base, filaments 15–17 mm long, villous on bases; stigmas ca. 2 mm long, situated near anthers. *Fruits* several, subglobose to ovoid, 22–25 mm diam., velutinous to glabrescent, yellow; mature seeds not seen.

Habitat, distribution, and phenology. In wet forests at 0–400 m in central Panama; collected in flower in May and June, in fruit in March, April, and September.

This new species is distinguished by its combination of densely velutinous pubescence, relatively large leaves (even for *Pentagonia,* i.e., to 1 m or more long), glomerate subsessile inflorescences, deeply lobed calyx limbs 12–20 mm long, acute calyx lobes, and yellow fruits 22–25 mm in diameter. The specific epithet refers to the only region from which this new species is known. Similar species are *Pentagonia macrophylla* and *P. dwyeriana,* which both differ from *P. sanblasensis* in their well-developed red inflorescence bracts 5–20 mm long, and *P. sprucei* Standley, which differs in its subtruncate to shallowly lobed calyx limbs 10–12 mm long with the lobes obtuse to rounded.

Paratypes. PANAMA. **San Blas:** El Llano–Cartí road, 19 km from Interamerican Hwy., *de Nevers & Herman 3830* (MO, PMA); Km 27.6, Río Pingandi, *de Nevers et al. 5027* (MO); Km 26.5, along Río Cartí Chico, *de Nevers et al. 5344* (MO, PMA), *5831* (MO sterile, PMA), *7830* (MO); Cangandí, *de Nevers 5698* (MO sterile); Río Cangandí, camino entre el pueblo Cangandí y el aeropuerto de Mandinga, *H. Herrera 107* (MO, PMA); frente a la Isla Miria Ubigandup, camino Sangandi, *H. Herrera & Harris 321* (MO); 34–38 km from Pan-American Hwy. on El Llano–Cartí road, *Knapp & Schmalzel 5466* (MO, PMA).

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Rubiacearum Americanarum Magna Hama Pars X. New Species and a New Subspecies of *Faramea* (Coussareae) from Central and South America

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ABSTRACT. Descriptions and illustrations are presented for the new species *Faramea accumulans* C. M. Taylor and *F. areolata* C. M. Taylor of the San Blas region of eastern Panama, *F. guaramacalensis* C. M. Taylor from cloud forests in northwestern Venezuela, and *F. longistipula* C. M. Taylor from montane forests in northwestern Colombia. The new subspecies *F. tamberlikiana* subsp. *sessifolia* (P. H. Allen) C. M. Taylor from southern Costa Rica represents the northernmost range extension of this species.

Key words: Coussareae, *Faramea*, neotropics, Rubiaceae.

During study of recent collections of *Faramea* Aublet from Central and South America for the *Flora Mesoamericana* and other projects, the following undescribed taxa were discovered. A summary of the morphology of *Faramea* has recently been presented (Taylor, 1999). This Neotropical genus of about 130 species is characterized by indehiscent, often leathery, blue to black fruits with a single rather thin-walled seed; the ovaries 1-locular or incompletely 2-locular with one or two basal ovules; and internally glabrous corollas with four valvate lobes. *Faramea* is similar to *Coussarea* Aublet; *Coussarea* is distinguished by its ovules inserted at the same point (vs. separately) and its vertical (vs. horizontal) seeds, and additionally usually by its inflorescences white (vs. green to blue) and its fruits white and spongy. *Faramea* has not been studied as a whole, but several floristic treatments have been presented, notably by Mueller (1881), Steyermark (1967, 1974), Burger and Taylor (1993), and Taylor (1999). Mueller recognized four sections within the genus, but subsequent authors have not used or expanded the infrageneric classification of *Faramea*.

Faramea is particularly well represented in wet lowland forests and montane forests, but it is found throughout a wide range of Neotropical habitats including pyrrhophytic vegetation (e.g., *F. crassifolia* Bentham), gallery forests in savanna regions (e.g., *F. sessilifolia* (Kunth) DC.), seasonal Antillean forests (e.g., *F. occidentalis* (L.) A. Richard), and Atlantic forests from Brazil (e.g., *F. percyanea* Zahlbruckner) through Paraguay (e.g., *F. cyanea* Mueller Argoviensis). The reproductive biology of *Faramea* has not been studied in much detail. The fruits of *Faramea* species are fleshy and presumably dispersed by animals. The flowers of several species of *Faramea* are visited by butterflies (Bawa & Beach, 1983), and are fragrant and white or blue with the color usually consistent in a particular species. As in *Coussarea*, the corollas of some species apparently elongate markedly and rapidly just before anthesis, so measurements of flower buds are often not informative about size of the flowers at anthesis. The white flowers of several species (e.g., *F. occidentalis*, pers. obs., Puerto Rico) have an odor similar to that of gardenia, while the blue flowers (e.g., *F. multiflora* A. Richard ex DC., pers. obs., Costa Rica) have a sweeter and lighter fragrance. Blue flowers are uncommon in the Rubiaceae and not known in *Coussarea*. They have been considered derived in the family (Robbrecht, 1988) and thus are likely derived within *Faramea*. The flowers of many species of *Faramea* are distylous, but sometimes do not show the reciprocal placement of anthers and stigmas found in most Rubiaceae (e.g., Faivre & McDade, 2001): in several species (e.g., *F. guaramacalensis*, described below), the anthers occupy nearly the same position in the corolla tube in all flowers seen while the styles are markedly dimorphic, so that the stigmas of the short-styled flowers are positioned below the anthers and included (e.g., Fig. 2C), while those of the long-styled flowers are positioned at or just above the corolla throat.

Some morphological features of *Faramea* are unusual in the Rubiaceae and have been used by previous authors to characterize the genus, but are actually not found in all species and thus are distinctive but not diagnostic. These features include blue flowers (discussed above), stipule form, leaf arrangement, leaf venation pattern, fruit shape, and calyx limb length.

The stipules are often described for *Faramea* (e.g., Steyermark, 1974) as interpetiolar, triangular, and aristate. The majority of species of *Faramea* do have this feature, and it allows recognition of this genus because the aristas of the stipules on the terminal bud typically cross each other at their bases and diverge at their apices in a manner found only in *Faramea*. However, some species of *Faramea* lack aristas on their triangular stipules (e.g., *F. flavicans* (Roemer & Schultes) Standley), while other species have the stipules completely fused into a calyptrate structure that may have two short projections at the apex (e.g., *F. longistipula*, described below), may terminate in a single short arista (e.g., *F. calyptrata* C. M. Taylor), or may lack any terminal projection (e.g., *F. parvibractea* Steyermark).

Another distinctive vegetative feature of *Faramea* is a distichous leaf arrangement; in the majority of Rubiaceae, including *Coussarea*, the leaves are decussate. However, the entire genus has not been surveyed in the field, and this character is not always evident on herbarium specimens. The leaves of many *Faramea* species have a distinctive venation pattern with one or more well-developed submarginal veins (e.g., *F. suerrensis* Donnell Smith, *F. exemplaris* Standley); however, the submarginal veins are only weakly developed in other species (e.g., *F. occidentalis*).

Similarly distinctive but not diagnostic are the strongly oblate (i.e., depressed-globose), laterally flattened fruits found in many *Faramea* species (e.g., *F. suerrensis*, *F. multiflora*), though the fruits of several *Faramea* species are ellipsoid to globose (e.g., *F. occidentalis*). Additionally, the calyx limb is usually rather short, truncate, and denticulate, but also may be rather well developed and even spathaceous to irregularly lobed (e.g., *F. cyathea* Standley, *F. macrocalyx* Mueller Argoviensis).

Other features that are particularly variable in *Faramea* are inflorescence position and arrangement. Inflorescence position varies from consistently terminal (e.g., *F. suerrensis*, *F. multiflora*), to variably axillary and/or terminal (e.g., *F. occidentalis*, *F. torquata* Mueller Argoviensis), to consistently axillary (e.g., *F. egregia* Sandwith, *F. maguirei* Steyermark, *F. guaramacalensis*). The inflorescences of some species are even supraaxillary, inserted 1 to several mm above the junction of the leaf and the stem (e.g., *F. spathacea* Mueller Argoviensis ex Standley, *F. guaramacalensis*); the developmental origin of this is not clear. As to inflorescence arrangement, *Faramea* shows nearly the full range found in the Rubiaceae: from flowers solitary (e.g., *F. capulifolia* Dwyer), to few (e.g., *F. quinqueflora* Poeppig & Endlicher), to numerous (e.g., *F. multiflora*); from flowers sessile or subsessile (e.g., *F. maguirei*), to borne on well-developed peduncles and/or pedicels (e.g., *F. egregia*, *F. guaramacalensis*), to presenting all these conditions in a single species (e.g., *F. occidentalis*); from inflorescence bracts reduced (e.g., *F. guaramacalensis*), to well developed (e.g., *F. guianensis* Aublet) and sometimes even petaloid (e.g., *F. anisocalyx* Poeppig & Endlicher; Classen-Bockhoff, 1996); and from thyrsiform with several orders of branching (e.g., *F. multiflora*, *F. suerrensis*) to densely capitate (e.g., *F. papirifolia* (Steyermark) C. M. Taylor). Similarly extensive variation in inflorescence arrangement is found in several other genera of Rubiaceae, including *Coussarea*.

Faramea accumulans C. M. Taylor, sp. nov. TYPE: Panama. San Blas: vecindad de Río Diablo, frente a la Isla Nargana, a unos 15 km de la costa, 9°22′N, 78°35′W, 100–180 m, 2 July 1992, *H. Herrera, B. Obladía, R. Obladía & N. Blanco 1198* (holotype, PMA; isotype, MO-5204021). Figure 1D.

Haec species a congeneris foliis elliptico-oblongis 28–44 cm longis basi cordulatis amplexicaulibus, inflorescentia cymosa axillari, pedicellis 5–12 mm longis, limbo calycino truncato ca. 3 mm longo atque fructu laevi oblato ca. 10 × 14 mm distinguitur.

Small trees to 5 m tall, glabrous. *Leaves* elliptic-oblong, 28–44 × 13–24 cm, at apex acute to shortly acuminate, at base shortly cordate and amplexicaul, drying chartaceous, adaxially shiny, abaxially matte; secondary veins 11 to 16 pairs, looping to interconnect forming an undulating submarginal vein, adaxially costa prominent and remaining venation plane, abaxially costa prominent and remaining venation plane to prominulous; petioles 0–3 mm long; *stipules* interpetiolar, persistent, main body deltoid, 9–12 mm long, abaxially smooth, at apex aristate with arista 5–6 mm long. *Inflorescences* axillary, cymose, 3–3.5 cm long, glabrous, ebracteate; peduncles 1 or 2 per axil; pedicels 5–12 mm long; flowers with hypanthium cylindrical to turbinate, ca. 1 mm long; calyx limb ca. 3 mm long, truncate, corolla in young bud glabrous externally, not seen at maturity; anthers and stigmas not seen. *Infructescences* similar to inflorescences; *fruits* oblate, ca. 10 × 14 mm, smooth, purple.

Distribution, habitat, and phenology. Wet forests at 50–180 m in northeastern Panama; collected

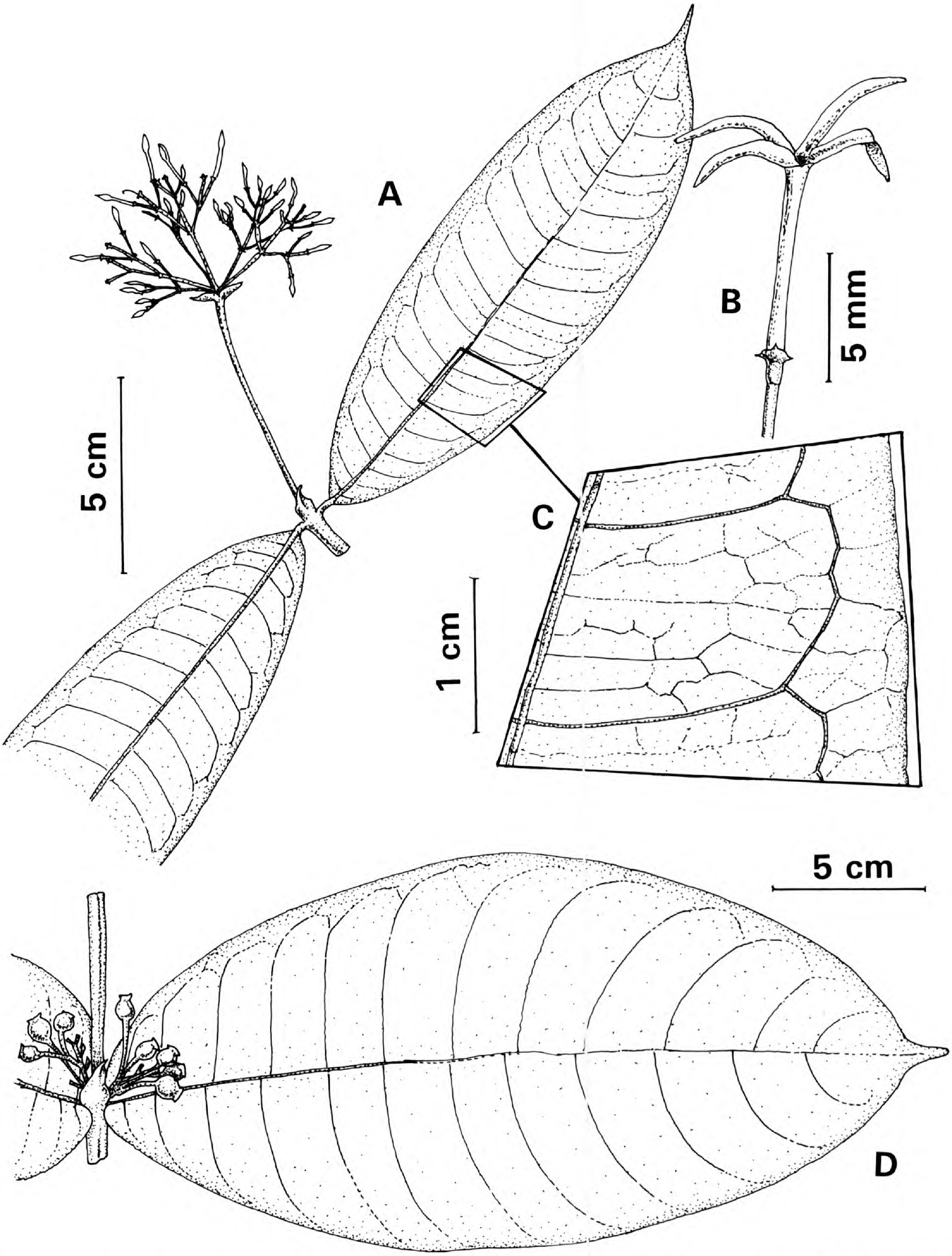

Figure 1. A–C. *Faramea areolata* C. M. Taylor. —A. Flowering branch. —B. Flower. —C. Detail of abaxial leaf surface, from costa (left) to leaf margin, showing venation pattern. —D. *Faramea accumulans* C. M. Taylor, part of branch with young infructescence. A, B, based on *McDonagh et al. 172*. C, based on *de Nevers et al. 7343*; D, based on *H. Herrera et al. 1178*.

with flowers in bud in July, with fruits in July and August.

This species apparently accumulates detritus in the clasping leaf bases that surround the stems, and the specific epithet refers to this habit. *Faramea accumulans* is similar to *F. correae* C. M. Taylor of central Panama; *F. correae* differs in its smaller leaves, 8–18 × 2.5–7 cm, and its fewer, sessile, terminal flowers. *Faramea accumulans* is also similar to *F. permagnifolia* Dwyer ex C. M. Taylor of southeastern Costa Rica; *F. permagnifolia* differs in its oblanceolate to obovate leaves that are rounded to truncate at the base and its fasciculate terminal flowers. *Faramea accumulans* is also similar to an unnamed species from northern Costa Rica and adjacent Nicaragua, which differs in its carinate calyces and fruits; and *F. accumulans* is similar to *F. cyathocalyx* Standley of northwestern Colombia, which differs in its fasciculate flowers and petiolate leaves that are acute to cuneate at the base.

Paratypes. PANAMA. **San Blas:** Cordillera frente a la Isla Narganá, Ribera de Río Diablo, *C. Galdames et al. 1480* (MO, PMA); Río Diablo y vecindad de Duque Sui, a unos 10 km de la costa frente a la Isla de Narganá, ruta hacia Cerro Ibedón, *H. Herrera et al. 1178* (MO, PMA); vecindad del Río Diablo, 8–9 km de la costa, *H. Herrera et al. 1728* (MO, PMA).

Faramea areolata C. M. Taylor, sp. nov. TYPE: Panama. San Blas: Nusagandi and road to Cartí, 9°18′N, 78°58′W, 400 m, 18 July 1986, *J. F. McDonagh, B. A. Lewis, N. J. Gumpel & A. J. Plumptre 172* (holotype, PMA; isotypes, BM-614523, MO-3622277). Figure 1A–C.

Haec species *Farameae eurycarpae* similis, sed ab ea foliis rigidioribus in sicco plumbeo-viridibus, inflorescentiae axibus secundariis verticillatis atque limbo calycino 0.5–0.8 mm longo distinguitur.

Shrubs or trees to 5 m tall, glabrous. *Leaves* elliptic-oblong to lanceolate, 8–19 × 2–8 cm, at apex acuminate with tips often well developed, at base cuneate to usually rounded, truncate, or occasionally shortly cordate, drying chartaceous, adaxially matte, usually shiny abaxially; secondary veins 8 to 13 pairs, looping to interconnect forming an undulate-angled, usually reticulating submarginal vein, adaxially and abaxially costa prominent and remaining venation reticulated and prominulous; petioles 3–7 mm long; *stipules* shortly to completely united around stem into a continuous sheath, caducous, main body of interpetiolar portion 5–7 mm long, abaxially smooth, at apex obtuse to broadly so, aristate with arista 2–5 mm long, inserted at or a little below apex. *Inflorescences* terminal, cymose, blue to white, glabrous; peduncles 2.5–6 cm long; branched portion corymbiform, 5–11 × 5–9 cm; secondary axes 3 to 8, verticillate to subverticillate; bracts triangular, to 1.5 mm long; pedicels 2–7 mm long; *flowers* distylous; hypanthium ellipsoid to cylindrical, 1–1.5 mm long; calyx limb 0.5–0.8 mm long, denticulate; corolla salverform, blue, externally glabrous, tube 7–8 mm long, lobes narrowly triangular, 3–5 mm long, acute; anthers and stigmas not seen in good condition. *Infructescences* similar to inflorescences; *fruits* oblate, ca. 5 × 11 mm, laterally somewhat flattened, smooth, blue.

Distribution, habitat, and phenology. In wet forests and cloud forests at 200–800 m in central and eastern Panama; collected with flowers in January, March through September, and December, with fruits in January, April, June, July, and October through December.

This species has previously been confused with *Faramea eurycarpa* Donnell Smith (e.g., Dwyer, 1980), but *F. eurycarpa* differs in its leaves that dry papyraceous and usually yellow-green and its calyx limbs 1–3 mm long. The leaves of *F. areolata* in particular are notable in being shiny abaxially and having the submarginal veins rather angled and the higher order venation of both surfaces raised and arranged in distinctive angled areoles (Fig. 1C); the specific epithet refers to this distinctive venation. *Faramea areolata* is similar to *F. ampla* Standley of northwestern Colombia; *F. ampla* differs in its leaves that dry papyraceous, are cuneate to obtuse at the base, and have submarginal veins more smoothly undulating and little or not at all reticulated.

Due to the poor preservation of the flowers on the specimens seen, the exact position of the anthers at anthesis is not clear, but it appears to be generally the same in both short-styled and long-styled flowers while the stigma position differs.

Paratypes. PANAMA. **Colón:** ridge top leading N from Río Escandaloso towards Cerro Burja [sic], *Hammel 2710* (MO); Santa Rita Ridge Road, 20–22 km from Transisthmica Highway, *Sytsma 1325* (MO); ridge between Río Piedras and Río Gatún waterbeds, along trail from end of Santa Rita Ridge Road, ca. 5–8 km SW of Cerro Bruja, *Sytsma et al. 4292* (MO). **Panamá:** Llano–Cartí road, 1 mi. past sawmill on dirt road, *T. Antonio 2533* (MO); along newly cut road from El Llano to Cartí–Tupile, 12 mi. above Pan-Am Highway, *Croat 22874* (MO), *Liesner 1120* (MO); El Llano to Cartí Road, 14 km N of Panamerican Highway, *J. Folsom & Kauke 1411* (MO), 14.9 km N of Panamerican Highway, *Folsom et al. 1449* (MO), 8.2 (on new road, 8.6 on old road) mi. from Pan-American Highway on the El Llano–Cartí Road, *Knapp & Huft 4421* (MO); high point of ridges S of Ipetí, 5–6 hrs. walk from Chocó village, Serranía de Maje, *Knapp et al. 4528* (MO); along new El Llano–Cartí road, 8–12 km N of El Llano, *Nee et al. 8769* (MO); El Llano–Cartí Road, 16 km N of

Pan Am. Highway at El Llano, *Nee & Dressler 9356* (MO), 16–18.5 km by road, *Nee & Tyson 10968* (MO); El Llano–Cartí Road, Km 10–15, *P. Maas et al. 2829* (MO); El Llano–Cartí road, 10.6 mi. from the Pan American Highway, *J. S. Miller et al. 875* (MO); El Llano–Cartí road, just S of San Blas border, *J. S. Miller et al. 1011* (MO); El Llano–Cartí road, 10 km from Inter-American Highway, *Mori & Kallunki 2299* (MO), *2305* (MO), 9.6–11 km, *Mori & Kallunki 3521* (MO), 21.1 km, *Mori & Kallunki 5112* (MO), 11–12 km, *Mori et al. 6885* (MO), 8–11 km, *Mori 7707* (MO); El Llano–Cartí Road, ca. 18 km from Pan Am Highway, *Stein 1029* (MO); El Llano–Cartí Road, 15 km above Pan-American Highway, *Systma & Sytsma 3140* (MO). **San Blas:** El Llano–Cartí Road, vicinity Nusagandí, sendero Nusagandí down to the Atlantic coast, *Croat 69256* (MO); Nusagandi, along the continental divide on the El Llano–Cartí Road, *de Nevers & Pérez 3581* (MO); Nusagandi, summit of El Llano–Cartí Road, along the first stretch of the trocha S of camp, *de Nevers & González 3641* (MO); El Llano–Cartí Road, Km 19.1, *de Nevers et al. 5010* (MO), *5876* (MO), *7343* (MO), Km 27, *de Nevers et al. 5094* (MO), Km 16.7, *de Nevers & Charnley 5903* (MO); 23–29 km from Pan-American Highway on El Llano–Cartí Road, *Knapp 1856* (MO).

Faramea guaramacalensis C. M. Taylor, sp. nov. TYPE: Venezuela. Lara: distrito Moran, carretera desde Humacaro Alto hacia Guaito, 2200 m, 14 Nov. 1984, *H. van der Werff & R. Rivero 7890* (holotype, MO-5204020; isotypes, PORT, US, VEN). Figure 2D, E.

Haec species a *Faramea larensi* inflorescentia axillari, pedicellis longioribus atque limbo calycino breviore; a *F. spathacea* limbo calycino pedicellis et lobulis corollinis brevioribus distinguitur.

Shrubs and small trees to 6 m tall; stems glabrous. *Leaves* elliptic to obovate or elliptic-oblong, 4–14 × 1.5–6 cm, at apex acute with tips 5–20 mm long and usually quite slender, at base cuneate to rounded, drying papyraceous to chartaceous, glabrous on both surfaces; secondary veins 6 to 9 pairs, looping to interconnect forming a curving to rather angled submarginal vein, without domatia, adaxially venation plane or costa prominulous, abaxially costa prominent, secondary veins prominulous, and remaining venation plane to usually thickened; petioles 3–5 mm long; *stipules* glabrous, persistent, shortly united around stem, main body interpetiolar portion deltoid to broadly triangular, 3–5 mm long, abaxially smooth in basal half and costate in upper part, at apex acute, aristate, arista linear, 1–3 mm long, apparently glandular at its apex. *Inflorescences* shortly supraaxillary, produced at first subterminal node of stems, inserted 1–2 mm above node, glabrous; peduncles 1 per axil, 16–28 mm long, terminating in a single 3-flowered cyme; bracts 0.5–2 mm long, narrowly triangular to linear; pedicels 3–8 mm long; *flowers* distylous, fragrant; hypanthium narrowly turbinate to cylindrical, ca. 1.5 mm long, glabrous; *calyx* limb 0.8–1 mm long, sinuate to truncate, with 4 linear teeth ca. 0.3 mm long; *corollas* salverform to narrowly funnelform, white, glabrous externally, tubes 13–18 mm long, lobes 4, narrowly triangular to lanceolate, 7–8 mm long, acute; anthers ca. 4.5 mm long, included, in short-styled form situated just below corolla throat, in long-styled form situated just above middle of corolla tube; stigmas 2, linear, in short-styled form ca. 3.5 mm long, included, situated near middle of corolla tube, in long-styled form ca. 2.5 mm long, partially exserted. *Infructescences* similar to inflorescences or sometimes displaced to second subterminal node by subsequent stem growth; *fruits* oblate, ca. 6 × 8 mm long, glabrous, color not noted.

Habitat, distribution, and phenology. In cloud forests at 1950–2200 m in Lara, Portuguesa, and probably adjacent Trujillo states of northwestern Venezuela; collected in flower in June and November, in immature fruit in May, June, and November.

This new species is distinguished by the combination of its shortly petiolate leaves, persistent aristate stipules, axillary, few-flowered inflorescences with well-developed peduncles and pedicels, relatively short denticulate calyx limb, white corollas with well-developed tubes, oblate (but not laterally flattened) fruits, and cloud forest habitat. This species was first noticed as undescribed by J. A. Steyermark, who passed the type collection on to J. D. Dwyer, who never advanced work on it and later passed this same specimen to me (J. D. Dwyer, pers. comm.). But this species has been best documented by the work of Cuello (1996, 1999) in Guaramacal National Park, and the specific epithet refers to its occurrence here. *Faramea guaramacalensis* was treated as "*Faramea* aff. *larensis*" in the recent flora of this park (Dorr et al., 2000). Cuello's focused floristic sampling showed strong altitudinal stratification in the vegetation of this park and the distribution of many of its plant species, including *F. guaramacalensis.*

Faramea larensis Steyermark is also found in cloud forest in northwestern Venezuela, but differs from this new species in its terminal inflorescences, stipule aristas ca. 4 mm long, pedicels 1.5–3.5 mm long, and calyx limbs 1–1.5 mm long. *Faramea larensis* is known only from a single collection with immature flowers, so the measurements provided by Steyermark represent only a minimum flower size.

In the treatment of the Rubiaceae of Venezuela (Steyermark, 1974), *Faramea guaramacalensis* will key to two different species, *F. spathacea* and *F. egregia. Faramea spathacea* differs from *F. guaramacalensis* in its peduncles 0–4 mm long, pedicels

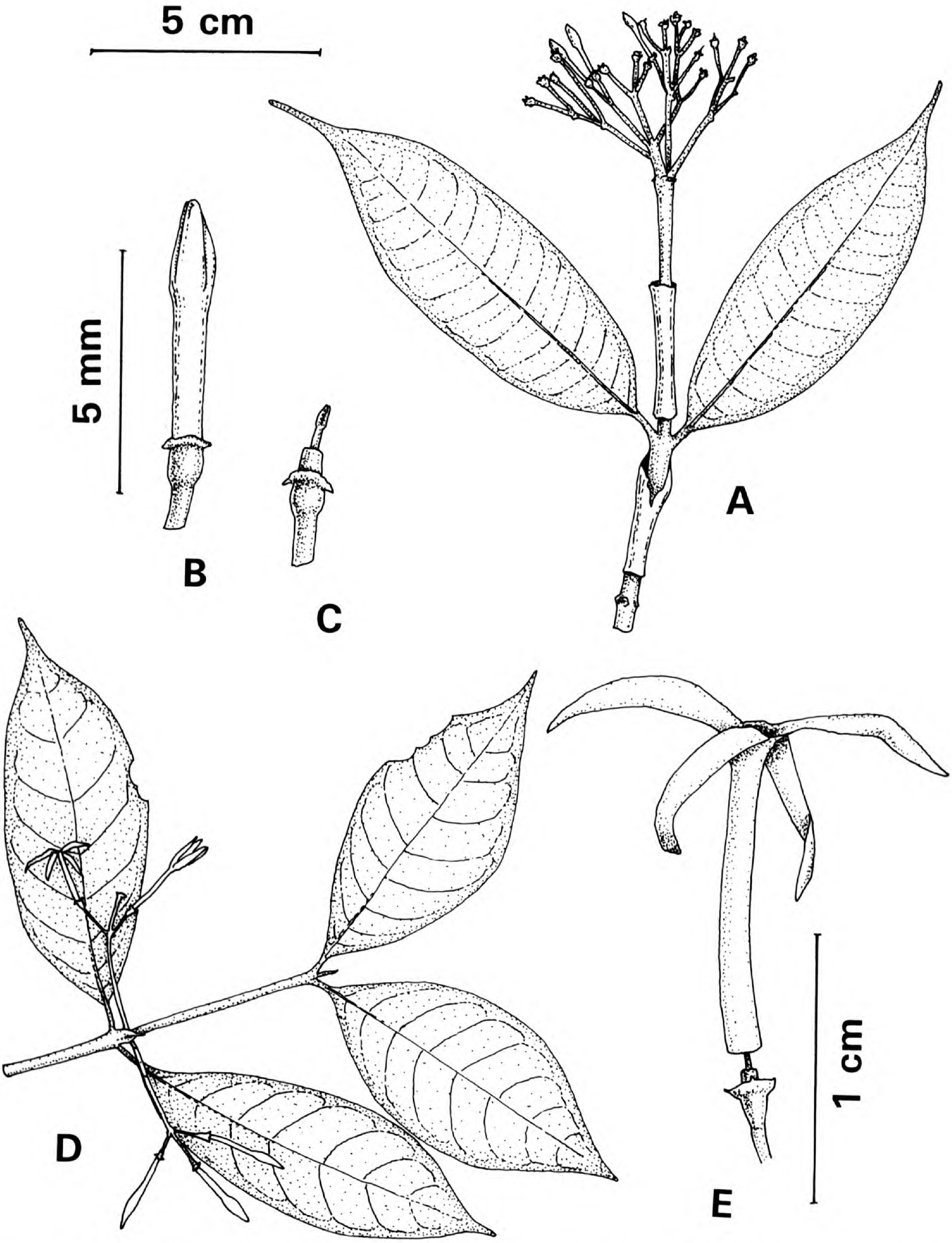

Figure 2. A–C. *Faramea longistipula* C. M. Taylor. —A. Flowering branch. —B. Flower bud. —C. Flower shortly after corolla has fallen off. D, E. *Faramea guaramacalensis* C. M. Taylor. —D. Flowering branch. —E. Flower, partially dissected. A, D to 5-cm scale. A, based on *Cogollo et al. 7839*; B, C, based on *Pipoly et al. 17263*; D, E, based on *van der Werff & Rivero 7890.*

10–30 mm long, calyx limbs 6–8 mm long, corolla lobes 13–20 mm long, and distribution in Venezuela at 700–1400 m; *F. egregia* differs from *F. guaramacalensis* in its solitary flowers, calyx limbs ca. 6 mm long, corolla lobes 16–30 mm long, and distribution in Guyana and adjacent southeastern Venezuela at 500–1000 m.

Paratypes. VENEZUELA. **Portuguesa:** mpio. Sucre, Parque Nacional Guaramacal, sector El Alto, límite con el Estado Trujillo, Camino Real Paramito–Batatal, 9°19–20′N, 70°05′W, *N. Cuello et al. 1623* (PORT), *1639* (PORT), *1699* (PORT).

Faramea longistipula C. M. Taylor, sp. nov. TYPE: Colombia. Antioquia: mpio. Urrao, vereda Calles, Río Calles, Parque Nacional Natural "Las Orquídeas," 4°36′N, 77°05′W, 1400–1500 m, 3 May 1995, *R. Fonnegra & Grupo de Palinología Semestre I-95 5496* (holotype, HUA; isotype, MO-5204022). Figure 2A–C.

Haec species a congeneris stipulis spathaceis breviter biaristatis 3.6–6.5 cm longis distinguitur.

Shrubs and small trees to 6 m tall; stems glabrous. *Leaves* elliptic-oblong to narrowly elliptic, 8–19 × 2.5–6 cm, at apex acuminate with tips 12–25 mm long and usually slender, at base cuneate to obtuse, drying papyraceous to chartaceous and often discolorous, glabrous on both surfaces; secondary veins 10 to 22 pairs, looping to interconnect forming an angled to undulate submarginal vein, without domatia, adaxially costa prominulous and remaining venation plane, abaxially costa prominent and secondary veins and reticulated higher order venation thickened to prominulous; petioles 5–12 mm long; *stipules* glabrous, united into a laterally flattened sheath, main body of sheath 3.5–6.5 cm long, at apex acute to obtuse, with aristas 2, closely set, 3.5–5 mm long, as new leaves expand sheath splitting from apex for up to ⅓ forming a spathaceous structure, eventually deciduous by fragmentation. *Inflorescences* terminal, corymbiform-rounded, 3.5–5 × 4.5–6 cm, branched to several orders, white, glabrous, subsessile and tripartite with subtending leaves often deciduous, principal axes terminating in dichotomous cymules of 3 to 5 flowers; bracts none or deltoid, to 0.5 mm long; pedicels 3–12 mm long; *flowers* with hypanthium ellipsoid to subglobose, 1–1.2 mm long, glabrous; *calyx* limb 0.3–0.5 mm long, truncate, entire to 4-denticulate, glabrous; *corolla* salverform, white to blue, externally glabrous, tube 7–9 mm long, lobes 4, narrowly triangular to narrowly lanceolate, 3–4 mm long, acute; anthers ca. 5 mm long, included, situated just above middle of corolla tube; stigmas 2, linear, ca. 1 mm long, included, situated near base of corolla tube on style ca. 1 mm long. *Infructescences* to 5 × 8 cm, their axes appearing jointed due to internodes often becoming thickened and nodes contracted; *fruits* oblate, ca. 8 × 15 mm, laterally rather flattened, glabrous, smooth, leathery, purple.

Habitat, distribution, and phenology. In wet montane forest at 1390–1750 m in the northwestern Cordillera Occidental of the Andes; collected in flower in May, November, and December, in immature fruit in March, May, and December.

This new species is distinguished by its unusually well developed, calyptrate to spathaceous stipules; it is also distinctive in its combination of corymbiform, well-branched inflorescences, slender white to blue corollas, oblate laterally flattened fruits, and montane forest habitat. The relatively large stipules separate this species from the other Andean species of *Faramea* except *F. calyptrata* C. M. Taylor of montane southwestern Colombia and northern Ecuador; the specific epithet refers to these stipules. *Faramea calyptrata* differs from *F. longistipula* in its stipules that are apically entire or bear only 1 arista, its 5 to 10 fasciculate peduncles each producing a single flower, and its corollas with tubes 16–25 mm long. *Faramea longistipula* is one of several species of *Faramea* from western Colombia that Standley annotated with the unpublished epithet "celata."

Paratypes. COLOMBIA. **Antioquia:** mpio. Urrao, vereda Calles, Parque Nacional Natural "Las Orquídeas," margen derecha del Río Calles, *Cogollo et al. 2564* (JAUM, MO), *3915* (JAUM, MO), *7435* (JAUM, MO), *7839* (JAUM, MO), *Pipoly et al. 17263* (JAUM, MO); Alto de Palmitas, *Pipoly et al. 17637* (JAUM, MO); Quebrada La Agudelo, *D. Cárdenas et al. 3180* (JAUM, MO).

Faramea tamberlikiana Mueller Argoviensis subsp. **sessifolia** (P. H. Allen) C. M. Taylor, comb. et stat. nov. Basionym: *Faramea sessifolia* P. H. Allen, Rain Forests of Golfo Dulce 409. 1956. TYPE: Costa Rica. Puntarenas: Esquinas Forest, area between the Río Esquinas and Palamar, 200 ft., 22 May 1950, *P. H. Allen 5539* (holotype, US; isotypes, F-1716255, F-1569883).

As circumscribed here, *Faramea tamberlikiana* Mueller Argoviensis is found in the western Amazon Basin of South America, throughout wet lowland Colombia including along its Pacific coast, and north into Panama and southern Costa Rica. Reproductive features are similar in plants from throughout this region, but there is notable variation in vegetative features. In particular *F. tamber-*

likiana subsp. *tamberlikiana*, found in the Amazon basin and central and eastern Colombia, has petioles 3–13 mm long, leaves with the bases acute to rounded or truncate, and calyx limbs ca. 0.2 mm long, while the allopatric subspecies *sessifolia*, found from southern Costa Rica to western Colombia, has petioles 1–5 mm long, leaves that are rounded to truncate or cordate at the base, and calyx limbs 0.5–1.5 mm long. The leaves of vegetative stems of subspecies *sessifolia* are subsessile, relatively larger, cordate at the base, and markedly amplexicaul, while those of reproductive stems are usually shortly petiolate, relatively smaller, and truncate to rounded at the base, though occasional leaves of reproductive stems are similar to those of vegetative stems. In contrast, subspecies *tamberlikiana* has similar leaves on both vegetative and reproductive stems. As a species *F. sessifolia* was considered restricted to southern Costa Rica (e.g., Burger & Taylor, 1993), but as circumscribed here its range is wider.

Specimens examined. COLOMBIA. **Antioquia:** mpio. Cáceres, Kms 10–15 SE de Cáceras, sobre La Troncal de La Paz, *Callejas et al. 5354* (HUA, MO); mpio. Tarazá, correg. El 12, vereda Banablanco, 210 km NE de Medellín, Troncal del Caribe, en la vía El 12-Barroblanco, cuenca del río Pubi, *Callejas et al. 10876* (HUA, MO); mpio. Puerto Nare, límites con la vereda El Prodigio (mpio. San Luis), vereda Serranías, *D. Cárdenas et al. 3017* (JAUM, MO). **Chocó:** mpio. Nuquí, correg. Termales, N of Quebrada Piedra Piedra, *Acevedo-Rodríguez et al. 6865* (MO, US); Serranía de Baudó, along road between Las Animas and Pato on Río Pato, ca. 5 km SW of Pato, *Croat 56086* (MO); carretera Panamericana (en construcción), adelante del Río Pató, *E. Forero et al. 5662* (COL, MO); Guayabal (just N of Quibdó), *Juncosa et al. 709* (NY). COSTA RICA. **Puntarenas:** Reserva Forestal Golfo Dulce, Los Mogos, Golfito, *R. Aguilar 546* (CR, MO); along road from Panamerican Highway at Piedras Blancas to Rincón (on Osa Peninsula), 3.7 mi. W of Panamerican Highway, *Croat 67636* (MO); Parque Nacional Corcovado, Sirena, on trail toward Laguna Corcovado ("The Swamp"), *Delprete 5202* (CR, MO); fila before Rancho Quemado, near Rincón, Osa Peninsula, *Gentry et al. 78652* (MO), *78684* (MO sterile); ridge between Río Riyito (valley of Laguna Chocuaco) and Quebrada Banegas, S of Cerro Rancho Quemado (ca. 7 km W of Rincón de Osa), *Grayum et al. 7566* (MO); Reserva Forestal Golfo Dulce, Osa Peninsula, Trocha de La Tarde rd. 10 km SW of La Plana, S of Rincón de Osa, E of the Río Rincón valley, *Hammel & Robleto 16730* (CR, MO); Osa Peninsula, trail from Rincón de Osa to Rancho Quemado, *H. Kennedy 1949* (MO); Corcovado National Park, trail from base of hills to Los Chiles, *Liesner 3075* (MO); Corcovado National Park, Llorona Plateau, along trail above Llorona station, *Neill 5045* (MO); along the Camino al Pacífico, W of Rincón de Osa, Osa Peninsula, near Mile 12, *Raven 21592* (F, MO); R.N.V.S. Golfito, Golfito, Valle de Coto Colorado, Fila La Gamba, *M. Segura 81* (INB, MO); on road to radio and telecommunications tower, 6 km N of Golfito, *Utley & Utley 4887* (DUKE, MO); Estación Biológica Marenco, parte NO de la Estación, sendero camino público, Península Osa, *Zamora et al. 1200* (CR, MO). PANAMA. **Coclé:** on the Atlantic side ca. 5 hr. walk from sawmill at El Cope, along slopes above Norte Río Blanco near small village of Caño Susio, *T. Antonio 3623* (MO); Penonomé–Coclecito, 5.6 mi. N of Llano Grande, along Río Cascajal, 1.4 mi. N of continental divide, *Croat 67473* (MO); area between Caño Blanco del Norte, Caño Sucio and Chorro del Río Tife, *Davidse & Hamilton 23638* (MO); 9 km N off Llano Grande on road to Coclesito, *Hammel 1897* (MO). **Colón:** along Portobelo–Nombre de Dios road, 10 km W of Nombre de Dios, *Knapp & Mallet 5707* (MO).

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Rubiacearum Americanarum Magna Hama Pars XI. A New Species of *Alseis* (Calycophylleae) from Central America and Notes on the Morphology of this Neotropical Genus

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ABSTRACT. The Neotropical tree genus *Alseis* is unusual in the Rubiaceae in having a typically deciduous habit and protogynous flowers that are produced just before or with the new leaves. *Alseis costaricensis* C. M. Taylor shares characteristics with both *A. hondurensis* Standley and *A. blackiana* Hemsley of Panama and adjacent Colombia, but is allopatric to and differs morphologically from both of these species.

Key words: *Alseis*, Calycophylleae, neotropics, Rubiaceae.

The genus *Alseis* Schott includes about 15 species of Neotropical trees found in lowland wet, seasonal, and dry forests and also in savanna habitats from southern Mexico to southern Brazil. *Alseis* is distinguished by its spiciform inflorescences; its relatively short corollas with the reduced lobes narrowly imbricate or sometimes apparently open in bud; its densely pubescent stamen filaments; its numerous ovules on pendulous placentas that are attached to the apical part of the septum; its narrow capsular fruits; and its flattened winged seeds (Andersson, 1994). *Alseis* was long classified in the tribe Cinchoneae (e.g., Steyermark, 1974; Robbrecht, 1988), but careful study by Andersson and Persson (1991) showed that this tribe was rather heterogeneous. Consequently they as well as later authors (e.g., Robbrecht, 1993) classified *Alseis* in the tribe Calycophylleae L. Andersson & Persson, which comprises several genera of Neotropical trees.

Alseis is well circumscribed as a genus but not well documented by most authors, and is poorly understood at the species level. Several features of *Alseis* that are unusual in the Rubiaceae have been documented repeatedly and independently by recent collectors, notably its usually deciduous habit and its protogynous flowers. Below I discuss these unusual features and describe a new species that was discovered during preparation of the Rubiaceae treatment for the *Flora Mesoamericana*.

Alseis trees are typically relatively large in both height and diameter, and often reach the subcanopy or canopy of the forest. Some specimen labels report heights up to 35 m, although most describe the trees as 15–20 m tall. Collection of fertile specimens from trees this size is often difficult, and *Alseis* is unsurprisingly represented by relatively few specimens from most regions. Additionally, many species of *Alseis* are reported by specimen labels and field observations to be at least facultatively deciduous and to produce their flowers usually just before or with the flushing of the new leaves (A. Jardim, pers. comm.; Andersson, 1994), an uncommon habit among Neotropical Rubiaceae. Thus, flowers of *Alseis* are nearly always collected separately from the leaves and fruits, so correlating these structures is difficult. And, the stipules of *Alseis* are usually quickly caducous as the new leaves flush, so they cannot be used to help correlate flowering and fruiting collections as can be done with many Rubiaceae.

The floral biology of *Alseis* is also unusual in being protogynous (Andersson, 1994; Burger & Taylor, 1993). This condition is found in several other Neotropical genera of Rubiaceae (e.g., *Warszewiczia* Klotzsch, *Simira* Aublet), but the flowers of *Alseis* show more marked developmental differences than in other genera, in particular in corolla size and form. Typically the corollas of *Alseis* are tubular and apparently pale green in the first, pistillate stage (Fig. 1B), but then they elongate, widen, and become white and campanulate in the second, staminate phase (Fig. 1D). The corolla in the staminate phase may be two to three times as large as it was in the pistillate phase, and the pubescent filaments that enlarge in the staminate phase produce the appearance of a densely barbate corolla throat in this phase. This complicated floral biology has also contributed to the poor taxonomic knowledge of the genus, because species descriptions frequently do not specify which stage of the corolla is being described. Clearly comparisons of corollas in different stages are not useful for species distinctions.

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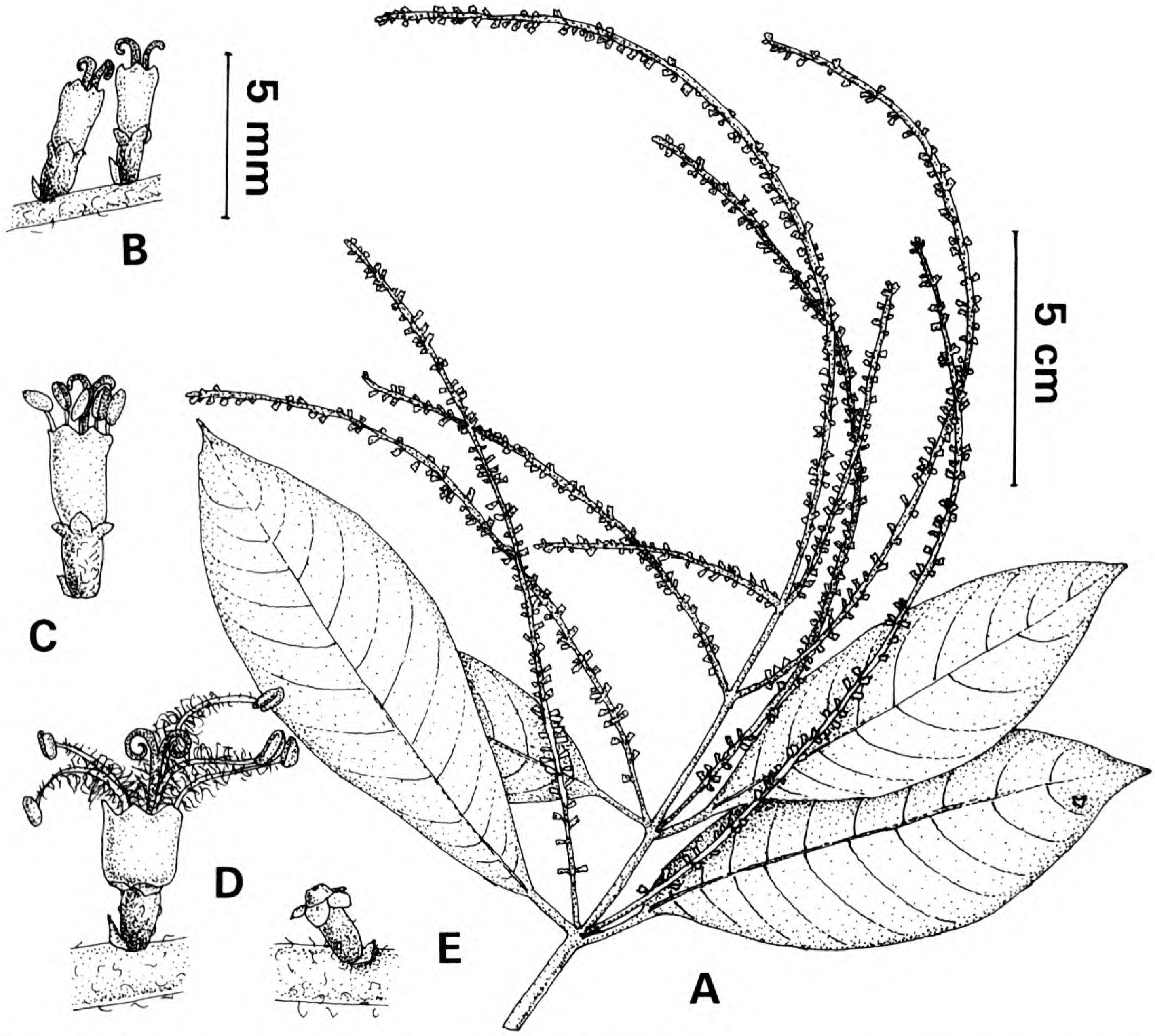

Figure 1. *Alseis costaricensis* C. M. Taylor. —A. Stem with old inflorescences (corollas fallen). —B. Detail of inflorescence showing two flowers in pistillate stage. —C. One flower between the pistillate stage and anthesis. —D. Detail of inflorescence showing one flower at anthesis. —E. Detail of inflorescence showing one old flower, after the corolla has fallen. A, based on *Jiménez et al. 670*, to 5-cm scale; B, C, D, E, all based on *Aguilar 927*, to 5-mm scale.

The capsules of *Alseis* species are all quite similar, about 1–2 cm long, relatively narrow (1–5 mm wide), widest at the top (obconic, obovoid, turbinate, clavate), chartaceous to woody, septicidal from the apex, and two-valved (Steyermark, 1974: 162, fig. 20). After dehiscence the capsule valves typically remain attached to the old infructescence axes for some time. The orientation of the capsules and the old valves, ascending versus reflexed, has been considered useful to distinguish among species (e.g., Standley & Williams, 1975) but actually seems to be quite variable. For example, all orientations from strongly ascending to completely reflexed are found among the specimens of *A. blackiana* Hemsley from Barro Colorado Island, a relatively small site. The individual capsule valves sometimes show a partial secondary splitting from the top, but this feature is variable and apparently not taxonomically significant.

Alseis costaricensis C. M. Taylor, sp. nov. TYPE: Costa Rica. Puntarenas: Reserva Forestal Golfo Dulce, Aguabuena, sector cuenca Norte, 8°42′N, 83°32′W, 50–150 m, 13 Feb. 1992, *R. Aguilar 927* (holotype, CR; isotypes, F-2142377, MO-4362115). Figure 1.

Haec species *Alseidi blackianae* Hemsley et *A. hondurensi* Standley similis, sed a hac lobulis calycinis brevioribus (0.5–1 mm longis) atque floribus sessilibus, ab illa inflorescentiis terminalibus axillaribusque plerumque ramosis distinguitur.

Trees to 30 m tall, deciduous; young twigs strigillose to glabrescent. *Leaves* oblanceolate to obovate, 7–22 × 3.5–9.5 cm, at apex acute to somewhat acuminate, at base acute, papyraceous, above and below sparsely strigillose rapidly becoming glabrescent except persistently puberulous to strigillose on costa and secondary veins; secondary veins 10 to 19 pairs, weakly looping to interconnect near margins, abaxially with hirtellous to pilosulous domatia in axils, adaxially costa, secondary veins, and higher-order venation prominulous, abaxially costa prominulous to prominent and secondary veins and higher order venation prominulous; petioles 10–25 mm long, puberulous to glabrescent; *stipules* 5–6 mm long, narrowly triangular, acute to acuminate. *Inflorescences* terminal and also in axils of uppermost leaves, produced immediately before new leaves, 15–25 × 10–20 cm, branched; secondary axes 1 to 2 pairs, densely strigillose to tomentellous, with trichomes generally appressed; peduncles 1–2 cm long; bracts narrowly triangular to linear, 0.8–1.5 mm long, acute. *Flowers* sessile, protogynous; hypanthium 1–1.5 mm long, densely tomentellous to strigillose; calyx limb divided nearly to base, lobes 5, 0.5–1 mm long, lanceolate to ovate; corolla in staminate phase campanulate, white to cream, 2–2.5 mm long, externally glabrous except often shortly puberulous near base, internally glabrous, lobes 5, reduced (i.e., 0.2–0.3 mm long), rounded, in bud narrowly imbricate to apparently open; anthers ca. 1 mm long, in staminate phase exserted, filaments 5–7 mm long, glabrescent in upper third and densely villous below; mature stigmas 2–2.5 mm long in pistillate phase, in staminate phase becoming twisted. *Capsules* narrowly turbinate, 9–12 × 1–1.5 mm, chartaceous to somewhat woody, brown, glabrescent; seeds linear-fusiform, 5–8 × 0.5–0.8 mm, papery.

Habitat, distribution, and phenology. Seasonal forests at 50–700 m in south-central Costa Rica; collected in flower in February, March, and June, in fruit in May, July, and September.

This species was treated by Burger and Taylor (1993) as "*Alseis* sp. aff. *A. hondurensis* Standl.," but with further study of this genus in Central America, its status is now clearer. *Alseis costaricensis* has been previously confused with both *A. hondurensis* Standley and *A. blackiana*. *Alseis blackiana* is found in central Panama and adjacent northwestern Colombia, and is quite similar to this new species in its floral morphology and also apparently in producing its flowers before its new leaves. However, *A. blackiana* differs from *A. costaricensis* in having unbranched, usually axillary inflorescences. *Alseis hondurensis* is found from southern Mexico through Honduras and is similar to *A. costaricensis* in having branched terminal inflorescences. However, *A. hondurensis* differs from *A. costaricensis* in its longer calyx lobes 1–2.5 mm long, and apparently in producing its flowers after the new leaves have flushed. These three species all appear to be allopatric, with *A. costaricensis* occupying a range between but isolated from the other two. The intermediate morphology of *A. costaricensis*, which shares some features with each of these other species, together with its intermediate range suggest the possibilities that it may be of hybrid origin, or that these three species are not completely isolated, or that these three species may have arisen from a formerly continuous population, perhaps with some clinal variation. At present, none of these possibilities can be excluded.

Paratypes. COSTA RICA. **Alajuela:** San Carlos, *Haber et al. 1804* (MO), *Haber et al. 1825* (F, MO). **Guanacaste:** Parque Nacional Guanacaste, Estación Pitilla, Sendero El Mismo, Finca La Pasmompa, *P. Ríos 229* (CR, MO sterile). **Puntarenas:** Drake-Osa, 3 km al E de Bahía de Drake, camino a Agujitas, *Q. Jiménez et al. 670* (CR, F, MO); cantón de Garabito, Reserva Biológica Carara, cuenca del Río Grande de Tárcoles, camino a Coopecarara, *Q. Jiménez et al. 1366* (CR, F, MO); cantón de Osa, Rancho Quemado, sector norte, camino a Estero Guerra, *J. Marín 412* (CR, F, MO); cantón de Garabito, Reserva Biológica Carara, cuenca del Río Grande de Tárcoles, Estación Quebrada Bonita, *E. Rojas 50* (CR, MO); cantón de Osa, Península de Osa, Aguas Buenas Norte, Sendero Los Guapinoles, *Zamora et al. 1891* (CR, MO sterile); Reserva Biológica Carara, Sector Quebrada Bonita, Sitio Quebrada Bonita, *R. Zúñiga 252* (CR, F, MO). **San José:** Carara National Park, Río Carara near Carara Guard Post, *Gentry et al. 79559* (CR, MO sterile); Reserva Forestal El Cangrejo Mastatal de Puriscal, along road between Puriscal and Quepos, forest patches along Río Negro at base of Cerro El Cangrejo, *Hammel et al. 17120* (CR, F, MO).

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A Synopsis of *Persea* (Lauraceae) in Central America

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ABSTRACT. During preparation of a treatment of *Persea* for the *Flora Mesoamericana* three new species were recognized. A description of these species (*Persea albiramea* van der Werff, *P. brevipetiolata* van der Werff, and *P. laevifolia* van der Werff) is presented, as well as a key to all the known species in the *Flora Mesoamericana* region including brief notes giving synonyms, distribution, and noteworthy features for these species.

Key words: Alseodaphne, Central America, Lauraceae, *Persea*.

The genus *Persea* was described by Miller in his *Gardener's Dictionary*, ed. 4, in 1754; the type species, *P. americana* Miller, was described in the 8th edition of the *Gardener's Dictionary* (1768). Since then, a rather large number of species have been placed in *Persea*, from both (sub)tropical Asia and America. The genus has been variously defined and is consequently quite variable in flower and fruit characters. The American species were last revised by Kopp (1966), who recognized two subgenera in the neotropics. *Persea* subg. *Persea* is characterized by having equal or subequal tepals, these reflexed and usually deciduous in fruit, in having quadrilocular anthers, stipitate glands at the base of the stamens of the 3rd whorl, and a pubescent pistil; the subgenus *Eriodaphne* Nees by its unequal tepals (the inner 3 clearly longer than the outer 3), the tepals persistent and patent in fruit, by its anthers with a variable number of locules (0, 2, or 4), sessile glands at the base of the filaments of the inner three stamens, and the pistil glabrous or pubescent. The main differences between the two subgenera (equal tepals, these reflexed or usually deciduous in fruit vs. unequal tepals patent and persistent in fruit) are easy to observe, and most species can be placed in a subgenus without any hesitation. However, in Kopp's (1966) treatment she also included a few anomalous species, which had equal tepals, persistent and patent in fruit. Some of these species are known from Central America. Finally, there is one species from Suriname, *P. julianae* van der Werff, with strongly unequal tepals that are deciduous in fruit. The seemingly clear division of Neotropical *Persea* species in two subgenera can no longer be maintained.

Kostermans (1993) added a further complication by describing the new genus *Mutisiopersea*, which differed from *Persea* solely by its persistent and indurate tepals in the fruiting stage, whereas the tepals in *Persea* s. str. are persistent or deciduous, but never indurate. I do not accept *Mutisiopersea* because I find the distinction between indurate and non-indurate tepals vague; in some species the tepals are clearly hardened and swollen in fruit, in others slightly so or not at all. A few Central American species of *Persea* were transferred by Kostermans (1993) to *Mutisiopersea*.

Two of the species described in this contribution (*P. albiramea* and *P. laevifolia*) differ in several characters from the other *Persea* species and warrant further comment. Both species have the leaves clearly clustered at the tips of the branches, their leaves have a glaucous lower surface, and the tepals are small, not exceeding 3 mm, and deciduous or persistent in fruit. If persistent (in *P. albiramea*), the tepals are not enlarged and are visible as small bracts at the base of the fruit. If deciduous (in *P. laevifolia*), the tepals are united at the base and dehisce as a unit, together with the stamens, unlike the situation in *P. americana*, where the tepals initially persist in young fruits and later break off individually. Mature fruits of *P. albiramea* are seated on a swollen pedicel, and fruits of *P. laevifolia* are not yet known. This combination of characters is also found in *Alseodaphne* Nees, an Asian genus closely related to *Persea* (Chanderbali et al., 2001), and these two species would very likely be included in *Alseodaphne* had they been collected in tropical Asia (van der Werff, 2001). Because of the great variation in floral characters present among the Neotropical species placed in *Persea*, it would be very difficult to separate the new species from *Persea* and I prefer to include them in *Persea* while realizing that a modern study might well radically change generic concepts in *Persea* s.l.

Type and density of indument are important characters in the species delimitation of Lauraceae. While density of pubescence is in general fairly

Table 1. Species groups of *Persea* in Central America.

	Tepals of whorl 1 and 2	Tepals in fruit	Length of tepals	Position of leaves
Group 1	equal	deciduous	4–6 mm	evenly distributed
Group 2	unequal	persistent	3–5 mm	evenly distributed
Group 3	equal	persistent	2.5–5 mm	clustered
Group 4	(sub)equal	persistent or deciduous	2–3 mm	clustered

constant within a species, I have found that sometimes this character is much more variable in *Persea* species than in species of other genera of Lauraceae. One example is the case of *Persea bullata* Kopp. This species is only known from southern Ecuador and was described as having densely pubescent twigs and pilose leaves. Subsequent collections have shown that this species can be entirely glabrous, and I have found glabrous plants growing almost side by side with pubescent ones. A comparable situation exists with *P. boldufolia* Mez. Kopp (1966) cited only the type, collected near Molinapampa, Dept. Amazonas, Peru. Around Molinapampa large areas occur covered by a shrubby vegetation growing on poor, sandstone-derived soils. In this scrub I found not only plants exactly matching the type, which is glabrous, but also plants that are moderately pubescent and plants that are densely pubescent. The densely pubescent plants are similar to *P. ferruginea* HBK. Plants ranging from glabrous to densely pubescent grow less than 100 m apart in the same vegetation, and thus it seems reasonable to consider *P. boldufolia* as a glabrous form of *P. ferruginea*. These examples led me to identify specimens from Costa Rica with a moderate to sparse, erect indument as the much more densely pubescent *P. donnell-smithii* Mez; describing a new species based only or largely on the density of indument in this case seemed unwise.

Persea Miller, Gard. Dict. ed. 4, 1754. TYPE: *Persea americana* Miller.

Mutisiopersea Kostermans, Rheedea 3: 133. 1993. Syn. nov. TYPE: *Mutisiopersea mutisii* (HBK) Kostermans.

Trees and shrubs. Leaves alternate, evenly distributed along the twigs or clustered, pinnately veined, axillary tufts of hairs or domatia lacking. Inflorescences in the axils of leaves or cataphylls, paniculate-cymose, lateral flowers of a cyme always strictly opposite. Flowers bisexual; tepals 6, equal or unequal; if unequal, outer 3 tepals smaller than the inner 3; tepals deciduous in fruit or persistent; if persistent, usually remaining entire, rarely with the tips of the inner tepals breaking off; stamens 9 or 6; if 6, stamens of whorl III staminodial; anthers usually 4-celled, rarely 2-celled; inner 3 stamens with 2 glands at the base; staminodia of whorl IV present, each with a sagittate or triangular apex. Fruit with or without persistent tepals at the base, but never with a cupule. 80–90 species in the neotropics, 1 species on the Canary Islands, ca. 100 species in tropical and subtropical Asia.

The altitudinal range given under the species is taken from Central American specimens and may vary in other parts of its distribution.

The Central American species of *Persea* can be placed in the following species groups (Table 1):

- Species with equal tepals, these ultimately deciduous in fruit; tepals rather large (4–6 mm long): subgenus *Persea* with *P. americana* and *P. schiedeana* Nees. Restricted to Central America, but *P. americana* widely cultivated.
- Species with unequal tepals, these persistent in fruit (part of the longer tepals sometimes breaking off and tepals appearing equal in fruit); tepals usually 3–5 mm long; subgenus *Eriodaphne* (including species placed in *Mutisiopersea*) with 12 species. An additional 50–60 species in South America.
- Species with equal tepals, these persistent in fruit; tepals 2.5–5 mm long. No name has been proposed for this group; it includes 4 species, *P. albida* Kostermans with leaves evenly distributed, and *P. brevipetiolata*, *P. rigens* C. K. Allen, and *P. silvatica* van der Werff, with leaves clustered at the swollen tips of the branches. Also a few species from South America and *P. indica* (L.) Sprengel from the Canary Islands.
- Species with small (2–3 mm long), equal or subequal tepals, these persistent or deciduous in fruit; pedicel swollen in fruit; leaves clustered, glaucous below. Similar to Asian *Alseodaphne*, including *P. albiramea*, *P. laevifolia*, and possibly *P. perglauca* Lundell. Also in South America

(*P. sphaerocarpa* (Winkler) Kostermans from Bolivia and an undescribed species from Ecuador).

KEY TO THE SPECIES OF *PERSEA* IN CENTRAL AMERICA

1\. Tepals equal or nearly so 2
1′. Tepals unequal, the outer 3 clearly shorter (not more than ⅔ the length of) than the inner tepals 11
2(1). Pistil pubescent; pedicels 5–15 mm long . . . 3
2′. Pistil glabrous; pedicels to 5 mm long 4
3(2). Pedicels 5–8 mm long; bracts surrounding terminal buds uniformly pubescent; pistil sparsely to densely pubescent . . . . *P. americana*
3′. Pedicels 10–25 mm long; bracts surrounding the terminal buds with a scarious margin; pistil densely pubescent . . . . *P. schiedeana*
4(2). Lower leaf surfaces glaucous; tepals 2–3 mm long 5
4′. Lower leaf surfaces not glaucous; tepals 3 mm or longer (*P. brevipetiolata* with tepals 2.5 mm long) 7
5(4). Leaves 15–30 cm long; petioles 15–40 mm long . . . . *P. albiramea*
5′. Leaves to 15 cm long, petioles to 16 mm long 6
6(5). Bark of twigs whitish; midrib impressed and reticulation raised on the upper leaf surface; terminal buds sparsely to moderately appressed pubescent . . . . *P. perglauca*
6′. Bark of twigs dark brown; midrib and reticulation immersed on the upper leaf surface; terminal buds densely white pubescent . . . . *P. laevifolia*
7(4). Leaves whorled, clustered near the tips of the branches; branches with thickened nodes from which multiple branches emerge 8
7′. Leaves evenly distributed; tips of branches not swollen, without multiple branches . . . *P. albida*
8(7). Inflorescences and flowers densely white pubescent, the surface of the flowers completely covered . . . . *P. rigens*
8′. Inflorescences and flowers sparsely pubescent or if densely pubescent, the indument brown 9
9(8). Petioles to 8 mm long; tertiary venation raised on the upper leaf surface, forming a coarse reticulum; flowers sparsely pubescent to subglabrous . . . . *P. brevipetiolata*
9′. Petioles 8–25 mm long; tertiary venation immersed or raised on the upper leaf surface; if raised, forming a fine reticulum; flowers moderately to sparsely pubescent 10
10(9). Leaves 3–6 cm wide, the base slightly decurrent on the petiole; flowers moderately pubescent, the hairs ascending to erect . . . *P. rufescens*
10′. Leaves 7–12 cm wide, the base not decurrent on the petiole; flowers sparsely pubescent; the hairs appressed . . . . *P. silvatica*
11(1). Flowers with nine 2-celled stamens *P. cuneata*
11′. Flowers with six or nine 4-celled stamens 12
12(11). Flowers with six 4-celled stamens . . . . *P. pseudofasciculata*
12′. Flowers with nine 4-celled stamens 13
13(12). Outer tepals glabrous or nearly so on the outer surface; inner tepals moderately to densely pubescent on the outer surface, the difference in indument between inner and outer surface readily visible . . . . *P. povedae*
13′. Indument, if any, on inner and outer tepals similar 14
14(13). Leaves sessile, the base cordate or rounded . . . . *P. sessilis*
14′. Leaves petiolate, the base never cordate 15
15(14). Twigs densely tomentose, the surface completely covered; lower leaf surface moderately to densely tomentose, the indument discernable to the touch . . . . . . *P. donnell-smithii*
15′. Twigs glabrous or variously pubescent, but not densely tomentose; lower leaf surface usually glabrous or appressed pubescent; if hairs ascending, then straight, not curly or crisped 16
16(15). Lower leaf surface covered by a short, dense, felt-like indument, this sometimes difficult to discern; individual hairs not or scarcely visible . . . . *P. vesticula*
16′. Lower leaf surface glabrous or with appressed or ascending hairs; if pubescent, indument not felt-like and individual hairs visible 17
17(16). Leaves, twigs, and terminal buds glabrous; leaves longer than 10 cm . . . . *P. standleyi*
17′. Plants vegetatively with some indument (occasionally specimens of *P. obtusifolia* may be glabrous, but this species has leaves generally less than 10 cm long) 18
18(17). Leaves and twigs initially pubescent, the hairs erect or ascending, but soon becoming glabrous; leaves coriaceous, rarely exceeding 10 cm in length . . . . *P. obtusifolia*
18′. Indument of twigs and leaves when present, strictly appressed; leaves coriaceous or chartaceous, usually exceeding 10 cm (to 10 cm long in *P. brenesii*) 19
19(18). Leaves elliptic, to 10 × 3.5 cm, petioles 1–1.5 cm; indument on twigs and lower leaf surface dense, consisting of coarse, appressed hairs . . . . *P. brenesii*
19′. Leaves elliptic to broadly elliptic or ovate, generally longer and/or broader than 10 × 3.5 cm; indument variable; if dense, then hairs fine 20
20(19). Inner tepals 3–4 times longer than the outer tepals; flowers with a distinct, slender pedicel; distal part of the inner tepals breaking off in fruit, thus fruit seemingly subtended by 6 equal tepals . . . . *P. caerulea*
20′. Inner tepals twice as long as the outer ones; flowers sessile or nearly so, without slender pedicel; distal part of inner tepals not breaking off in fruit, thus fruit subtended by 6 unequal tepals 21
21(20). Inflorescences clustered at the base of seasonal growth or near the tip of the twigs, in the axils of bracts or leaves, about as long as the leaves . . . . *P. veraguasensis*
21′. Inflorescences ± evenly distributed along the seasonal growth, mostly in the axils of leaves, rarely more than half as long as the subtending leaves . . . . *P. liebmannii*

Persea albida Kostermans, Reinwardtia 7: 511. 1969. Replaced name: *Persea pallida* Mez & Pittier, Bull. Herb. Boissier, ser. 2, 3: 231. 1903, non (Nees) Oliver, Hooker's Icon. Pl. 14: 11. 1880. TYPE: Costa Rica. Valle de Coto, *Pittier 11111* (isotype, G).

Persea guatemalensis Lundell, Wrightia 5: 37. 1974. Syn. nov. TYPE: Guatemala. *Contreras 10943* (isotype, MO).

Distribution. Guatemala, Honduras, Costa Rica; possibly Chiapas (*Breedlove 31306*, CAS, a fruiting specimen), from 1200 to 2100 m altitude.

Best recognized by its densely pubescent flowers, equal tepals, and evenly distributed (not clustered) leaves. Differs from *P. americana* in its glabrous (not pubescent) pistil and shorter tepals (to 4.5 mm long in *P. albida*, to 6 mm long in *P. americana*).

Persea albiramea van der Werff, sp. nov. TYPE: Costa Rica. Puntarenas: Canton de Osa, Rancho Quemado, Aug. 1991, *J. Marin 128* (holotype, MO; isotype, INB). Figure 1.

A congeneris foliis magnis, subtus glaucis, ad apices ramulorum aggregatis, floribis parvis, glabris, tepalis subaequalibus diversa est.

Trees, to 30 m. Twigs thick, ridged or angular, with pale gray bark, glabrous or with a few appressed hairs near the apex, grouped toward the tip of leafless shoots, clusters of bract scars lacking; terminal buds densely pubescent, the hairs brownish, ascending, completely covering the surface, not protected by bracts. Leaves 15–30 × 5–10 cm, elliptic, chartaceous, grouped along the distal parts of seasonal shoots, the base and apex acute, the margin thickened, glabrous on both surfaces, or minutely puberulous along the major veins on the lower surface, the lower surface glaucous, midrib immersed or slightly raised, lateral veins and tertiary venation immersed on the upper surface, midrib and lateral veins raised, tertiary venation immersed on the lower surface; lateral veins 10–16 on each side; petioles 1.5–4 cm, ridged, glabrous, dark brown and contrasting in color with the light-colored twigs. Inflorescences 7–15 cm, paniculate-cymose, sparsely puberulous, in the axils of bracts immediately below the tip of seasonal flushes. Flowers 2.5–3 mm diam., white, pedicels slightly longer than the flowers. Tepals ca. 2 mm, the outer 3 slightly shorter than (⅔ to ⅘ the length of) the inner 3, erect at anthesis, sparsely puberulous or glabrous on the outer surface, puberulous on the inner surface; stamens 9, 4-celled, ca. 1.5 mm, the filaments pubescent, about as long as the anthers, slightly narrower than the anthers; outer 6 anthers with the cells introrse, inner 3 with the cells extrorse, filaments of the inner 3 stamens with 2 globose glands at the base; staminodia 0.8 mm, broadly triangular, with a cordate apex, abaxially pubescent, adaxially pubescent near the base only; pistil 1.5 mm, glabrous, the style distinct and about as long as the ovary; receptacle cup-shaped, densely pubescent inside. Fruits 1.4 × 1.9 cm, wider than long, tepals persisting at the base of the fruits, reflexed, not enlarged or thickened; pedicel thickened toward the fruit, at the base 4 mm diam., near the tip 8 mm diam.

Distribution. Costa Rica, Panama, from 200 to 600 m.

Persea albiramea is a very distinctive species and is easily recognized by the combination of large, glaucous leaves grouped near the tips of the branches, the thick, pale twigs, and the long petioles. As is the case with *P. laevifolia*, it does not fit well in any of the proposed infrageneric taxa of *Persea* due to its small flowers with subequal tepals and the persistent, but not enlarged tepals in fruit. It strongly resembles Asiatic species placed in *Alseodaphne* or *Dehaasia* and is likely closely related to these species. An unusual feature, shared with *P. laevifolia*, is the impressed tertiary venation on the upper leaf surface. Most *Persea* species have the tertiary venation raised and forming a fine reticulum. A related species from Bolivia is *P. sphaerocarpa* (Winkler) Kostermans with large, clustered leaves, these glaucous below, and thick twigs with pale bark; it differs from *P. albiramea* in its erect indument on the lower leaf surface and along the major veins. *Persea sphaerocarpa* is only known from the fruiting type collection. Several collections from Ecuador also show the combination of clustered, glaucous leaves and thick twigs with pale bark. These collections are either sterile or in bud, and additional collections are needed for their identification.

The Panamanian specimen included here differs from the Costa Rican specimens in its glabrous flower buds; vegetatively, it is a good match with the Costa Rican specimens.

→

Figure 1 (left). Holotype of *Persea albiramea* van der Werff.

Figure 2 (right). Holotype of *Persea brevipetiolata* van der Werff.

MISSOURI
BOTANICAL GARDEN
HERBARIUM

Nº 5294891

MUSEO NACIONAL
COSTA RICA
LAURACEAE dup.: 3
Persea albiramea van der Werff
Det.
Holotype

PUNTARENAS: Cantón de Osa
Bosque de Grupo Conservación. Fila al Oeste de Rancho Quemado.
8°41'25"N 83°35'00"W 300 m
Arbol de 30 m x 20 cm DAP. Flores blancas.

Juan Marín 128 13 August 1991

HERBARIO NACIONAL DE COSTA RICA (CR)
INSTITUTO NACIONAL DE BIODIVERSIDAD/MISSOURI BOTANICAL GARDEN (MO)

HERBARIO-HORTORIO, COLEGIO DE POSTGRADUADOS, CHAPINGO, MEXICO
14 PLANTAS DE LA ZONA UXPANAPA
ejem. VERACRUZ-OAXACA, MEXICO
Persea brevipetiolata van der Werff
Holotype

EDO. VERACRUZ: Mpio. Jesús Carranza. Lomas al S del Poblado 2(+ 3 Km. al S del entronque de la terracería La Laguna-Sarabia con el camino al N al Pob. 2); lomas con suelos prof., selva alta perennifolia muy perturbada con Dialium, Licania hypoleuca, Eschweilera, Ormosia panamensis, Symphonia, etc. Arbolito de 6 m. d.a.p. 20 cm.; corteza fisurado-escamosa, gris o gris-parda; brecha de corteza: roja, capa interior crema-amarilla, sin olor de Lauraceae, albura color crema, madera amarilla; hojas tiernas rosadas o salmón-rosadas; flores color crema (en alcohol); pendiente perturbada.

Lat 17° 12' "N. Long. 94° 34' "O.
Elev. 250 m. Fecha: 21 Abril 1985
Col.: Tom Wendt, J. García P., W. Thomas, J. Grimes y A. Montero H. No. 4794
Colectado con la cooperación de la Comisión del Papaloapan, S.A.R.H.

Paratypes. COSTA RICA. **Puntarenas:** Canton de Osa, *G. Herrera & J. Marin 1980* (INB, MO), *B. Hammel & J. Marin 18315* (INB, MO), *G. Herrera 5019* (INB, MO), *K. Thomsen 491* (MO). PANAMA. **Darién:** Rio Tuquesa, *T. Croat 27170* (MO).

Persea americana Miller, Gard. Dict. ed. 8. 1768. *Laurus persea* L. TYPE: Plate 222, fig. 2 in Sloane (1725; lectotype, designated here).

Persea americana var. *angustifolia* Miranda, Anal. Inst. Biol. Mexico 17: 129. 1946. TYPE: Mexico. Puebla, *Miranda 3482* (UNA not seen).

Persea drymifolia Schlechtendal & Chamisso, Linnaea 6: 365. 1831. *Persea americana* var. *drymifolia* (Schlechtendal & Chamisso) Blake, J. Wash. Acad. Sci. 10: 15. 1920. *Persea gratissima* var. *drymifolia* (Schlechtendal & Chamisso) Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 147. 1889. TYPE: Mexico. *Schiede & Deppe 1140* (isotype, MO).

Persea edulis Rafinesque, Sylva Tell. 134. 1838. Nom. superfl. for *Persea americana* Miller.

Persea floccosa Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 148. 1889. TYPE: Mexico. *Liebmann 85* (holotype, C).

Persea gigantea L. O. Williams, Ceiba 4: 39. 1953. TYPE: Honduras. *Williams & Molina 12629* (holotype, EAP not seen).

Persea gratissima Gaertner, Fruct. Sem. Pl. 3: 222. 1807. Nom. superfl. for *Persea americana* Miller.

Persea gratissima var. *oblonga* Meissner, DC. Prodr. 15(1): 53. 1864. TYPE: Mexico. *Aschenborn 110* (syntype, not seen), *Galeotti 7010* (syntype, not seen); Peru. *Ruiz & Pavon s.n.* (syntype, not seen); Brazil. *Riedel 106* (syntype, not seen), *Martius s.n.* (syntype, not seen); Java, *Zollinger 457 & 3101* ex parte (syntype, not seen).

Persea gratissima var. *praecox* Nees, Syst. Laurin. 129. 1836. *Persea gratissima* var. *macrophylla* Meissner, DC. Prodr. 15(1): 53. 1864. TYPE: Peru. *Poeppig 2446* (not seen).

Persea leiogyne Blake, J. Wash. Acad. Sci. 10: 19. 1920. TYPE: U.S.A. Florida: *Popenoe 219* (holotype, US not seen).

Persea nubigena Williams, Ceiba 1: 55. 1950. *Persea americana* var. *nubigena* (Williams) Kopp, Mem. New York Bot. Gard. 14: 19. 1966. TYPE: Guatemala. *Williams & Molina 16833* (isotype, MO).

Persea paucitriplinervia Lundell, Wrightia 5: 146. 1975. TYPE: Guatemala. *Lundell & Contreras 19177* (isotype, MO).

Persea steyermarkii Allen, J. Arnold Arbor. 26: 286. 1945. TYPE: Guatemala. *Steyermark 37061* (holotype, F).

Distribution. Widely cultivated in tropical and subtropical countries for its edible fruits.

Persea americana is morphologically a variable species and is closely related to *P. schiedeana.* It can be separated from this species by its shorter pedicels (to 8 mm long), the uniformly pubescent bracts protecting the terminal buds, and its narrower leaves. Smith (1966) reported that *Persea americana* cotyledons were found in cave deposits approximately 10,000 years old; thus the species has been cultivated for a long period. Much of the variation in fruit shape and size as well as variation in indument and leaf shape can be attributed to the process of cultivation. A classification based on these characters (for instance, the one proposed by L. O. Williams in 1977) will only lead to the recognition of cultivars; I prefer to accept *Persea americana* in a wide sense and ignore the cultivated races of this species. It seems likely that *P. americana* originated in the highlands of Central America (Kopp, 1966). However, I would not know how to recognize the "wild" *P. americana* and include all specimens matching the description given above in *P. americana,* regardless of whether they come from obviously cultivated or seemingly native trees.

The type of *P. leiogyne* is from a cultivated tree; I assume that the types of *P. americana, P. gratissima,* and *P. edulis* also come from cultivated trees, based on their origin outside the Central American highlands or their specific epithets.

Two invalidly published names, *Persea tolimanensis* (Zentmyer & Schieber, 1990) and *P. zentmyerii* (Schieber & Berg, 1987), have been applied to *P. americana* s.l. These names were published without a Latin diagnosis, and no type specimens were designated.

Kopp (1966) designated the description in Clusius (1601: 2) as the lectotype of *Laurus persea,* but because descriptions cannot serve as lectotypes according to Article 8.1 of the St. Louis Code (Greuter et al., 2000), a new one had to be chosen. The illustration in Sloane (1725) is quite adequate, has a brief description as well, and is backed by a specimen (no. 965) in the Sloane herbarium at BM. Therefore, I designate here the illustration in Sloane (1725) as the lectotype of *Laurus persea* L. and therefore of *Persea americana* Miller.

Persea brenesii Standley, Publ. Field Mus. Nat. Hist., Bot. Ser. 18: 458. 1937. *Mutisiopersea brenesii* (Standley) Kostermans, Rheedea 3: 134. 1993. TYPE: Costa Rica. La Palma de San Ramon, *Brenes 4451* (holotype, F; isotype, CR not seen).

Distribution. Costa Rica, from 900 to 1200 m altitude.

A poorly known species, best recognized by its dense indument, consisting of coarse, appressed hairs on twigs and lower leaf surface.

Persea brevipetiolata van der Werff, sp. nov. TYPE: Mexico. Vera Cruz: Mpio. Jesus Carranza, Apr. 1985, *T. Wendt, J. García, W. Thomas, J. Grimes & A. Montero 4794* (holotype, CHAPA; isotype, MO). Figure 2.

Perseae rufescentis similis, sed floribus inflorescentiisque glabris vel subglabris, reticulatione subtus elevata et petiolis brevioribus recedit.

Small trees, to 8 m. Twigs smooth, terete, solid, glabrous, thickened at nodes, from which multiple branches may emerge, a few bracts or bract scars present at the base of seasonal growth; terminal buds small, glabrous, protected by a few bracts. Leaves 10–16 × 2.5–5 cm, elliptic, clustered near the tips of seasonal growth, coriaceous; the base acute or somewhat decurrent on the petiole, apex gradually acute, glabrous on both surfaces, midrib, lateral veins, and tertiary venation weakly raised on the upper surface, the tertiary venation forming a coarse reticulum, midrib, lateral veins, and tertiary venation raised on the lower surface; lateral veins 7–10 pairs; petioles 5–8 mm, glabrous, flat above, with the same color as the twigs. Inflorescences 10–15 cm, paniculate-cymose, glabrous or nearly so, often with a few bracts or bract scars at the very base, in the axils of leaves or bracts at the nodes. Flowers 4 mm diam., green-yellow, pedicels 5 mm. Tepals equal or subequal, with the outer tepals slightly shorter, 2.5 mm, broadly elliptic, erect or weakly spreading at anthesis, the outer surface glabrous or very sparsely and minutely pubescent, the inner surface glabrous or nearly so, stamens 9, 4-celled, ca. 2 mm, the anthers as long as the filaments, anthers glabrous, filaments pubescent, filaments half as wide as the anthers; outer 6 stamens with introrse cells, inner 3 with extrose-lateral cells, filaments of the inner stamens with 2 globose glands near the base; staminodia present, 1.3 mm, broadly triangular, abaxially pubescent; pistil 2 mm, glabrous, the ovary 1.2 mm, distinct from the narrow style; receptacle shallowly cup-shaped, glabrous inside. Fruits globose, ca. 2 cm diam., tepals persistent in fruit, but not enlarged, spreading, the pedicel a little thickened and warty.

Distribution. *Persea brevipetiolata* is only known from three collections from Mexican lowland forests (200–250 m altitude) on the Isthmus of Tehuantepec. It is closely related to *P. rufescens* Lundell (Fig. 3), which occurs in montane forests between 1500 and 2500 m in Chiapas and Oaxaca, Mexico; it differs from this species in its glabrous (or nearly so) flowers and inflorescences, in the raised reticulation on the lower leaf surface, and in its shorter (to 8 mm long vs. 15–25 mm in *P. rufescens*) petioles. *Persea brevipetiolata* is also close to the Costa Rican–Panamanian *P. rigens* C. K. Allen and *P. silvatica* van der Werff. The former can be recognized by its dense, white indument on flowers and inflorescences; the latter differs in its larger and wider leaves and longer inflorescences. All four species in this group are rarely collected, and more collections are needed for a better understanding of this group.

Paratypes. MEXICO. **Oaxaca:** Mpio. Matías Romero, *Hernandez & Sanchez U-16* (CHAPA). **Vera Cruz:** Mpio. Hidalgotitlan, *T. Wendt & I. Navarrete 3252* (MO).

Persea caerulea (Ruiz & Pavón) Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 171. 1889. *Laurus caerulea* Ruiz & Pavón, Fl. Peruv. 4: t. 350. 1802. TYPE: Peru. *Ruiz & Pavón s.n.* (MA not seen).

Persea petiolaris HBK, Nov. Gen. Sp. 2: 159. 1817. TYPE: Colombia. *Humboldt & Bonpland s.n.* (B not seen).

Persea laevigata HBK, Nov. Gen. Sp. 2: 157. 1817. TYPE: Colombia. *Humboldt s.n.* (B not seen).

Persea lignitepala Lasser, Bol. Soc. Venez. Ci. Nat. 9: 177. 1944. TYPE: Venezuela. *Pittier 7541* (holotype, VEN not seen).

Persea skutchii C. K. Allen, J. Arnold Arbor. 24: 289. 1945. TYPE: Costa Rica. *Skutch 4812* (holotype, GH not seen).

Distribution. Honduras, Nicaragua, Costa Rica, Panama, South America, from 500 to 1800 m altitude.

A common species characterized by its strongly unequal tepals, with the outer ones ⅓ to ¼ the length of the inner ones and small (1 cm diam.), greenish blue fruits. Vegetatively, it resembles *P. americana*, which has equal tepals and much larger fruits.

Persea cuneata Meissner, DC. Prodr. 15(1): 46. 1864. *Beilschmiedia cuneata* (Meissner) Kostermans, Bol. Técn. Inst. Agron. N. 28: 59. 1959. *Mutisiopersea cuneata* (Meissner) Kostermans, Rheedea 3: 134. 1993. TYPE: Colombia. *Jervise* (K not seen).

Distribution. Costa Rica, Panama, northern South America, from 1000 to 1900 m altitude.

The only species of *Persea* with nine 2-celled stamens in Central America. Vegetatively very similar to *P. povedae* Burger, but this species has larger leaves, flowers (with 4-celled stamens), and fruits.

Persea donnell-smithii Mez, Arbeiten Königl. Bot. Gart. Breslau 1: 113. 1892. *Mutisiopersea donnell-smithii* (Mez) Kostermans, Rheedea 3: 134. 1993. TYPE: Guatemala. Alta Verapaz, *J. Donnell Smith* 1718 (syntype, MO); Mexico. *Liebmann Laurac. 11* (syntype, C not seen).

Distribution. Chiapas, Guatemala, Honduras, Nicaragua, Costa Rica, from 900 to 2400 m altitude.

A rather common, montane species characterized by its unequal tepals and dense, erect indument on twigs and lower leaf surface. Collections from Costa Rica placed here have a sparser indument than the collections from Nicaragua northward. It is similar to *Persea chamissonis* Mez from Mexico in indument, but the latter has narrower leaves. It is also possible that *P. donnell-smithii* is conspecific with *P. chamissonis*; the fact that a syntype of *P. donnell-smithii* was collected in Veracruz, Mexico, lends support to this idea.

Persea laevifolia van der Werff, sp. nov. TYPE: Costa Rica. Heredia: Chilamate de Sarapiqui, May 1989, *B. Hammel & M. Grayum 17334* (holotype, MO; isotypes, BM, BO, CANB, F, HBG, INB, KUN, L, LE, MEXU, MO, NY, P, PMA, TI, US, XAL). Figure 4.

Perseae perglaucae similis, sed ramulis fuscis, gemmis terminalibus dense pubescentibus costisque immersis recedit.

Trees, to 20 m. Twigs slightly ridged, glabrous or nearly so, dark brown, the branching not clustered, clusters of bract scars lacking; terminal buds densely white pubescent, not protected by bracts. Leaves 7–15 × 2–4 cm, chartaceous, elliptic to slightly obovate, alternate and clustered near the tips of the branches; base narrowly cuneate and somewhat decurrent on the petiole, the margin thickened, the apex acute or shortly acuminate, glabrous on both surfaces, midrib immersed or weakly raised, lateral veins and tertiary venation immersed on the upper surface, midrib raised, lateral veins and tertiary venation immersed on the lower surface, lower surface glaucous; lateral veins 7–10 on each side, poorly visible; petioles 7–14 mm, glabrous, canaliculate. Inflorescences 4–12 cm, paniculate-cymose, sparsely pubescent when immature, glabrous in young fruiting stage, near the base of seasonal flushes. Flowers unknown; description of floral parts based on remnants at the base of young fruits. Tepals 1.7 mm, broadly elliptic, equal, the outer surface sparsely to moderately, the inner surface moderately to densely pubescent; stamens 9, all 4-celled, but often only 2 or 3 cells opening, the inner 3 stamens sometimes with the upper 2 cells vestigial, the outer six 1 mm, the anther clearly wider than the filament, the cells introrse, anther about as long as the basally pubescent filament; inner 3 stamens as long as the outer 6, anther slightly wider than the filament, filament as long as the anther, densely pubescent, with large glands near the base, staminodia 0.8 mm, broadly triangular, pubescent on both surfaces, pistil glabrous. Young fruits globose, the largest seen 6 mm diam., tepals in very young stage persisting, but ultimately dehiscing as a unit with the stamens attached or, less frequently, individually.

Distribution. Costa Rica, only known from the lower Atlantic slope, 100–200 m.

Persea laevifolia is an unusual *Persea* species because of its small, equal tepals, which are dehiscent in the fruiting stage. Thus, it does not fit well in the previously recognized infrageneric taxa of *Persea*. Most Neotropical species of *Persea* have unequal tepals or equal, persisting tepals or equal, deciduous tepals that are not basally united. Nearly all have clearly larger flowers. *Persea laevifolia* resembles *P. perglauca* from Guatemala vegetatively, but differs in having dark brown (not very pale to whitish) twigs, a densely pubescent (not sparsely pubescent) terminal bud, immersed (not raised or slightly raised) lateral and tertiary veins on both surfaces, the leaf bases slightly decurrent on the petioles and the midrib immersed (not impressed) on the upper leaf surface. These differences are slight, but constant, and I expect that when good flowering collections become available floral differences will be found as well.

Paratypes. COSTA RICA. **Heredia:** Chilamate, *B. Hammel & I. Chacon 16055* (INB, MO), *B. Hammel et al. 14135* (MO), *G. Herrera 4987* (INB, MO); Sarapiqui, Rancho El Bejuco, *H. van der Werff et al. 14045* (INB, MO).

→

Figure 3 (left). *Persea rufescens.*

Figure 4 (right). Holotype of *Persea laevifolia* van der Werff.


MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 3667506
Colegio de Postgraduados, Montecillos, México
Herbario-Hortorio (CHAPA)
FLORA DE CHIMALAPA
OAXACA, MEXICO
5 ejem.
Persea rufescens Lundell ~~vel aff.~~
Det.: H. van der Werff, 1989 + 2001
Mpio. San Miguel Chimalapa. Cerro Salomón, ca. 2 km en línea recta al NNO del Cerro Guayabitos, ca. 43 km en línea recta al N de San Pedro Tapanatepec, ca. del límite con Mpio. de Sta. María Chimalapa: parte baja del filo, al S del cerro, con bosque mesófilo bien desarrollado con Podocarpus, Magnolia, Alfaroa, Quercus, etc., suelos prof., y ricos. Lat. 16 45'N, Long. 94 11'30"O. Alt. 1050 m.
Árbol 11 m, dap. 30 cm: corteza color bronce, blanda, escamosa; brecha rojo-café, olor dulce algo a cedro; albura amarillo-crema; ejes de infructescencia rojizos; fr. verde oscuro, lustroso, carne verde oscuro; cotiledones adentro anaranjado-café muy claros.
23 Diciembre 1985
Col.: T. Wendt, S. Maya, M. Ishiki, K. Collins 5154
Proyecto Flora Mesoamericana con apoyo CONACYT


MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 5294890
COSTA RICA
LAURACEAE
Dup.=22
Persea laevifolia van der Werff
Det.
Holotype
HEREDIA: Chilamate de Sarapiquí
En bosque primario de Selva Verde, en fila al sur del Río Sarapiquí.
10°27'N 84°04'W 150 m
Árbol 20 m; ramificación llamativamente simpodial; hojas glaucas en el envés; frutos inmaduros, verde oscuro.
Barry Hammel 17524
& Michael Grayum
HERBARIO NACIONAL DE COSTA RICA (CR)

Persea liebmannii Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 166. 1889. *Mutisiopersea liebmannii* (Mez) Kostermans, Rheedea 3: 135. 1993. TYPE: Mexico. Oaxaca: *Liebmann 115* (syntype, C not seen), *Liebmann 116* (syntype, C not seen, photo MO).

Persea flavifolia Lundell, Contr. Univ. Michigan Herb. 6: 17. 1941. TYPE: Mexico. *Matuda 1821* (isotype, MO).

Persea petenensis Lundell, Wrightia 4: 109. 1969. Syn. nov. TYPE: Guatemala. *Contreras 903* (isotype, MO).

Persea podadenia Blake, Contr. Gray Herb. 52: 62. 1917. TYPE: Mexico. *Palmer 119* (isotype, MO).

Distribution. Mexico, Guatemala, from 2000 to 2500 m.

Can be recognized by its rather large (to 16 cm long and 8 cm wide) leaves, inflorescences evenly distributed along the twigs, and appressed indument. Vegetatively similar to *P. veraguasensis* Seemann from Panama and Costa Rica, which has longer inflorescences clustered near the tips of the branches.

Persea obtusifolia Kopp, Mem. New York Bot. Gard. 14: 81. 1966. TYPE: Panama. Chiriquí: Cerro Copete, *Allen 4883* (isotype, MO).

Distribution. Costa Rica, Panama, from 2500 to 3300 m.

Best recognized by its rather small (to 10 cm long), coriaceous leaves, which have, when young, an erect or ascending indument, but which become quickly glabrous with age.

Persea perglauca Lundell, Wrightia 5: 147. 1975. TYPE: Guatemala. Baja Verapaz, *Lundell & Contreras 19217* (isotype, MO).

Distribution. Guatemala; altitudinal distribution not known.

Typical are the whitish twigs contrasting with the dark petioles, clustered leaves, which are glaucous on the lower surface, the impressed midrib, and the small flowers with tepals 2 mm long. Similar to *P. laevifolia*, which has darker twigs and an immersed midrib. It is possible that *P. perglauca* is only a small-flowered variety of *P. americana*.

Persea povedae Burger, Fieldiana Bot., n.s. 23: 105. 1990. TYPE: Costa Rica. Alajuela: *Poveda 740* (isotype, MO).

Distribution. Costa Rica, Panama, Ecuador, Venezuela, from 700 to 1100 m.

Readily recognized by the indument on the tepals (inner 3 tepals much more densely pubescent than the outer 3) and its 4-celled stamens. Similar to *P. cuneata*, which has 2-celled stamens.

Persea pseudofasciculata Kopp, Mem. New York Bot. Gard. 14: 85. 1966. TYPE: Bolivia. La Paz, *Krukoff 11283* (isotype, MO).

Distribution. Costa Rica (1 collection), South America, at 500 m.

The only species of *Persea* with six fertile stamens and whorl III staminodial in Central America. The inflorescences are short, branched, and densely pubescent.

Persea rigens Allen, J. Arnold Arbor. 26: 297. 1945. TYPE: Panama. Chiriquí: *Little 6058* (isolectotype, MO).

Distribution. Costa Rica, Panama, probably Colombia, from 1360 to 1600 m.

A poorly known species with clustered leaves, thickened branch tips, and densely white-pubescent flowers. Similar to *P. silvatica*, which has less pubescent flowers. Kopp (1966) discussed the problems with the type designated by Allen. She concluded that the holotype (*Little 6075*, F) was a mixed collection consisting of a sterile twig of *Little 6075* and a flowering twig of *Little 6058* and selected the flowering twig of *Little 6058* in F as the lectotype. On labels of duplicates of *Little 6075* (for instance, in MO) it is clearly mentioned that no flowers or fruits were in evidence, while labels of *Little 6058* state that immature flowers were present. Allen (1945) described flowers of *P. rigens* and thus must have seen material of *Little 6058*. Both *Little 6058* and *6075* were collected in Panama. Allen's statement that *Little 6075* was collected in Costa Rica is incorrect.

Persea rufescens Lundell, Wrightia 5: 38. 1974. TYPE: Mexico. Chiapas: *Matuda 5394* (isotype, MO).

Distribution. Oaxaca, Chiapas, from 1500 to 2550 m.

A poorly known species with clustered leaves, thickened branch tips, and moderately brown-pubescent flowers, with spreading to ascending hairs. See under *P. brevipetiolata* for differences with that species.

Persea schiedeana Nees, Syst. Laurin. 130. 1836. *Persea gratissima* var. *schiedeana* (Nees) Meissner, DC. Prodr. 15(1): 53. 1864. TYPE: Mexico. Misantla, *Schiede 1141* (holotype, B not seen).

Persea pittieri Mez, Bot. Jahrb. Syst. 30, Beibl. 67: 15. 1901. TYPE: Costa Rica. *Pittier 1156* (holotype, BR not seen).

Distribution. From Mexico to Panama, at 800–2500 altitude.

Readily identifiable by its large flowers (tepals 6–8 mm long) and long pedicels (10–25 mm long). Its leaves are somewhat clustered and to 20 cm broad.

Persea sessilis Standley & Steyermark, Publ. Field Mus. Nat. Hist., Bot. Ser. 23: 115. 1944. TYPE: Guatemala. Zacapa, *Steyermark 42487* (holotype, F).

Distribution. Guatemala, at 2100–2400 m.

Rarely collected, but easily identified by its sessile leaves. Flowers and fruits poorly known, but definitely a *Persea* species. Only known from the type collection.

Persea silvatica van der Werff, Fieldiana Bot., n.s. 23: 107. 1990. TYPE: Costa Rica. Heredia: *Schatz & Young 964* (holotype, MO).

Distribution. Costa Rica, at 80–300 m.

Best recognized by its clustered leaves, swollen branch tips, and sparsely pubescent flowers. Close to *P. rigens*, which has densely white-pubescent flowers.

Persea standleyi Allen, J. Arnold Arbor. 26: 301. 1945. *Mutisiopersea standleyi* (Allen) Kostermans, Rheedea 3: 135. 1993. TYPE: Guatemala. Sololá: *Steyermark 47130* (holotype, F).

Distribution. Guatemala, Honduras, from 1500 to 2100 m.

Poorly known and best recognized by its glabrous leaves, twigs, and vegetative buds.

Persea veraguasensis Seemann, Bot. Voy. Herald 193. 1854. *Mutisiopersea veraguasensis* (Seemann) Kostermans, Rheedea 3: 135. 1993. TYPE: Panama. Veraguas: Volcan Chiriquí, *Seemann 1578* (BM, photo MO).

Distribution. Costa Rica, Panama, from 1200 to 2000 m.

Similar to *P. liebmannii*, but differs in having the inflorescences about as long as the leaves and clustered at the base of seasonal growth. Meissner (1864) erroneously used the name *P. veraguensis* for this species.

Persea vesticula Standley & Steyermark, Publ. Field Mus. Nat. Hist., Bot. Ser. 23: 116. 1944. *Mutisiopersea vesticula* (Standley & Steyermark) Kostermans, Rheedea 3: 135. 1993. TYPE: Guatemala. San Marcos, *Steyermark 36207* (holotype, F).

Persea chiapensis Lundell, Wrightia 1: 150. 1946. TYPE: Mexico. Chiapas: *Matuda 5498* (isotype, MO).

Persea popenoei L. O. Williams, Ceiba 1: 57. 1950. TYPE: Honduras. *Williams & Molina 13692* (isotype, MO).

Distribution. Chiapas, Guatemala, Honduras, El Salvador, from 1800 to 2500 m.

Characterized by a short, dense, felt-like indument on the lower leaf surface, which may be difficult to discern. Specimens from Costa Rica previously identified as *P. vesticula* are here placed in *P. obtusifolia*. These specimens lack the dense, felt-like indument on the lower leaf surface and instead have longer, straighter hairs, which may wear off with age.

EXCLUDED SPECIES

Persea primatogena Williams & Molina = *Beilschmiedia riparia* Miranda (Nishida, 1999).

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Isoetes yunguiensis (Isoetaceae), a New Basic Diploid Quillwort from China

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ABSTRACT. *Isoetes yunguiensis,* a basic diploid species with a chromosome number of $2n = 22$, is described and illustrated. This species occurs on the Yunnan–Guizhou Plateau in southwest China. It is similar to *I. japonica* in its appearance and emergent aquatic habit. Herbarium specimens of *I. yunguiensis* previously have been misidentified as *I. japonica*. *Isoetes yunguiensis* differs from *I. japonica* in megaspore and microspore morphology and chromosome number.

Key words: China, East Asia, Isoetaceae, *Isoetes*, quillwort, Yunnan–Guizhou Plateau.

Two basic diploid species ($2n = 22$), *Isoetes hypsophila* Handel-Mazzetti and *I. taiwanensis* DeVol, one tetraploid species ($2n = 44$), *Isoetes sinensis* Palmer, and one hexaploid species ($2n = 66$), *I. japonica* A. Braun, have been reported from China (Diao, 1990; DeVol, 1972). Over the last four years, field, herbarium, and laboratory studies have been conducted on the genus *Isoetes* in the vast area of mainland China, where quillworts are increasingly threatened with extirpation due to ongoing anthropogenic changes. During the course of these studies, specimens collected from the Yunnan–Guizhou Plateau in southwest China that superficially resembled and had been identified as *I. japonica* were found in herbaria. Study of these herbarium specimens and live specimens from the field revealed that they were different from *I. japonica* in spore morphology and chromosome number. These specimens represent a previously undescribed species of *Isoetes*.

Isoetes yunguiensis Wang Q. F. & W. C. Taylor, sp. nov. TYPE: China. Guizhou: Pingba County, Shashi Valley, plants in *Juncus bufolius–Eriocaulon schochianum* marsh, along a stream originating from the Shashi Valley Reservoir, ca. 4 km E of Pingba Town, 9 Aug. 2001, *Wang Q. F., Liu X. & Yang X. L. WH2001166* (holotype, WH). Figures 1, 2.

Planta aquatica, submersa vel emergens ex caudice trilobo. Folia 20 ad 70, viridia, 10–52 cm longa, patentissima, basi dilatata et complanata, marginibus membranacea; ligula triangulata, cuspidata, 1.0–2.5 mm longa, 1.5–3.0 mm lata. Sporangium basale, ovale, 2–7 mm longum, 1.5–4.5 mm latum; velum brevissimum, fibris periphericis destitutum. Megasporae albae, 340–430 μm diametro, cristate-reticulatae. Microsporae pallide canae in massa dispositae, ellipticae, 20–25 μm longae, laeves vel granulatae. Chromosomatum numerus $2n = 22$ (Fig. 2I).

Plants aquatic, submersed or emergent. Rootstock 3-lobed. Leaves spirally arranged, widely spreading, 10–52 cm long, ca. 2.5 mm wide at mid length, in tufts of 20 to 70, flattened on upper side, rounded on lower side (Fig. 1C), base expanded with membranous margins, peripheral fibers absent. Ligule triangular, cuspidate, 1–2.5 × 1.5–3.0 mm. Velum rudimentary, covering only the distal edge of the sporangium. Sporangia basal, oval, 2–7 × 1.5–4.5 mm (Fig. 1B). Megaspores gray when wet, white when dry, 340–430 μm diam. (mean = 390 μm), with cristate-reticulate ornamentation (Fig. 2A–E). Microspores gray in mass, elliptic, 20–25 μm long (mean = 23 μm), laevigate to granulate (Fig. 2F–H). Some sporangia contain both megaspores and microspores. The megaspores in these mixed sporangia are slightly smaller than those

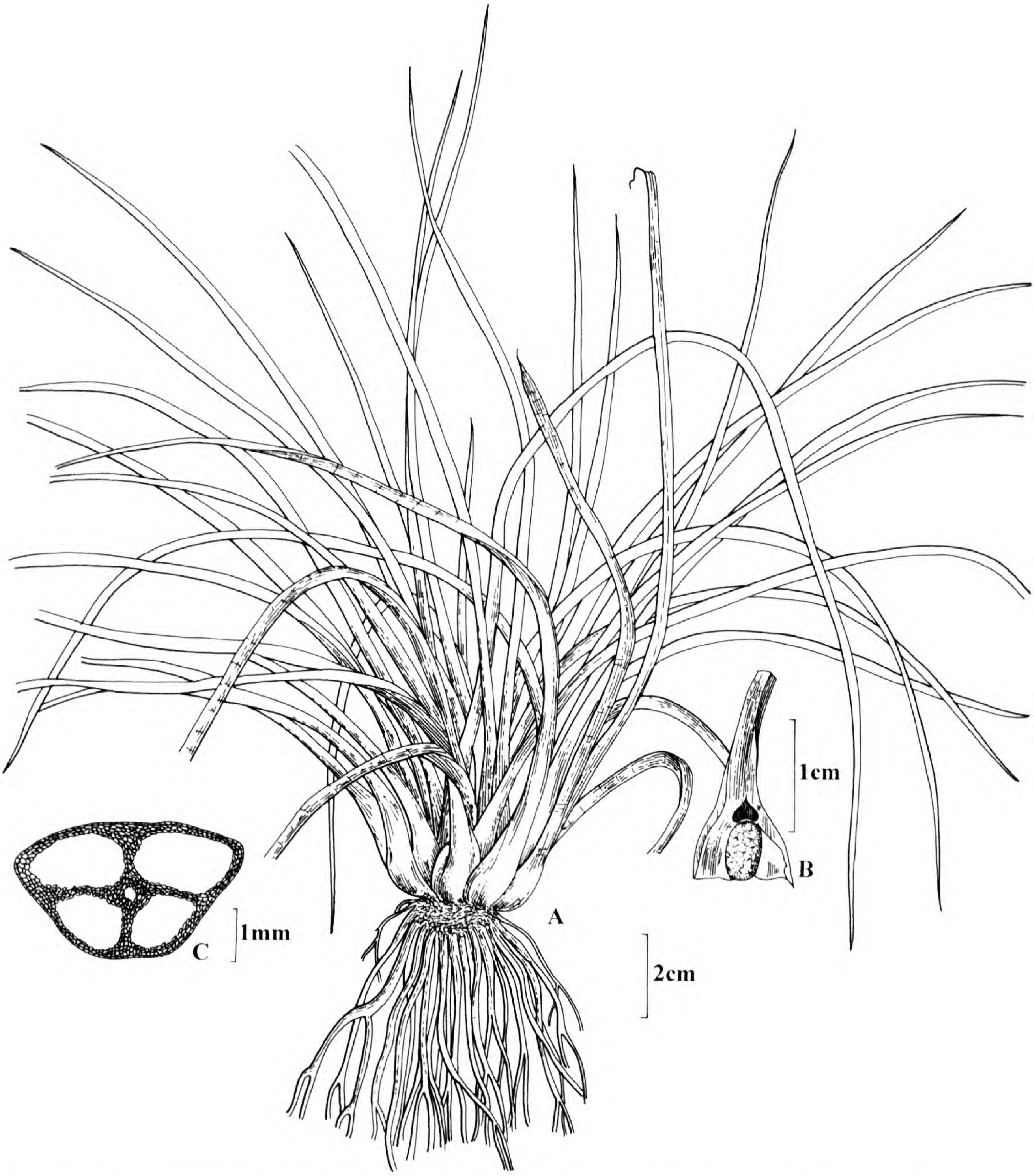

Figure 1. *Isoetes yunguiensis* Wang Q. F. & W. C. Taylor. —A. Habit. —B. Adaxial view of leaf base. —C. Transsection of leaf at mid length. Scale bar: A = 2 cm; B = 1 cm; C = 1 mm.

found in normal megasporangia. Chromosomes: $2n = 22$.

Distribution. In China, Kunming City and Xundian County of Yunnan Province; Pingba County and Guiyang City of Guizhou Province.

The specific epithet for this species is derived from the names Yunnan and Guizhou, the provinces from which the new species has been collected. These two provinces constitute the main section of the Yunnan–Guizhou Plateau in the upper reaches of the Yangtze River in southwest China.

Spore morphology. Spores of *I. yunguiensis* were obtained from specimens collected at the Shashi Valley and Shuangshao Village localities. Samples were prepared for scanning electron microscopy following the methods of Huang et al. (1992). Observations, measurements, and photomicrographs were made using a Hitachi S-800

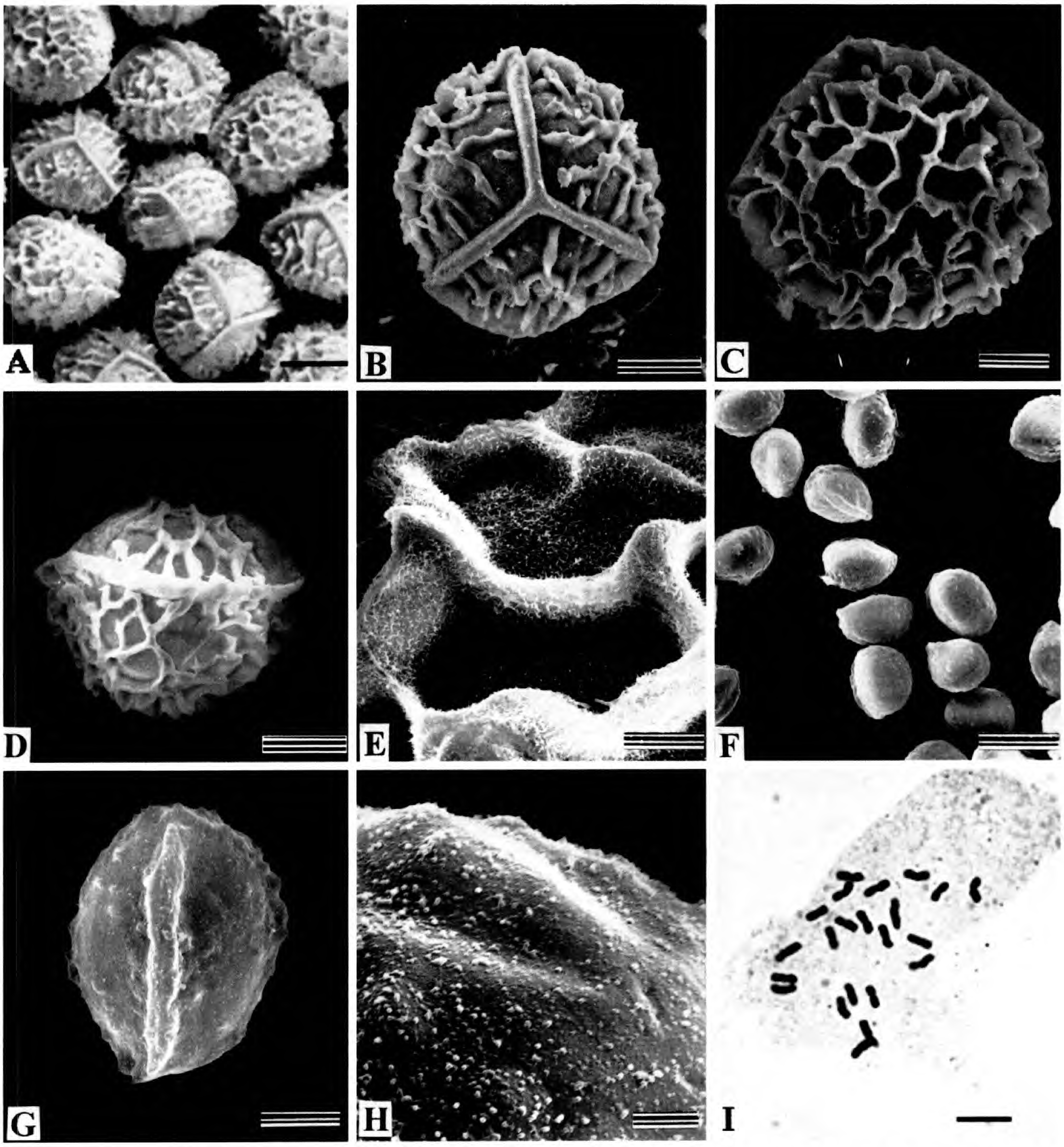

Figure 2. *Isoetes yunguiensis* Wang Q. F. & W. C. Taylor. —A. Megaspores. —B. Proximal view of megaspore. —C. Distal view of megaspore. —D. Equatorial view of megaspore. —E. Megaspore surface. —F. Microspores. —G. Microspore. —H. Microspore surface. —I. Somatic chromosomes in mitotic root tip squash (*Chu W. M. & He Z. R. 29306* (MIL)). Scale bar: A = 200 μm; B & D = 75 μm; C = 50 μm; E & F = 15 μm; G = 4 μm; H = 1 μm; I = 10 μm.

scanning electron microscope and with Olympus BX60 and SZX12 research microscopes. Megaspores of *I. yunguiensis* have a cristate, irregularly reticulate texture with the crests of the ridges uneven (Fig. 2 A–E). These megaspores are 360–450 μm diam. ($\bar{x}$ = 390 μm diam., N = 30). In contrast, the megaspores of *I. japonica* have a more regularly reticulate texture with the crests of the ridges more uniform (Takamiya, 1999: 124, fig. 10B). The megaspores of *I. japonica* are larger, 390–550 μm diam. ($\bar{x}$ = 500 μm diam., N = 30).

The cristate-reticulate megaspores of *I. yunguiensis* clearly differ from the other basic diploid species in East Asia. *Isoetes asiatica* (Makino) Makino has echinate megaspores (Takamiya et al., 1997), *I. hypsophila* has laevigate megaspores (Palmer, 1927), and *I. taiwanensis* has rugulate-reticulate megaspores (Huang et al., 1992; Britton &

Brunton, 1991). The tetraploid *I. sinensis* has megaspores with a cristate texture (Takamiya et al., 1997; Takamiya, 1999).

Microspores of *I. yunguiensis* have a laevigate to verrucate texture (Fig. 2F, G). At higher magnifications, using the scanning electron microscope, the microspores are seen to have a granulate texture (Fig. 2H). In texture, the microspores of *I. yunguiensis* are similar to *I. japonica* (Takamiya, 1999: 124, fig. 10E), but *I. yunguiensis* microspores are smaller than *I. japonica* microspores. The microspores of *I. yunguiensis* are 20–25 μm long and average 23 μm long. In contrast, the microspores of *I. japonica* are 28–34 μm long and average 31 μm long.

Although the megaspores and microspores of *I. yunguiensis* differ in size from those of *I. japonica*, *I. yunguiensis* is similar to *I. japonica* in its appearance and emergent aquatic habit. They are much alike in corm, leaf, sporangium, and velum characters. Both species occur in marshes, ponds, and streams. Early descriptions of *Isoetes* species were based on habit and habitat, and this could be the reason all of the *I. yunguiensis* plants deposited in different herbaria in China were identified as *I. japonica*.

Cytology. Plant materials for chromosome counts were collected from the Shashi Valley and Shuangshao Village localities and cultured in pots at the Botanical Garden, College of Life Sciences, Wuhan University, and in the Botany Department at the Milwaukee Public Museum. Root tips were prepared for observation of somatic chromosomes following the methods of Takamiya et al. (1994) and Taylor and Luebke (1988). Chromosome counts from 70 cells in root tip squashes from 14 individuals showed that *I. yunguiensis* is a basic diploid with the chromosome number of $2n = 22$ (Fig. 2I). The discovery of this basic diploid species brings the total of basic diploids in East Asia to four, including *I. asiatica*, *I. hypsophila*, and *I. taiwanensis*, out of a total of about eight species.

Isoetes yunguiensis is the only East Asian, basic diploid species with a vegetative morphology similar to the hexaploid *I. japonica*. Therefore, one could hypothesize that *I. yunguiensis* is involved in the evolution of *I. japonica*. It is possible that *I. japonica* is an autohexaploid, arising through autopolyploidy in the basic diploid *I. yunguiensis*. Alternatively, it is possible that *I. japonica* is an allohexaploid arising through allopolyploidy involving a cross between *I. yunguiensis* and a tetraploid species to produce a sterile triploid hybrid that doubled its chromosome number. Relationships among the basic diploid and polyploid *Isoetes* species distributed in East Asia, such as those between the basic diploid *I. yunguiensis* and the hexaploid *I. japonica*, need to be investigated by cytological and molecular studies.

Ecology. The streams, marshes, and ponds in which *I. yunguiensis* grows belong to the river systems of the Yangtze River on the Yunnan–Guizhou Plateau at an altitude of 1200–1900 m. Water pH value here is about 6.3. As with most quillworts, *I. yunguiensis* is easy to overlook, for it blends in with associated species such as *Juncus bufonius* L., *Leersia hexandra* Swartz, *Rotala rotundifolia* (Buchanan-Hamilton) Koehne, *Mariscus umbellatus* Vahl, *Hippuris vulgaris* L., *Eriocaulon schochianum* Handel-Mazzetti, and *Hypericum japonicum* Thunberg ex Murray.

Megaspores of *I. yunguiensis* mature from the middle of June to the end of September. Microspores develop from the end of June to the middle of October. By the end of October most sporophylls have decayed, and only a few small leaves that lack sporangia remain green during the winter. A similar overwintering condition is found in *I. sinensis*.

Like all other quillworts in China, *I. yunguiensis* is a rare and endangered species. To date it has been found at only four sites. Field investigations have revealed that two of these populations have been decimated. Of the remaining two sites, the Shuangshao population covers about 100 square meters and contains less than 100 plants, and the Pingba population covers about 400 square meters and holds 200 to 300 individuals. Pollution and increasing urbanization in China continue to raise the risk of extinction for this rare species. Searches for more field localities as well as conservation studies on this species are urgently needed.

Paratypes. CHINA. **Guizhou:** Pingba County, Shashi Valley, *Wang P. S. 75043, 75425* (CDBI, HGAS); Guiyang City, Wangwu, *Peng H., Wang P. S. & Zhao P. 79060* (HGAS). **Yunnan:** Kunming City, Heilongtan, *Chu W. M. 3636* (PYU, WH); Xundian County, Tianshengqiao, *Song Z. H. 80902* (PYU, WH); Kunming City, Shuangshao Village, swamp near reservoir, *Chu W. M. & He Z. R. 29306* (MIL, PYU).

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