Ahlquist, T.K. and M.A. Vincent. 2018. *Trifolium sonorense* (Fabaceae), a new species in the *T. amabile* species complex from Arizona and Mexico. Phytoneuron 2018-1: 1–5. Published 26 February 2018. ISSN 2153 733X

TRIFOLIUM SONORENSE (FABACEAE), A NEW SPECIES IN THE *T. AMABILE* SPECIES COMPLEX FROM ARIZONA AND MEXICO

TIA K. AHLQUIST
School of Human Evolution and Social Change
Arizona State University
Tempe, Arizona 85281
tia.ahlquist@asu.edu

MICHAEL A. VINCENT
Department of Biology
Miami University
Oxford, Ohio 45056-1879
vincenma@miamioh.edu

ABSTRACT

Trifolium sonorense T.K. Ahlquist & Vincent, **sp. nov.**, is described from southern Arizona in the USA and the states of Chihuahua, Jalisco, Sinaloa, and Sonora in Mexico. It is distinguished from other members of the *Trifolium amabile* species complex by a suite of characters, primarily in the flowers.

In their monograph of the genus *Trifolium,* Zohary and Heller (1984) recognized five varieties within their circumscription of *Trifolium amabile* Kunth. A reexamination of the *T. amabile* species complex (Ahlquist 2012) has not supported the five varieties described by Zohary and Heller (1984). This has long been suspected, as noted by the monographers themselves as well as by McVaugh (1987), who called for a revision of the Mexican species. A closer analysis of *T. amabile* var. *amabile* sensu Zohary & Heller has revealed a new species, *T. sonorense* (Fig. 1), which occurs in southern Arizona and in the Mexican states of Chihuahua, Sonora, Sinaloa, and Jalisco. Distinctions involve the lengths of sepal lobes, keel petal claw, and filament tube. The new species is described and illustrated below.

TRIFOLIUM SONORENSE T.K. Ahlquist & Vincent **sp. nov.** **TYPE**: **UNITED STATES**. **Arizona**. Cochise Co.: Huachuca Mountains, Garden Canyon. 31.49°, -110.32°, 1500m, 3 Sep 1928, *G.J. Harrison 5768 with T.H. Kearney* (holotype: ARIZ 92895!; isotypes: US 1435169!, US 1435168!). Figure 1.

Trifolium sonoranense shares many characters characteristic of the *T. amabile* species complex, including a perennial life cycle, its woody roots, its habit, and its pubescence characters. The new species differs from *T. amabile* in the following ways: in *T. amabile,* the keel petal claw length is 0.9–1.6 mm, the sepal lobe length is <3 mm, the connate filaments length is <3.6 mm; and the wing petal claw length is <1.5 mm, whereas in *T. sonorense*, the keel petal claw length is 1.7–2 mm, the sepal lobe length is ≥3 mm, the connate filament length is >3.6 mm, and the wing petal claw length is >1.5 mm.

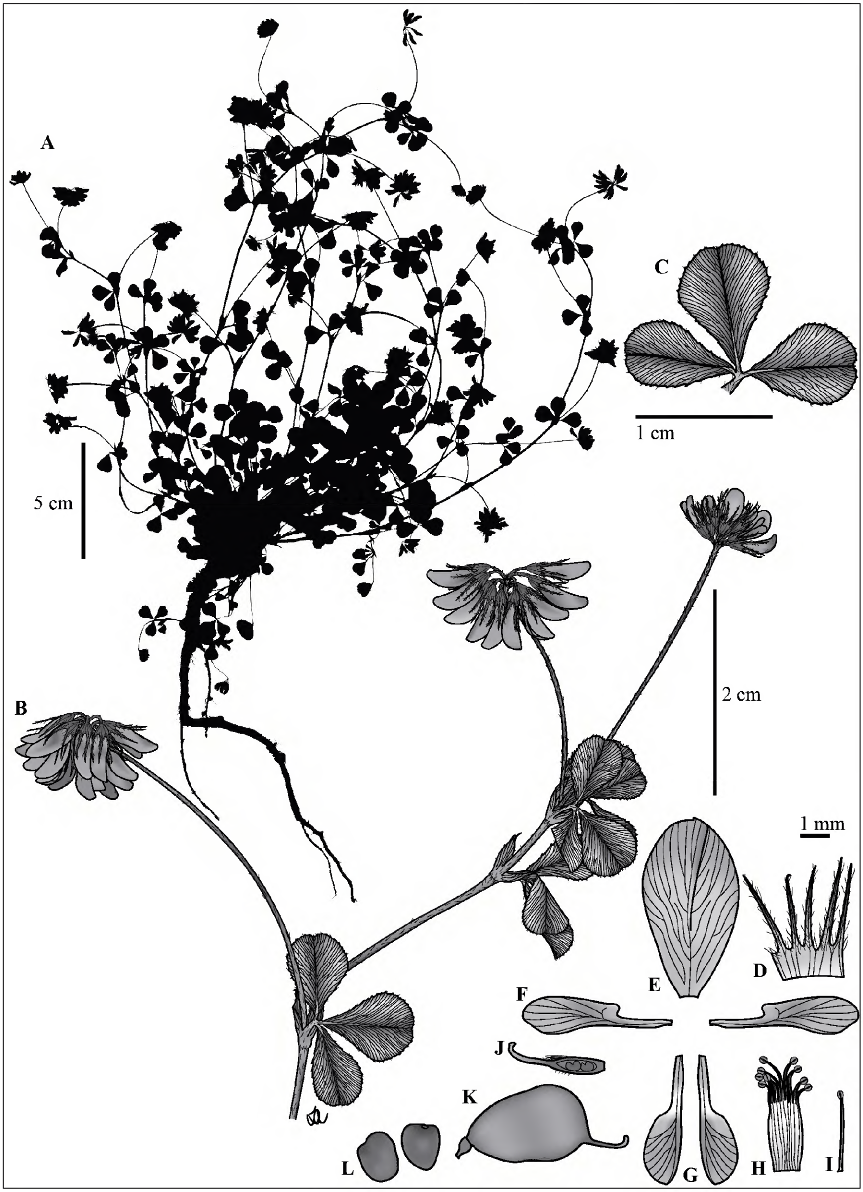

Figure 1. *Trifolium sonorense* (from the holotype). A. Habit silhouette. B. Fertile branch. C. Abaxial leaf surface. D. Sepals. E. Banner petal. F. Wing petals. G. Keel petals. H. Connate stamens. I. Free stamen. J. Ovary. K. Legume. L. Seeds.

Plants perennial. **Roots** woody, 3.5–8 mm in diameter. **Stems** prostrate, 25–38+ cm in length, 0.8–1.5 mm in diameter, internodes sparsely–moderately pubescent, nodes moderately–densely pubescent. **Leaves** trifoliate, ± uniform in size throughout. **Stipules** narrowly triangular, 6.7–16.5 mm × 1.8–3.1 mm, glabrous adaxially, glabrous–sparsely pubescent abaxially, margins entire–weakly serrate, sparsely pubescent, apices acute. **Petioles** 2.5–50.5 mm × <1 mm, moderately–densely pubescent. **Petiolules** 0.6–1.6 mm × ≤0.5 mm, sparsely–densely pubescent. **Leaflets** obovate–obcordate, glabrous adaxially, sparsely–moderately pubescent along midribs abaxially, glabrous–sparsely pubescent abaxially on outer halves of lateral leaflets, bases acute, margins weakly serrate–serrate, often with short, straight teeth alternating with larger, antrorsely curved teeth, sparsely pubescent, apices rounded–emarginate, weakly mucronulate, terminal leaflets 9.5–16.5 mm × 6.8–11.5 mm. **Peduncles** 28–50 mm × <1 mm, moderately–densely pubescent. **Inflorescences** axillary, racemose-umbellate, 8.5–15.5 mm × 9–15.5 mm. **Flowers** 10–20, each subtended by a linear triangular bract, in 1–2 whorls. **Pedicels** 1.2–2.7 mm × <0.5 mm, sparsely–densely pubescent. **Calyx** 3.3–5 mm long, tubes 2–3 mm in circumference, sparsely–densely - pubescent, lobes narrowly triangular, 2.5–4 mm × ≤0.5 mm, sparsely–densely pubescent abaxially, margins entire, sparsely–densely pubescent, apices acuminate. **Petals** white–pink. **Banner petals** obovate, 5.3–6.5 mm × 2.8–3.8 mm. **Wing petals** 4.5–5.3 mm long, asymmetrically clawed, claws 1.5–1.9 mm × ≤0.3 mm, laminae spatulate, 2.8–3.5 mm long, 1–1.5 mm wide at widest point, <1 mm wide at narrowest point, bases auriculate, auricles acute, margins entire, apices rounded. **Keel petals** 3.7–4.8 mm long, asymmetrically clawed, claws 1.7–2 mm × <0.5 mm, laminae spatulate, 1–1.3 mm long, 0.8–1.3 mm wide at widest point, 0.9–1.3 mm wide at narrowest point, bases truncate, margins entire, apices rounded. **Stamens** diadelphous, connate filaments 3.1–4 mm × 1.1–1.5 mm, fused for 50–56% of their length, free filaments 1.9–2.5 mm × ≤0.1 mm. **Pistils** sessile, ovaries 1.3–3.1 mm × 0.4–1.4 mm, moderately–densely pubescent distally and occasionally along suture, styles 1.3–2 mm × ≤0.2 mm, glabrous, ovules 2. **Legumes** laterally compressed, 4.3–4.4 mm × 2–2.7 mm. **Seeds** 2, globular–mitten-shaped, brownish orange–olive brown, occasionally dark-speckled, 1.2–1.7 mm × 1.2–1.5 mm.

Additional collections examined. **Mexico**. **Chihuahua**. Mpio. de Temoschi, Nabogame, pine/oak/cypress forest, trailing, flowers pink, 28.5°, -108.5°, 1800m, 24 Aug 1988, *Laferrière 1771* (ARIZ). **Jalisco.** Forest of *Quercus* scattered with *Arbutus*, 14–18 km SW of Tequila on Volcán de Tequila, flowers pink, 20.788°, -103.847°, 2600m, 7 Nov 1974, *Breedlove 39248* (MICH). **Sinaloa**. Mpio. de Concordia, 1–2 km N of the Mazatlan to Durango road at Loberas, pine-oak forest, perennial, flowers white, 23.47°, -105.85°, 1850m, 2 Oct 1985, *Bartholomew 2551 et al.* (GH, NY). **Sonora**. El Llano on Mesa del Campanero (W of Yécora), uncommon herb, flowers white, 28.341667°, -109.031944°, 2100m, 16 Aug 1998, *Reina G. 98-958 et al.* (NY); Yecora, 9.5 km W of Maycoba on Mex. 16, oak woodland, uncommon herbaceous perennial on moist roadside, flowers pink, 28.408889°, -108.725°, 1495m, 7 Aug 2000, *Van Devender 2000–406 et al.* (ASU, MO, RSA). **United States**. **Arizona**. Cochise Co.: wet soil at streamside in woodland with *Juniperus deppeana*, *Pinus leiophylla*, NW 1/4, Sec. 15, T23S R19E, 31.4314°, -110.4007°, 1783m, 11 Aug 1990, *Bowers 3242 & McLaughlin* (ARIZ); Huachuca Mountains, Tanner Canyon, wet places near springs, 31.49°, -110.32°, 1500m, 24 Aug 1910, *Goodding 794* (ARIZ, NY, US); Bear Canyon, at junction of jeep trail with canyon bottom, about 2 km NE of canyon crossing with road from Parker Canyon Lake to Montezuma Pass, common in patches in moist soil, with grasses, on stream bank under *Platanus wrightii*, 31.3914°, -110.347°, 1770m, 26 Sep 1980, *Yatskievych 80–719* (ARIZ).

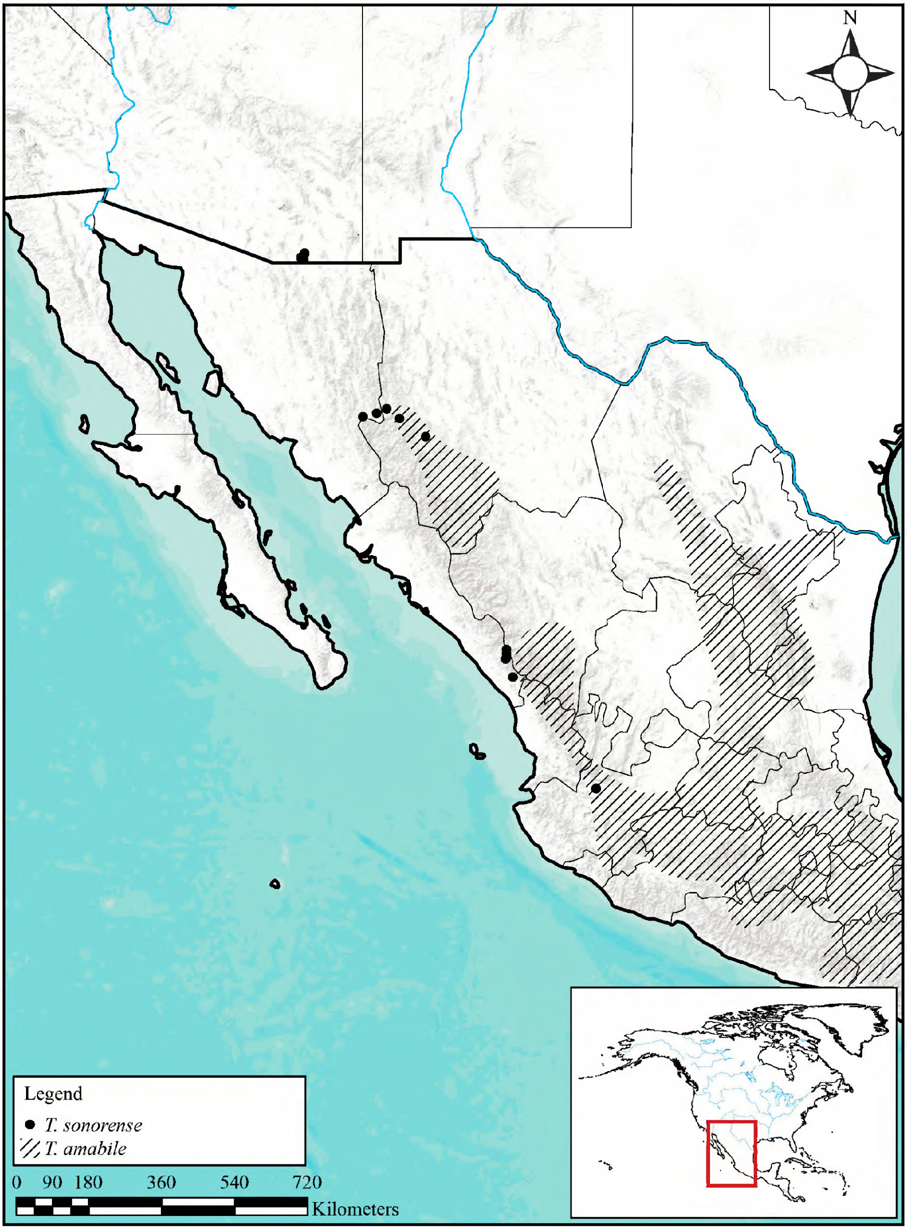

Figure 2. Distribution of *Trifolium sonorense* compared with the general range of *T. amabile*.

Trifolium sonorense is found largely in the Sonoran Desert of North America, but its range continues on eastward and southward. It has been collected in the state of Arizona in the USA and the states of Chihuahua, Jalisco, Sinaloa, and Sonora in Mexico (Fig. 2). Its habitat consists of open pine forests in canyons by stream banks or in moist soil from 1495 m to 2600 m in elevation.

Of the 50 characters observed in this study, over 42% of them were significantly different between *Trifolium amabile* and *T. sonorense* shown by T-tests (α=.05) run for each character (Ahlquist 2012). These include vegetative characters such as terminal leaflet size and petiole size, as well as floral characters. Among the most strikingly different are keel and wing petals, stamen, and sepals. The following key contrasts the distinguishing characteristics.

1. Keel petal claw length 0.9–1.6 mm; sepal lobe length <3 mm; connate filaments length <3.6 mm; wing petal claw length <1.5 mm .... **Trifolium amabile**
1. Keel petal claw length 1.7–2 mm; sepal lobe length ≥3 mm; connate filament length >3.6 mm; wing petal claw length >1.5 mm .... **Trifolium sonorense**

ACKNOWLEDGEMENTS

We thank the herbarium of Miami University (MU) for providing the support and resources necessary for this endeavor. We would also like to thank the curators of the following herbaria for loans of specimens for this study (acronyms from Thiers [continuously updated]): ARIZ, ASU, DAV, F, GH, MEXU, MICH, MO, US, NY, P, RSA, US, VT, and XAL. Finally, the authors thank Eric Tepe and Tom Lammers for their comments on a draft of the manuscript.

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Ertter, B. 2018. Two new North American *Potentilla* sect. *Rubricaules* (Rosaceae). Phytoneuron 2018-2: 1–14. Published 26 February 2018. ISSN 2153 733X

TWO NEW NORTH AMERICAN *POTENTILLA* SECT. *RUBRICAULES* (ROSACEAE)

BARBARA ERTTER
University and Jepson Herbaria
University of California
Berkeley, California 94720-2465
ertter@berkeley.edu

Snake River Plains Herbarium
Boise State University
Boise, Idaho 83725

Natural History Collections and Programs
The College of Idaho
Caldwell, Idaho 83605

ABSTRACT

Two new entities of *Potentilla* are described in sect. *Rubricaules*. **Potentilla hudsonii** Ertter, **sp. nov.**, which ranges from the prairies of Saskatchewan and adjacent Montana to southwestern Yukon, differs from *Potentilla modesta* in having both ternate and palmate leaves equally common, from *P. furcata* in having a more congested inflorescence with shorter pedicels, and from both in its more deeply incised leaves with more densely hairy adaxial surfaces, and near absence of visible glands. **Potentilla hookeriana** var. **charletii** Ertter, **var. nov.**, endemic to the Snake Range in White Pine County, Nevada, differs from typical *P. hookeriana* in having more densely hairy adaxial leaflet surfaces, leaves that are more often subpalmate, and pedicels somewhat longer and sturdier, resulting in a more open inflorescence. A table and key summarize the diagnostic differences among these species and varieties.

The complexities of *Potentilla* sect. *Rubricaules* (Rydb.) A. Nelson were such that a detailed synopsis (Ertter et al. 2013) was published as precursor to the more condensed account of the genus in *Flora of North America North of Mexico* (Ertter et al. 2015). Even with the extensive collaborative efforts that went into preparing this treatment, several elements were specifically excluded pending further research. Subsequent fieldwork and analysis of herbarium specimens has now provided sufficient data to recognize two of these elements as additions to sect. *Rubricaules*, described below. The descriptions and discussions are followed by a table and key summarizing the differences among the new taxa and other members of sect. *Rubricaules* that have overlapping or adjacent ranges. Descriptions and terminology largely follow that of other species in sect. *Rubricaules* in Ertter et al. (2015). All photos are by the author.

A new species of *Potentilla* centered in the Canadian prairies

Among the specifically excluded elements were "plants from the northern prairies of Saskatchewan, Alberta, and Montana [which] evidently represent an undescribed taxon" (Ertter et al. 2013). These plants are described here as a new species.

POTENTILLA HUDSONII Ertter, **sp. nov.** (Figures 1–4) TYPE: **Canada. Saskatchewan.** Mennon, dry rocky grassy slope at top of North Saskatchewan River breaks, occasional with *Geum triflorum, Senecio, Avena hookeri*, 8 Jun 1969, *Hudson 2612* (holotype: SASK170533; isotypes: DAO, SASK40926).

Differs from *Potentilla modesta* Rydb. in having both ternate and palmate leaves equally common, from *P. furcata* A.E. Porsild in having a more congested inflorescence with shorter pedicels, and from both in its more deeply incised leaves with more densely hairy adaxial surfaces, near absence of visible glands, and core distribution on the northern prairies.

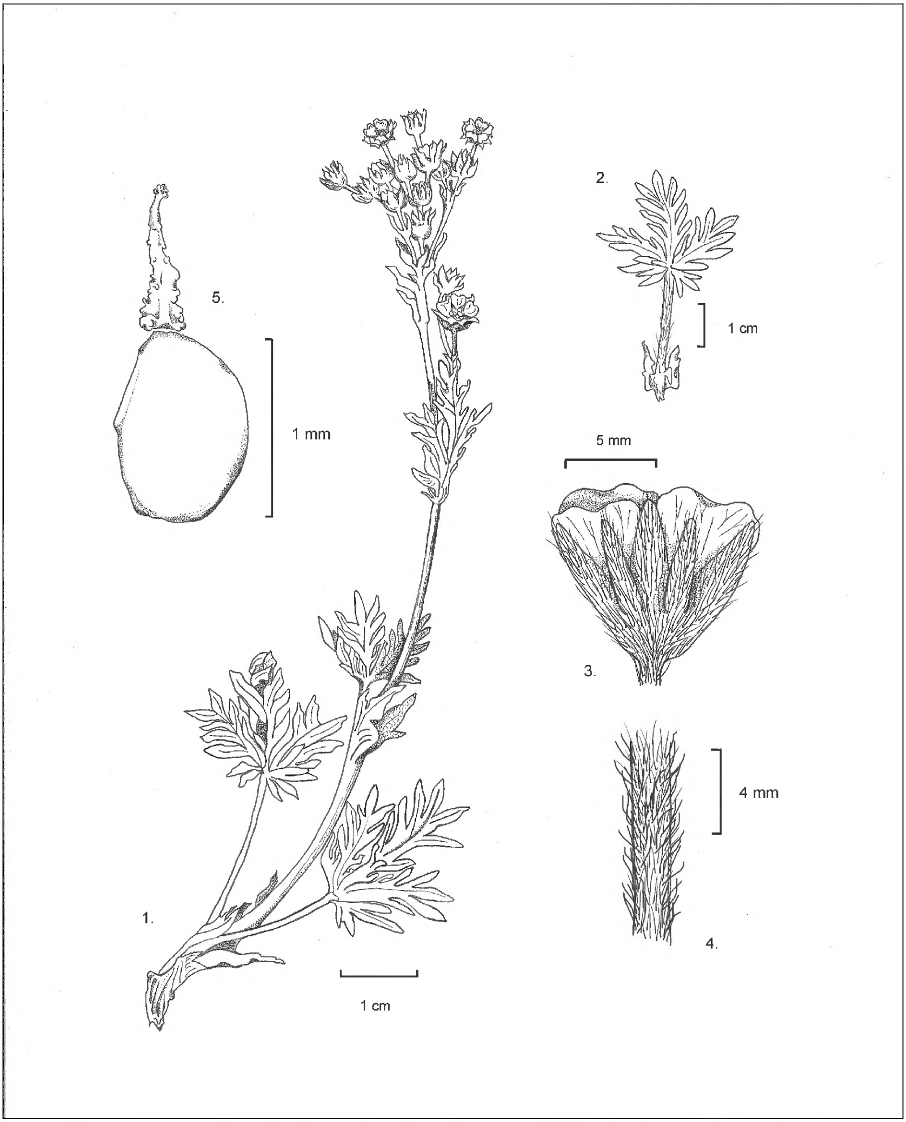

Figure 1. Line drawing of *Potentilla hudsonii*, by Karie Pappani. 1. Habit. 2. Adaxial side of subpalmate basal leaf. 3. Flower, side view. 4. Schematic showing relative density and orientation of petiole hairs. 5. Achene and style. (drawn from *Ertter et al. 22380*, supplemented by field photos and other collections).

Plants gray-green to silvery-white, ± tufted. **Caudex** simple or few-branched, not sheathed with marcescent whole leaves. **Stems** ascending to nearly erect, (0.7–)1–3 dm long. **Basal leaves** usually both ternate and palmate on same plant (or only ternate in Yukon), rarely subpalmate, (2.5–)3–9(–14) cm long; petiole (0.5–)1–5(–8) cm long, long hairs abundant to dense, appressed to ascending, 1.5–2 mm long, usually stiff, verrucose, short-crisped hairs common, cottony hairs absent, glands absent; leaflets 3–5, not to somewhat overlapping, proximalmost separated from others by 0(–5) mm of leaf axis, central leaflet oblanceolate to elliptic, (0.8–)1.2–3(–5) × 0.7–1.5(–2) cm, petiolule 0–2(–6) mm long, nearly all of margin incised ¾ or more to midvein, revolute, teeth (3)4–5(–7) per side, usually not or scarcely overlapping (except in Yukon), ± linear to oblanceolate, small secondary teeth sometimes present, 3–7(–10) mm long, apical tufts 0.5–1 mm long, abaxial surface white, long hairs dense on veins, cottony-crisped hairs dense, short hairs and glands absent or obscured, adaxial surface grayish green to grayish, long hairs common to dense, 1.5–2 mm long, usually stiff, short and/or crisped hairs common to abundant, glands, if present, obscured. **Cauline leaves** (1)2(3). **Inflorescences** (3–)8–20(–25)-flowered, congested at anthesis, sometimes becoming more open and elongate with age, branch angle 10–30°. **Pedicels** 0.2–0.7 cm long, proximal ones to 1.2(–1.5) cm long. **Flowers** cup-shaped at anthesis; hypanthium 2–4(–5) mm diam.; epicalyx bractlets linear to narrowly lanceolate-elliptic, 2–4 × 0.5–1 mm; sepals 3–4.5(–5.5) mm long, apex ± acute, glands absent or obscured (except in Yukon); petals canary yellow, lacking darker basal patch, ± ascending at anthesis, scarcely overlapping, 3–5(–6) × 3–4 mm, equalling or slightly longer than sepals, apex shallowly retuse; filaments opposite sepals ca 2 mm long, other filaments ca 1 mm long, anthers ca 0.4 mm long; carpels ca 30–70, styles ± 1 mm long, ± tapered, proximal ½(–¾) strongly papillate. **Achenes** ca 1.3 mm long, smooth or lightly veined.

Flowering from (May) June to July, or to August in Montana. Mostly open spots in grasslands, often in thin-soiled, rocky, sandy, and/or heavily grazed sites, as well as gravelly slopes and roadsides; elev. 490–2100 m (highest in Montana).

Figure 2. Habitat (on top of blow-out) of *Potentilla hudsonii* (*Ertter et al. 22380*).

Etymology. Named for John Howard Hudson (1923–2010), a professional chemist whose passion for the Saskatchewan flora resulted in thousands of specimens collected over the course of 50 years (MacPherson 2000). Hudson's collections, donated to SASK in 2008, provide excellent documentation of the declining remnant flora of Saskatchewan's prairies, including multiple collections of this new species named in his honor.

Figure 3. Plant of *Potentilla hudsonii* (*Ertter et al. 22380*).

Figure 4. Cup-shaped flowers of *Potentilla hudsonii* (*Ertter et al. 22380*).

Figure 5. Habitat and habit of *Ertter 22896* in Kluane National Park, Yukon.

Other collections examined. CANADA. Alberta. Hill back of Camp Chelan on Ghost River, 5 Jul 1950, *McCalla 11102* (ALTA); Kle[s]kun Hill, 19 Jun 1979, *Wallis s.n.* (ALTA); Kleskun Hills Park NE of Grand Prairie, 15 Jun 1979, *Wilkinson 33* (ALTA); Snaring River campsite road, Jasper NP, 10 Jun 2006, *Yakimchuk & Ottenbreit s.n.* (ALTA). **Saskatchewan**. Nisbet Provincial Forest, 20 June 1949, *Boivin & Breitung 6119* (DAO); 7 milles au sud-est du lac Bulkin (Bengough), 10 Aug 1951, *Boivin & Gillet 8744* (SASK); no locality, 1857-8, *Bourgeau s.n.* (K); Leslie, 20 Jun 1935, *E.T.H. & R.C.R[ussell] s.n.* (SASK); ca 2 airkm NNW of Petrofka Bridge, 24 Jun 2015, *Ertter et al. 22380* (SRP, UC); Saskatoon, 29 Jun 1939, *Fraser s.n.* (ALTA, DAO, SASK); Saskatoon, 19 Jul 1938, *Furniss 989* (V); Red Deer River plains, Prince Albert, 27 Jun 1942, *Furniss 1004* (SASK, V); Warman, 20 Jun 1935, *Groh s.n.* (DAO); Environ, 25 Jun 196, *Hudson 2508* (DAO, SASK); Herschel, 3 Jun 1984, *Hudson 4437* (SASK); Wolverine, 15 Jun 1989, *Hudson 4829* (SASK); Kerrobert, 10 Jun 1992, *Hudson 5048* (SASK); Richard, 13 Jun 1953, *Jenkins 1240* (DAO); townsite of Richard, 15 Jun 1953, *Jenkins 1269* (DAO);10 mi E of Saskatoon, 20 Jun 1952, *Ledingham 1364* (NY); Heatherleigh Community Pasture near Sandwith, 7 Jun 1991, *Leighton et al. s.n.* (SASK); ca 1 km N of Petrovka Bridge over North Saskatchewan River along Rt. 12, Aug 1988, *Marvin 3418* (ALTA); N of Rosthern, 1939, *Stevenson 11* (DAO); Rosthern, Jun 1939, *Stevenson s.n.* (SASK). **Yukon** (see discussion). Bear Cr, Alaska Hwy km 1646, 29 Jul 1980, *Cody & Ginns 28592* (DAO); W end Sheep Ridge Trail from Soldier Summit trail, 26 Jun 2017, *Ertter 22896* (ALA, BABY, NY, SRP, UC); Congdon Creek campground, 27 Jun 1987, *Marvin 2502* (ALTA); Alaska Hwy ca 4.8 km S of Edith Creek, 27 Jun 1987, *Marvin 2509* (ALTA). **USA. Montana.** Liberty Co.: Les Trois Buttes (Sweetgrass Buttes), Butte de l'Est, Sommet du Mont-Royal, 10 Aug 1955, *Boivin & Mosquin 11427* (DAO). Toole Co.: Les Trois Buttes, Butte de l'Ouest, 8 Aug 1955, *Boivin & T Mosquin 11267* (DAO).

Most of the existing collections of *Potentilla hudsonii* were originally identified as *Potentilla quinquefolia* Rydb., *P. nivea* L. var. *pentaphylla* Turcz. (mistakenly attributed to Lehm.), *P. subquinata* (Lange) Rydb., *P. rubricaulis,* or *P. hookeriana* Lehm. The first four names have commonly been treated as synonyms or elements of a single broadly circumscribed taxon, to which Soják (1986) added *P. hookeriana* after re-evaluating the type. The homotypic synonyms *P. quinquefolia* and *P. nivea* var. *pentaphylla* are now understood to apply to the Asian *P. altaica* Bunge, while *P. subquinata* is now interpreted as the casual hybrid of *P. nivea* and *P. arenosa* (Turcz.) Juz. (Ertter et al. 2013; Soják 1986). In Scoggan's (1978) *Flora of Canada*, plants of *P. hudsonii* would presumably be encompassed by *P. nivea* subsp. *subquinata* (Lange) Hultén, even though the key to species only allows for plants with three leaflets in *P. nivea.*

One possible nomenclatural complication that needed to be resolved prior to publishing *Potentilla hudsonii* was whether the type of *P. hookeriana* might possibly be conspecific. Although the name had traditionally been used for a wide-ranging arctic and alpine species with trifoliate leaves (now known as *P. arenosa*), Soják (1986) noted that the type collection is 3–5-leaved and therefore part of the *P. rubricaulis* species complex. The type locality of *P. hookeriana* is vague, simply "Rocky Mts.," potentially anywhere from central Alberta to central Utah based on the collector Joseph Burke's itinerary (McKelvey 1955). The northern boundary of Burke's activities was within the range of *P. hudsonii,* and the deeply incised 5-foliate leaves are compatible with that species. The plants themselves are in early anthesis, so that the inflorescences have not yet fully developed. However, it is clear that some pedicels are significantly longer and leaves more bicolored than those of *P. hudsonii*, consistent with the current circumscription of *P. hookeriana* (Ertter et al. 2013, 2015).

The core range of *Potentilla hudsonii* is the prairies of Saskatchewan and Alberta, extending into the edges of jack pine woodland in Nesbit Provincial Forest. Whether the apparently sporadic distribution in Alberta is a true indication of the historical range, or simply an artifact of collecting bias, is uncertain. The species is known in the USA only from the Sweet Grass Hills ("Les Trois Buttes") in north-central Montana, and from there only by two collections by Boivin and Mosquin in

1955. Throughout this area it is the only representative of sect. *Rubricaules*, distinctive in its combination of deeply incised silvery leaves, compact inflorescence, and absence of visible glands.

The situation is less clear farther to the northwest, where the range of *Potentilla hudsonii* overlaps the ranges of both *P. rubricaulis* Lehm. and *P. furcata* in southern Yukon (and very likely adjacent British Columbia, though no collections of *P. hudsonii* from this province are currently confirmed). Assigning collections from this area of overlap to one of these three species can be problematic, complicated by the high probability of introgression and hybrid swarms. This is particularly well documented by multiple collections from Congdon Campground, an easily visited site on the Alaskan Highway on the west side of Kluane Lake, including several by the author (*Ertter 22729* in July 2016 and *22886-22887* in June 2017). Nevertheless, at least one population from Kluane National Park in the Yukon (*Ertter 22896*, Fig. 5) consists of morphologically uniform plants whose adaxially silvery leaves and compact inflorescences are diagnostic of *P. hudsonii*, although differing from those in the northern prairies in being more visibly glandular and other exceptions noted in the description. One possible interpretation is that the distribution of *P. hudsonii* in the Yukon is largely relictual and that the species is being swamped by introgression with *P. rubricaulis* and/or *P. furcata* in this part of its range.

The abundance of historical collections of *Potentilla hudsonii* in Saskatchewan obscures the species' possible current rarity. Two days of intensive search for extant populations within a few hours' drive from Saskatoon in 2015 located a single small population of less than twenty plants (*Ertter et al. 22380,* Figs. 2–4), too few to serve as a type collection. The single site was a sandy blow-out in well-grazed pastureland, in contrast to the dense stands of invasive *Bromus inermis* Leyss. that dominated most of the other sites that were searched, most of which were historical localities.

A new variety of *Potentilla hookeriana*

The nomenclatural history of *Potentilla hookeriana* Lehm. in the broad sense is convoluted, as summarized in Ertter et al. (2013) and mentioned above. Prior to 1986, the name encompassed widespread arctic and alpine plants that had three leaflets that were tomentose abaxially and petioles with stiff spreading hairs. Sometimes this circumscription was treated as a subspecies of *Potentilla nivea* L. (e.g., Scoggan 1978). A period of nomenclatural transition ensued when Soják (1986) not only noted that the type of *P. hookeriana* had some 5-foliate leaves, but then subsequently (1989) noted that the type of *P. nivea* was in fact conspecific with what had been called *P. hookeriana,* rather than with tomentose-petioled plants that had traditionally been called *P. nivea* s.s. The use of *P. nivea* for plants that had previously been called *P. hookeriana* was briefly adopted, until the original application of *P. nivea* was re-established as a result of conserving the type (Eriksen et al. 1999). The name *P. arenosa* was subsequently adopted for the 3-foliate arctic component of former *P. hookeriana,* while the latter name was retained for 3–5-foliate alpine plants in the Rocky Mountains and eastern Great Basin (Ertter et al. 2013, 2015).

The treatment of *Potentilla* for the Intermountain Flora (Holmgren 1997), which was published during the nomenclatural transition period, used *P. nivea* to encompass both *P. nivea* s.s. (tomentose petioles) and at least trifoliate *P. hookeriana* (hirsute petioles) as now recognized in *Flora of North America* (Ertter et al. 2015). These latter treatments excluded a series of collections from the Intermountain region that differed in having notably hairier adaxial leaflet surfaces and more open inflorescences than typical *P. hookeriana.* These collections are all from the Wheeler Peak area in the Snake Range (mistakenly referenced as "Schell Peak" in Ertter et al. 2013), White Pine County, Nevada. These collections are described here as a new variety, using the rank that is appropriate for the highly restricted range surrounded by the common variety, with nearby intermediates and diagnostic characters that are a matter of degree rather than absolutes.

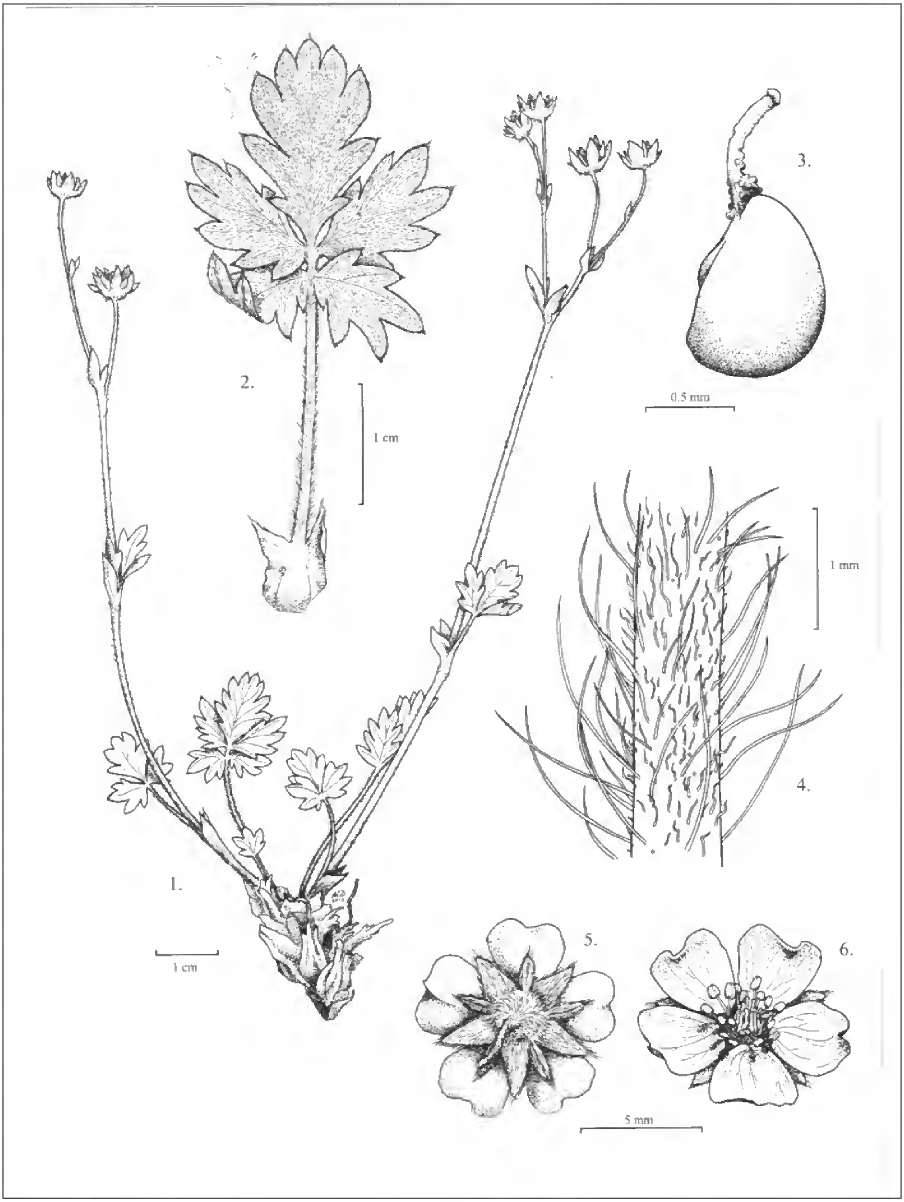

Figure 6. Line drawing of *Potentilla hookeriana* var. *charletii* by Alexa DiNicola. 1. Habit. 2. Adaxial side of subpalmate basal leaf. 3. Achene and style. 4. Petiole hairs. 5. Flower, abaxial side. 6. Flower, adaxial side. (drawn from *Ertter & Baker 20433*, supplemented by field photos).

POTENTILLA HOOKERIANA Lehm. var. CHARLETII Ertter, **var. nov.** (Figs. 6–9) **TYPE: USA. Nevada.** White Pine Co.: Snake Range, ridge N of Wheeler Peak, frequent, 12,000 ft., 4 Aug 1941, *Maguire 21165* (holotype: UC1249488; isotypes: DAO, NY, UTC, WTU).

Differs from typical *Potentilla hookeriana* in having more densely hairy adaxial leaflet surfaces, leaves that are more often subpalmate, and somewhat longer and sturdier pedicels resulting in a more open inflorescence.

Plants gray-green, tufted. **Caudex** branched, usually sheathed with old leaf-bases. **Stems** decumbent to ascending-erect, 0.5–2.1 dm long. **Basal leaves** usually both ternate and palmate or subpalmate on same plant, 1–6(–8) cm long; petiole 0.3–4(–5) cm long, long hairs sparse to abundant, ascending (appressed), 1–1.5(–2) mm long, ± stiff, verrucose, short-crisped (to cottony) hairs common, glands sparse; leaflets 3–5, ± overlapping, proximalmost pair separated from others by 0–2 mm of leaf axis, central leaflet ± obovate, 0.7–1.5(–2) × 0.5–1.2(–1.5) cm, petiolule 0–1 mm long, distal ¾+ of margin incised ± ½ –⅔(–¾) to midvein, ± revolute, teeth 3–6 per side, often overlapping, ± ovate to elliptic, 2–5 mm long, apical tufts 0.5–1 mm long, abaxial surface greenish gray to white, long hairs dense on veins, cottony-crisped hairs abundant to dense, short hairs absent, glands probably present but usually obscured, adaxial surface grayish green to grayish, long hairs common to abundant (sparse), ± 1 mm long, weak to stiff, short and/or crisped hairs sparse to common, glands sparse, sometimes obscured. **Cauline leaves** (0)1(2). **Inflorescences** (1)2–10-flowered, open, branch angle (10–)20–60°. **Pedicels** 0.8–3 cm long, proximal ones to 5 cm long. **Flowers** bowl-shaped at anthesis; hypanthium 3–5 mm diam.; epicalyx bractlets narrowly elliptic, 2–3.5 × 0.5–1 mm; sepals 3–5 mm long, apex acute, glands sparse to common, not obscured; petals yellow, lacking darker basal patch, slightly overlapping, 4–6 × 3.5–5 mm, slightly longer than sepals, apex ± retuse; filaments opposite sepals 1.5–2 mm long, other filaments 0.5–1 mm long, anthers ca 0.5 mm long; carpels ca 20–30, styles ± 1 mm long, distal ⅔–¾ ± columnar, proximal ¼–⅓ strongly papillate. **Achenes** 1.3–1.5 mm long, smooth or lightly veined.

Flowering from July to August. Alpine ridges, fellfields, quartzite rubble; elev. 3400–3700 m.

Etymology. I am pleased to name this *Potentilla* after David Alan Charlet (b. 1953), in recognition of his contributions to our understanding of the distribution of high-montane plants in Nevada, in particular conifers (Charlet 1996, 2007).

Other collections examined. Nevada. White Pine Co. (all Snake Range): trail to Wheeler Peak, above treeline, *Charlet 2572* (UC); trail up Wheeler Peak; N38.9964° W114.3225°, *Ertter & Baker 20433* (see discussion); saddle between Wheeler Peak and Bald Mountain, rocky ridgetop, *Holmgren & Vincent 10975* (BRY, NY, RSA, UC); NW side of Wheeler Peak, near rim of cirque, *Marvin 3193* (ALTA); N side Wheeler Peak, rocky slopes above Stella Lake, *McVaugh 6031* (UC).

As previously indicated, *Potentilla hookeriana* var. *charletii* is known only from the north end of the Snake Range in Great Basin National Park, White Pine Co., Nevada, from Wheeler Peak to Bald Mountain. Plants occur above timberline on a quartzite substrate, sometimes with the endemic *P. holmgrenii* D.F. Murray and Elven (Fig. 10). Two collections from relatively nearby mountain ranges in Utah approach var. *charletii* in their leaflet adaxial vestiture but lack the other diagnostic characters. These are *Goodrich 19022* (BRY, NY, UT) from the Deep Creek Mountains in Juab County and *Goodrich 24187* (ASU, BRY) from Mount Terrill in Sevier County. Both collections lack subpalmate leaves and have inflorescences more diagnostic of var. *hookeriana*. Pubescence of plants in *Goodrich 19022* is silkier than typical for *P. hookeriana*; further research on populations in the Deep Creek Mountains is warranted.

Permission to collect this and other *Potentilla* in Great Basin National Park (permit GRBA-2010-SCI-0012) is gratefully acknowledged, and it was a genuine pleasure to spend a day on Wheeler Peak with park naturalist Gretchen Baker. Unfortunately, the current requirement that national parks retain ownership of any specimens collected within the park is incompatible with most herbaria's accession policies. A previously distributed collection is therefore reluctantly used as the holotype for this new variety, while the ultimate disposition of the collection that was made with this use in mind (*Ertter & Baker 20433*), and on which the description is primarily based, remains to be determined.

Figure 7. Habitat of *Potentilla hookeriana* var. *charletii* on the north side of Wheeler Peak, looking north across saddle to Bald Mountain (upper left).

Figure 8. Habit of *Potentilla hookeriana* var. *charletii* (*Ertter & Baker 20433*).

Figure 9. Flower of *Potentilla hookeriana* var. *charletii* (*Ertter & Baker 20433*); sixth petal is anomalous.

Figure 10. *Potentilla holmgrenii* (left) and *P. hookeriana* var. *charletii* (right of center) growing side by side on Wheeler Peak.

Table 1. Summary of significant differences among *Potentilla hudsonii, P. hookeriana* var. *charletii,* and other members of sect. *Rubricaules* that have overlapping or adjacent ranges. Full descriptions of other species, along with explanations of terminology, are in Ertter et. al (2015).

	rubricaulis	***furcata***	***hudsonii***	***modesta***	***hookeriana***	***charletii***
stem length dm	1.5–4	(0.5–)1–3	(0.7–)1–3	(0.3–)0.5–1.5(–2.5)	(0.3–)0.5–2	0.5–2.1
leaf dissection	ternate and palmate, rarely subpalmate	ternate and palmate, sometimes subpalmate or only ternate	ternate and palmate, rarely subpalmate or only ternate	usually palmate, rarely ternate or subpalmate	usually ternate and palmate, rarely subpalmate	ternate and palmate or subpalmate
petiole length cm	2.5–7	2.5–8	(0.5–)1–5(–8)	0.5–3.5(–5)	0.5–6	0.3–4(–5)
central lflt length cm	1.5–4	1.4–2.5(–5)	(0.8–)1.2–3(–5)	0.5–2(–2.5)	0.5–2.5	0.7–1.5(–2)
lflt incision to midvein	½–¾(+)	½–¾+	¾+	½–¾	½–¾(+)	± ½–⅔(–¾)
lflet teeth per side	(4)5–8	3–5	(3)4–5(–7)	2–5	2–6	3–6
lflt tooth length mm	4–5 mm	5–6	3–7(–10)	(1–)2–5	1–5	2–5
lflet adaxial color	green to grayish green	green to grayish green	grayish green to grayish	grayish green	green to grayish green	grayish green to grayish
lflet adaxial hair density	sparse to common	sparse to common	common to dense	common to abundant	sparse to common	common to abundant (sparse)
infl. density	open	± open	congested	± congested	open	open
infl. branch angle	(10–)20–45°	5–30(–50)°	10–30°	20–35°	20–50°	(10–)20–60°
flower # per infl.	4–20	7–12(–20)	(3–)8–20(–25)	(1–)3–10	1–6(–8)	(1)2–10
pedicel length cm (proximal maximum)	0.5–3(–5)	(0.5–)1–2(–3)	0.2–0.7(–1.5)	0.2–0.5(–1.2)	(0.5–)1–2(–3)	0.8–3(–5)
hypanth. diam. mm	4–6	2.5–3.5	2–4(–5)	3–4	3–4	3–5
sepal glands	evident	evident	absent or obscured (except Yukon)	evident	evident	evident
petal length × width mm	5–7 × (4–)5–6.5	3–5(–6) × 3–4(–5)	3–5(–6) × 3–4	3.5–5 × 3–4	3–6(–7) × 4–5	4–6 × 3.5–5

Key to the species in Table 1 (modified from Ertter et al. 2015)

1. Inflorescences ± congested; pedicels 0.2–0.7 cm long, proximal to 1.2(–1.5) cm long; leaflets grayish green to grayish adaxially — inflorescence branch angle 10–35°; leaves rarely subpalmate.

    2. Sessile glands evident on sepals (and elsewhere); leaves almost all palmate, rarely ternate, incised ½–¾ to midvein; teeth (1–)2–5 mm long; mountains of Colorado, Idaho, w Montana, Utah, and Wyoming .... **Potentilla modesta**
    2. Sessile glands absent or obscured on sepals (and elsewhere) except in Yukon; leaves usually both ternate and palmate on same plant, incised ¾ or more to midvein; teeth 3–7(–10) mm long; Great Plains in Saskatchewan, Alberta, and n-central Montana, sporadic in s Yukon .... **Potentilla hudsonii**

1. Inflorescences ± open; pedicels 0.5–3 cm long, proximal to 5 cm long; leaflets green to grayish adaxially — sessile glands evident on sepals; leaves usually both ternate and palmate or subpalmate on same plant, incised ½–¾+ to midvein.

    3. Inflorescence branch angle 5–30(–50)°; petals 3–5(–6) × 3–4(–5) mm — leaflets green to grayish green adaxially, teeth 3–5 per side; unglaciated areas in ne British Columbia, Yukon, and interior Alaska .... **Potentilla furcata**
    3. Inflorescence branch angle (10–)20–60°; petals 3–7 × 3.5–6.5 mm.

        4. Stems 1.5–4 dm long; leaflet teeth (4)5–8 per side; inflorescence 4–20-flowered; hypanthium 4–6 mm diam.; glaciated regions of w Canada and adjacent Alaska — leaflets green to grayish green adaxially .... **Potentilla rubricaulis**
        4. Stems (0.3–)0.5–2.1 dm long; leaflet teeth 2–6 per side; inflorescence 1–10-flowered; hypanthium 3–4(–5) mm diam.; mostly alpine regions, Rocky Mountains to eastern Great Basin .... **Potentilla hookeriana**

            5. Leaves green to grayish green adaxially with sparse to common hairs; leaves rarely subpalmate; pedicels (0.5–)1–2 cm long, proximal to 3 cm long; s Canadian Rockies to Idaho, Nevada (but not the Snake Range), Utah, and Colorado ..... var. **hookeriana**
            5. Leaves grayish green to grayish adaxially with common to abundant (rarely sparse) hairs; leaves often subpalmate; pedicels 0.8–3 cm long, proximal to 5 cm long; Snake Range, White Pine Co., Nevada .... var. **charletii**

ACKNOWLEDGEMENTS

I am indebted to staff and students at the University of Saskatchewan who made my search for *Potentilla hudsonii* and other prairie species possible: Eric Lamb, for providing use of a vehicle and student; Alicia Blyth Merriam (the aforementioned student) for her invaluable field assistance and delightful companionship; herbarium curator Hugo Cota-Sánchez and herbarium technician Denver Falconer for access to SASK collections and shipping of my specimens. I am equally indebted to Bruce Bennett for hosting my trips to the Yukon and arranging my invitation to the 2017 BioBlitz of Kluane National Park, along with the staff of Kluane National Park, other BioBlitz participants, and the staff of the Kluane Lake Research Station. The assistance and field companionship of Great Basin National Park naturalist Gretchen Baker is gratefully acknowledged, as is the generosity of Darren Sacher and other Saskatchewan landowners in allowing access to their property. Alexa DiNicola and Karie Pappani graciously shared their artistic talents in creating the lovely line drawings of the two new *Potentilla,* and Anna Leighton provided biographical information on John Hudson. I am grateful to the directors and/or staff of the herbaria ALTA, ASU, BABY, BM, BRY, DAO, E, K, NY, PR, RENO, RSA/POM, SASK, SRP, UC/JEPS, UT, UTC, V, W, and WTU for loans, access to collections, and general herbarium support. The field companionship of Lindsay Woodruff is always appreciated, as are the friendship and enlightening conversations with David Charlet. Convenient accommodations made available by the generous hospitality of Bruce Pavlik, Erica Wheeler, Joanne Kerbavaz, and James Wood has been critical to my ongoing research on *Potentilla*. Support from the Lawrence R. Heckard, Mary L. Bowerman, Louise Kellogg, Clara Ball Pearson, and Harriet A. Walker endowment funds of the University and Jepson Herbaria is gratefully acknowledged. Collections in Kluane National Park were made under permit KLU-2017-25041; those in Great Basin National Park were made under permit GRBA-2010-SCI-0012.

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VAILIA ANOMALA, A NEW NAME FOR *BLEPHARODON MUCRONATUM* (APOCYNACEAE, ASCLEPIADOIDEAE)

W.D. STEVENS
Missouri Botanical Garden
P.O. Box 299
St. Louis, Missouri 63166-0299
douglas.stevens@mobot.org

ABSTRACT

The common Mesoamerican species *Blepharodon mucronatum* (Schltdl.) Decne. is transferred to the genus *Vailia* Rusby. Since *Vailia mucronata* Rusby precludes that epithet, the next available name results in the combination **Vailia anomala** (Brandegee) W.D. Stevens, **comb. nov.**

Blepharodon Decne. was originally described with nine species, including *B. mucronatum*, (Decaisne, 1844) and was lectotypified with *B. lineare* (Decne.) Decne. by Fournier (1885). The genus has been twice reviewed (Fontella & Marquete, 1973; Morillo, 1976) and with gradual additions now comprises about 66 published names and perhaps 15–20 recognizable species, all South American except *Blepharodon mucronatum,* which ranges from central Mexico to northern South America. Morillo (1976) excluded *Blepharodon mucronatum* from the genus: "My definition of *Blepharodon* eliminates *B. mucronatum* as a member of the genus. *Blepharodon mucronatum* differs from *Blepharodon* (as defined here) by its vesicular corona segments and its stipitate gynostegium." However, Morillo did not suggest another name for the species and floristic treatments have only used the name in *Blepharodon* (e.g. Balick et al. 2000; Molina, 1975; Spellman, 1975; Standley &Williams, 1969; Stevens, 2001, 2009).

Molecular studies have, to date, too poorly sampled the species of *Blepharodon* to offer any guidance for the proper placement of *B. mucronatum.* However, it seems from those molecular studies (Liede, 2005, 2013; Rapini et al. 2003, 2006) that *Blepharodon* is not monophyletic, with two species, *B. lineare* and *B. ampliflorum* E. Fourn., standing well apart from the remaining species. In his review, Morillo (1976) divided the genus into two (unpublished) morphological subgenera, with *Blepharodon lineare* representing the type subgenus and *B. ampliflorum* as a synonym of *B. lineare.* Besides the list of floral differences described by Morillo (1976), these plants are the only erect (non-twining) species of the genus and have strikingly large flowers. Earlier, Woodson (1941) had reached the same conclusion: "The nine species assigned to *Blepharodon* by Decaisne fall into two groups superficially marked by volubile or erect herbaceous habits, but accompanied by interesting differences in the corona and pollinia as well." Woodson went on to ineffectively typify the genus with the twining species. Standley & Williams (1969) made a similar observation: "Decaisne's generic description seems to be based on a mixture of two genera. We accept the name based on *B. mucronatum.*"

The only generic synonym of the current circumscription of *Blepharodon* is *Vailia* Rusby, described with the single species *V. mucronata* Rusby. Morillo (1997) added *Vailia salicina* (Decne.) Morillo, based on *Blepharodon salicinum* Decne., and considered *V. mucronata* to be a synonym of that name. Morillo further suggested that *Vailia* belonged in the tribe Marsdeniae rather than the Asclepiadeae, because of the erect pollinia. The pollinium position is actually ambiguous and Liede (1996), Goyder (2009), and Endress et al. (2014) have maintained the species as *Blepharodon* in the Asclepiadeae.

It seems clear that in the future *Blepharodon* will be restricted to the two southern South American erect species, *B. lineare* and *B. ampliflorum*, and that the Mesoamerican species needs a new name. It is not yet clear whether *Vailia* can accommodate species with both short, erectish pollinia and long pendent pollinia, as well as with both vesicular and laminar corona lobes. My best guess is that this expanded concept of *Vailia* will survive, and I have chosen to place the Mesoamerican species there.

VAILIA ANOMALA (Brandegee) W.D. Stevens, **comb. nov.** *Philibertia anomala* Brandegee, Univ. Calif. Publ. Bot. 4: 277. 1912. *Blepharodon anomalum* (Brandegee) Schltr., Repert. Spec. Nov. Regni Veg. 13: 283. 1914. *Astephanus mucronatus* Schltdl., Linnaea 8: 518. 1833 [1834], non *Vailia mucronata* Rusby, 1898. *Blepharodon mucronatum* (Schltdl.) Decne. in A. DC., Prodr. 8: 603. 1844. **TYPE: MEXICO. San Luis Potosí.** Rascón, Aug 1911, *C. A. Purpus 5258* (holotype: UC; isotypes: F, MEXU, MO).

Figure 1. Flower of *Vailia anomala* with white, vesicular corona lobes. *Stevens 27809*. Photo: O.M. Montiel.

Figure 2. Lateral view of flowers of *Vailia anomala* with white, vesicular corona lobes. *Stevens 28310.* Photo: O.M. Montiel.

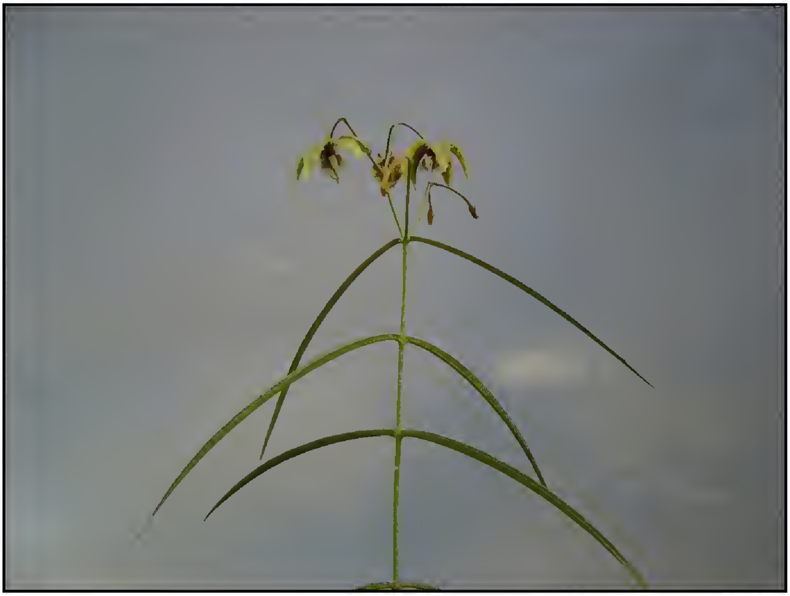

Figure 3. Flowering shoot of *Blepharodon lineare*, type species of the genus. *Fuentes 5731.* Photo: A.F. Fuentes C.

Figure 4. Flower of *Blepharodon amazonicum* (Benth.) Fontella & Marquete, a typical non-type *Blepharodon* with laminar corona lobes. *Van der Werff et al. 24571.* Photo: R. Rojas.

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PALHINHAEA CERNUA (NODDING CLUB-MOSS) WEST OF THE MISSISSIPPI RIVER

M.H. MACROBERTS & B.R. MACROBERTS
Herbarium (LSUS), Museum of Life Sciences
Louisiana State University in Shreveport
Shreveport, Louisiana 71115
mmacrobe@lsus.edu

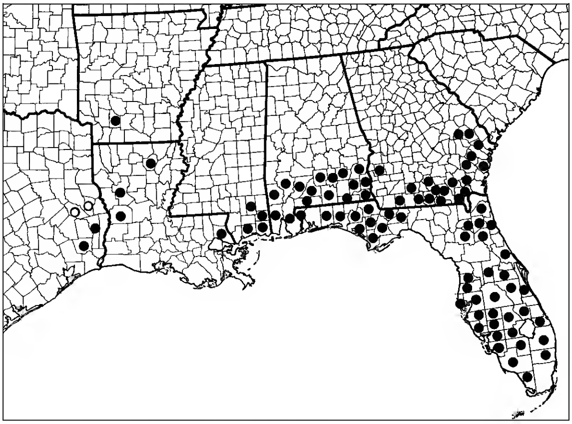
E.L. KEITH
Research Affiliate
University of Texas at Austin
Plant Resources Center
24 Summer Place
Huntsville, Texas 77340

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109

ABSTRACT

Palhinhaea cernua has been found on the West Gulf Coastal Plain in few numbers in Texas (Hardin and Jasper cos.; undocumented records from Angelina and San Augustine cos.), Louisiana (Natchitoches, Ouachita, and Vernon parishes), and Arkansas (Nevada Co.). Plants at some of these localities, however, are known to have become extinct in the last 10-20 years, suggesting that they are essentially waifs, arriving relatively recently through long-distance dispersal and not persisting.

Palhinhaea cernua (L.) Vasc. & Franco (nodding club-moss) occurs in the southeastern USA from Florida and Georgia west to Mississsippi and Plaquemines Parish, Louisiana (east of the Mississippi River). On the West Gulf Coastal Plain, it has been found at scattered sites in Louisiana and in Arkansas and Texas (Map 1). Evidence at hand suggests that the WGCP plants are essentially waifs, probably recently established through natural processes of dispersal and apparently not persisting in the region.



Map 1. Distribution of *Palhinhaea cernua* in the USA. Open circles in Texas are undocumented records.

LOUISIANA

Palhinhaea cernua was found in 1976 at Middle Branch Bog in Natchitoches Parish, southeast of Natchitoches in Kisatchie National Forest. "This area was searched extensively by Holmes and by Thomas on separate occasions in the fall of 1977 but no plants of [*Lycopodium cernuum*] could be located" (Thomas et al. 1978). It was found there again, however, in 1978 and 1980, apparently of rare occurrence. Subsequent surveys of Middle Branch Bog as well as other western Louisiana bogs did not encounter the species (MacRoberts & MacRoberts 1988, 1993, 1995a). Vouchers: Red Dirt Game Management Area, sec 27, roadside ditch near artesian well in hillside bog, rare, 15 Oct 19786, *Holmes 2902* (IBE digital image!, NATC); Red Dirt Management Area, ca 20 mi S of Natchitoches, 29 Sep 1978, *Holmes & Wells 3360* (NATC, NLU); hillside seepage area in longleaf pine woods beside Middle Branch Rd, 10 Oct 1980, *Thomas 74133* (NLU).

Thomas and Allen (1993) included a record in Ouachita Parish for *Palhinhaea cernua*, based on several collections from the same site: seepage area in sandy soil beside George Simmons Rd, 1.1 mi S of La. 557 at Cypress Turnoff W of Luna, near a branch of Gladden Branch, 29 Oct 1987, *Thomas 103145* (NLU digital image!); large clearcut area of baygall and sandy hills S of La. 557, between Luna and Cypress Turnoff S of West Monroe, 11 Oct 1989, *Thomas 113634* (NLU digital image!). clearcut baygall area S of La Hwy 557 at Cypress turnoff W of Luna at a branch of Gladden Branch, 29 Oct 1990, *Thomas 122,254* (NLU digital image!). The current status of this population is unknown.

A sterile plant of *Palhinhaea cernua* was collected in Vernon Parish: 16 mi N of Pitkin, south-central northwest portion of Sec 6 T1N R5W, drainage area just upslope from baygall, 4 Sep 1999, *Allen 18398* (NLU!). The current status of this population is unknown.

Collections from St. Tammany Parish appear to be at the western extremity of the "main" range of the species and continuous with it -- they are not on the WGCP. Apparently all are from within about a 2-mile radius: Hwy 41, 1/2 mi N of jct Hwy 36, disturbed, low, sandy spot, 30 Apr 1977, *Barton 40* (LSU); very abundant in old gravel pit, 0.25 mi E on La. Hwy 36 from jct with Hwy 41, 6 Nov 1977, *Landry s.n.* with R.D. Thomas (LSU); woods between Pearl River Canal and west Pearl River E of La. Hwy 41 and Evans Creek, 13 Sep 1975, *Thomas 46276* (NLU digital image!); 3 colonies along base of W-facing bank of Pearl River Canal at Dr. Caire's camp E of Evans Creek, grocery on La. Hwy 41, S of Talisheek, 26 Sep 1975, *Thomas 47241* (NLU 28421); abandoned gravel pit E of La. Hwy 41 at La. Hwy 36 in Hickory, 4 Nov 1979, *Thomas 69513* (NLU 28423).

ARKANSAS

Palhinhaea cernua was discovered in Nevada County in October 1995 with other species of Lycopodiaceae on a red clay bluff underlain by a layer of sand (Bray 1996). It was represented by a single plant with immature strobili -- reexamination of the site in November found the above-ground parts turning brown before completion of strobilus maturation. "The plant persisted for three years at this location, but with failing vigor and thriftiness until it was no longer evident by 1997. No other plants of this species were seen at that time or in subsequent visits to the location" (Peck 2011, p. 15). Voucher: Nevada Co.: *Bray 269* (HEND). Theo Witsell (Arkansas Natural Heritage Commission, pers. comm.) notes that searches for *P. cernua* at the same site in 2015 and in 2017 also were unsuccessful.

TEXAS

MacRoberts & MacRoberts (1995b) reported *Palhinhaea cernua* as new to the Texas flora, based on two sterile plants found in a hillside pitcher plant bog in the Angelina National Forest in Jasper County in August 1995. Plants were not collected but photographs were distributed as herbarium vouchers (*MacRoberts & MacRoberts 2860*, ASTC, BRCH, LSUS, VDB). The plants did

Figure 1. *Palhinhaea cernua* in Hardin Co., Texas. Photo by Eric Keith, 15 Jul 2009.

not persist at this site –– the site was surveyed for three subsequent years after the discovery and no nodding club-moss was found.

In 2009 *Palhinhaea cernua* was found in Hardin Co., Texas: Village Creek State Park near Lumberton, UTM NAD 83: 386391.4 E, 3347244.1 N, sandy mound along old logging road, mesic loblolly pine-hardwood forest, five stems in two clumps, sterile, 15 Jul 2009, *Keith 973* (SHST) (Figure 1). This find was reported in an *Inaturalist* entry as *Lycopodiella cernua.* The site was examined again in September 2015 but no plants were found. By 2015, vegetation at the site had become dense and grown up.

Turner et al. (2003) mapped *Palhinhaea cernua* as occurring in San Augustine and Angelina counties. This distribution has been repeated by Kartesz (2014), USDA, NRCS (2018), and by Diggs et al. (2006), but Diggs and Lipscomb (2014) were unable to find vouchers for these two county records. We also have been unable to find evidence to confirm them.

Broader geographical range and habitat

Palhinhaea cernua in its more compact southeastern USA range occurs in some habitats where other lycopods are characteristic (e.g, baygalls, hillside seeps, bogs) but most of the collections are from disturbed or even ruderal habitats (canal banks, ditch banks and bottoms, pond and lake margins, borrow pits and gravel pits, road cuts, etc.; from label data of BRIT specimens and from online data –– Wunderlin et al. 2018; Keener et al. 2018). Nodding clubmoss clearly is a colonizer of wet sites and many of these occurrences surely are ephemeral –– this perhaps underlies Weakley's speculation (2015) that it may be adventive in some of its USA occurrences. Or perhaps its entire range there is continuously, even if sporadically, replenished by dispersal. If so, it seems likely that the primary range of *P. cernua* in the Southeast has been populated from the Caribbean area.

The relatively few known WGCP localities appear to mirror the habitat diversity for the species in the Southeast. WGCP occurrences, however, seem more likely to have their origin in eastern Mexico.

Palhinhaea cernua grows in South America, Central America, and Mexico (as far north as southeastern Tamaulipas), the southern half of Africa, southeast Asia, Indonesia, Australia, and New Zealand, and it is scattered in various islands in the Pacific, Atlantic, and Indian oceans (see worldwide distribution map at GBIF.org 2017). It is "a common pioneer on disturbed soil in most tropical areas, especially in the lowlands" (Matos 2013) and is probably the world’s most abundant club-moss (Wagner & Beitel 1993).

ACKNOWLEDGEMENTS

We are grateful Theo Witsell for comments on the Arkansas plants.

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NEW VASCULAR PLANT RECORDS FOR ALABAMA

THOMAS C. BYRD
Department of Biological and Environmental Sciences
Troy University
Troy, Alabama 36082
tcbyrd@troy.edu

ALVIN R. DIAMOND
Department of Biological and Environmental Sciences
Troy University
Troy, Alabama 36082
adiamond@troy.edu

ABSTRACT

Two exotic vascular plant species are reported new to Alabama and one native species is reported new to the southeastern region of the state. *Butia odorata* (Arecaceae) and *Camellia sasanqua* (Theaceae) are reported as new to Alabama. *Populus heterophylla* (Salicaceae) is reported new to southeast Alabama.

New records for native and established exotic species have resulted during field studies in Geneva and Houston counties, Alabama. *Butia odorata* (Arecaceae) and *Camellia sasanqua* (Theaceae) are reported as new to Alabama, and *Populus heterophylla* (Salicaceae) is reported new to southeast Alabama. Complete sets of voucher specimens are housed at the Troy University Herbarium (TROY), and the University of West Alabama Herbarium (UWAL). State records were determined using the Alabama Plant Atlas (Keener et al. 2018, the North American Plant Atlas (Kartesz 2015), and literature searches.

Butia odorata (Barb. Rodr) Noblick. (Arecaceae)

Vouchers. **Alabama**. Geneva Co.: Geneva. Alabama Hwy 27, 0.1 mi N of Alabama Hwy 52, overgrown area and trash dump east of the road, with *Liriope muscari, Aspidistra elatior,* and *Quercus nigra,* 31.041617° -85.85813°, elev. 102 ft, 10 Dec 2015, *Diamond 27122* (TROY; UWAL); S side of service road, 0.1 km NE of Alabama Hwy 52 and Hwy 27 intersection, trash dump in disturbed sandy woods, moist sandy soil with partial shade, 31.041234° -85.857699°, elev. 101 ft, 27 Jan 2017, *Byrd 665* (TROY; UWAL); N side of Dogwood Trail, 0.2 km E of Coffee Springs Road intersection, overgrown wooded area with moist sandy soil and partial shade, with *Pinus palustris, Liquidambar styraciflua,* and *Quercus nigra,* 31.165822° -85.912165°, elev. 216 ft, 11 Jul 2017, *Byrd 1347* (TROY; UWAL).

These are the first reports of *Butia odorata* escaping in Alabama. It is common in the city of Mobile (Mobile Co.), where it is widely planted for decoration or fruit production (Finch 2010). Previous collections of this species in the USA have been reported as *Butia capitata* (Mart.) Becc. It has previously been reported as naturalizing in Florida and sparsely naturalizing in North Carolina, South Carolina, and Georgia (Nelson 2014).

Noblick (2011) recognized *Butia capitata* (Mart.) Becc. var. *odorata* (Barb. Rodr.) Becc. (on the coastal plain of Uruguay and Brazil) as distinct from var. *capitata* (in the central planalto of Brazil) and raised it to species rank. This was supported by lamina anatomy studies conducted by Sant'Anna-Santos et. al (2015). *Butia odorata* is the entity in cultivation, with *B. capitata* being virtually unknown (Rare Palm Seed 2018).

Butia odorata is usually short and stocky, reaching approximately 6 m in height with an average DBH of 50 cm. This palm has long, strongly recurved pinnate leaves reaching 3 m in length and appearing blue-gray or pale green in color with leaflets ranging close to 1 m in length (Fig. 1). The fruit (Fig. 2) are fleshy drupes and occur on densely packed, elongated structures (Nelson 2011; Nelson et al. 2014).

Figure 1. *Butia odorata* in overgrown vacant lot in Geneva Co., Alabama.

Figure 2. Fruit on *Butia odorata*.

Camellia sasanqua Thunberg (Theaceae)

This represents the first report of this taxon escaping in Alabama. Native to Japan, *Camellia sasanqua* has previously been reported as escaping or persisting from cultivation in Arkansas, Georgia, North Carolina, and South Carolina (Kartez 2015). Three species of *Camellia* have been reported as escapes in the USA: *C. japonica* L., *C. sasanqua* L., and *C. sinensis* (L.) Kuntze (Kartez 2015). Diamond previously reported *C. japonica* as an escape in Alabama (2013). Both species are widely cultivated as ornamentals and often produce abundant viable fruit (Fig. 4).

Camellia sasanqua is a large evergreen shrub reaching 5 m in height with alternate toothed leaves and pubescence on the stems and fruit (Serviss & Peck 2016). Addition differences separating *Camellia sasanqua* from *Camellia japonica* are the size and disposition of the leaves, flowering times, and sepals being deciduous or persistent (Weakley 2015; USDA, NRCS. 2016).

Voucher. **Alabama**. Geneva Co.: Samson, S side of Morris St., 0.1 km E of Alabama Hwy 87, in overgrown wooded lot, moist soil with partial shade, with *Cynodon dactylon*, *Cissus trifoliata,* and *Ilex opaca,* 31.114555° -86.044956°, elev. 205 ft, 27 Jan 2017, *Byrd 681* (TROY, UWAL).

Figure 3. *Camellia sasanqua* in vacant overgrown lot in Samson, Alabama.

Figure 4. *Camellia sasanqua* fruit.

Figure 5. *Populus heterophylla* growing in swampy lowland in Geneva Co., Alabama.

Populus heterophylla L. (Salicaceae)

These are the first reports of this taxon from southeastern Alabama. *Populus heterophylla* was previously reported in Alabama from Baldwin, Clarke, Mobile, and Washington counties in southwestern Alabama and Jackson and Limestone counties in northeastern Alabama (Keener et al. 2018). *Populus heterophylla* is a large tree (Fig. 6 reaching 50 m in height, with deciduous cordate leaves (Fig. 5; USDA, NRCS. 2016; Weakley 2015).

Voucher. **Alabama**. Geneva Co.: S side of Geneva Co. 4 and Jessica Rd intersection, in swamp with waterlogged soil and moderate shade, with *Vitis rotundifolia, Liriope muscari,* and *Quercus nigra*, 31.028213° -85.488957°, elev. 237 ft, 20 Oct 2017, *Byrd 391* (TROY, UWAL). Houston Co.: 0.1 mi E of Rambo Mill Road at the N side of Spring Creek, hardwood swamp forest over limestone, with *Acer rubrum, Salix nigra, Nyssa aquatic,* and *Taxodium distichum*, 31.009041° -85.347505°, elev. 161 ft, 22 Nov 2016, *Diamond 27727* (TROY, UWAL).

ACKNOWLEDGEMENTS

The authors thank Clark Harris, Claude Bailey Jr., Eric Minton, Michael Woods, and Guy Nesom for their reviews of this paper.

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PYRACANTHA (ROSACEAE) IN THE ARKANSAS FLORA

BRETT E. SERVISS
Biology Department
Box H-7570
Henderson State University
1100 Henderson Street
Arkadelphia, Arkansas 71999
servisb@hsu.edu

JONATHAN W. HARDAGE
2268 Highway 128
Bismarck, Arkansas 71929
jh201098@reddies.hsu.edu

KEENAN B. SERVISS
Sylvia Street
Arkadelphia, Arkansas 71923

JAMES H. PECK
P.O. Box 705
Cedar Key, Florida 32625
james.peckck@gmail.com

ABSTRACT

Pyracantha fortuneana is reported here as new to the Arkansas flora. A single, escaped plant of *P. fortuneana* was discovered growing on a steep slope of a narrow, urban greenbelt in Clark County. Photographs of both species of *Pyracantha* that occur in the state's flora, including the escaped *P. fortuneana* plant, along with notes on the genus *Pyracantha* in Arkansas, are provided.

In 2017, a single, escaped individual of *Pyracantha fortuneana* (Maxim.) H.L. Li (Chinese firethorn) was documented from a highly disturbed, urban greenbelt in Clark County (Fig. 1). The escaped plant was growing on a steep, rocky slope within the greenbelt. Two cultivated, reproductively mature plants of *P. fortuneana* were present in the vicinity of the escaped plant and are presumed to be the source of it via bird-mediated seed dispersal.

Voucher specimen of *P. fortuneana*: **Arkansas.** Clark Co.: Arkadelphia, steep slope of narrow, urban greenbelt, SW of the intersection of 10th St. and University Ave., off 10th St., one escaped plant less than 2 m tall, two cultivated plants of the species in the vicinity, 27 Nov 2017, *Serviss 8611* (HEND).

Pyracantha fortuneana is an evergreen, thorny shrub to 3 meters tall, native to China (Gu & Spongberg 2003). It is cultivated in Arkansas, and spontaneous seedlings in the immediate vicinity of cultivated *P. fortuneana* plants were observed previously (Serviss, unpublished data; Fig. 2A–C). Lance and Zika (2014) note that seedlings of naturalized *Pyracantha* most frequently occur in ruderal habitats, roadsides, edges, thickets, and in the vicinity of plantings. *Pyracantha fortuneana* has been documented outside of cultivation in a number of other southern states (Nesom 2010; Wunderlin & Hansen 2011; Lance & Zika 2014; Kartesz 2015; Weakley 2015; Keener et al. 2017; USDA, NRCS 2017).

The genus *Pyracantha* was first documented for the Arkansas flora by Serviss (2009—Fig. 3A), based on a Garland County specimen of naturalized *P. koidzumii* (Hayata) Rehd. (Formosa firethorn). Additional naturalized plants of *P. koidzumii* were subsequently documented from Arkansas in 2012 and 2016 from locations in Clark and Garland counties (Serviss et al. 2016). Our record of *P. fortuneana* marks the second species of *Pyracantha* documented from Arkansas, outside of cultivation.

Figure 1. Escaped plant of *Pyracantha fortuneana* from Clark County, Arkansas. A. Plant in habitat. B–C. Close-up of stems and leaves. Plant was less than 2 m tall and growing on a steep slope of a highly disturbed, narrow greenbelt, with a number of other naturalized exotic species, including *Ligustrum lucidum* (glossy privet), *Lonicera fragrantissima* (fragrant shrub honeysuckle), *L. japonica* (Japanese honeysuckle), and *Nandina domestica* (nandina), among others. Two cultivated, reproductively mature plants of *P. fortuneana* occur in the vicinity of the escaped plant and are the presumed source of it.

Also in 2017, a population of 11 naturalized plants of *P. koidzumii* was documented within and immediately adjacent to an area of disturbed, upland woods in Hot Springs National Park in Garland County (Figs. 3B, 4). This discovery represents the largest naturalized population of any species of *Pyracantha* documented to date in Arkansas. Naturalized plants of *P. koidzumii* from this location ranged in size from small individuals less than 2 m tall, to larger, reproductively mature individuals that were ca. 3–4 m with nearly mature fruits. Plants were distributed between the woods, edge, and into an adjacent open area. One plant also was disjunct from the main population by several meters and occurred along the edge of a dense thicket. The site of the naturalized *P. koidzumii* plants borders and partially encompasses the remnant of an old residential area, where the homes are no longer present. Two larger plants of the species, in addition to the 11 naturalized plants, also were present at the location and could represent plants persistent from cultivation.

An additional record of *P. koidzumii* from Clark County also was documented in 2017, providing a second occurrence of this species from that county. It consisted of a single, escaped plant growing at the edge of a highly disturbed, semi-wooded, urban greenbelt (Fig. 5A). Several reproductively mature plants of *P. koidzumii* were present in an adjacent residential area and are the presumed source of the escaped *P. koidzumii* plant.

Figure 2. Spontaneous plants of *Pyracantha fortuneana* from Clark County. A–C. Spontaneous, juvenile plants documented from 2005 — Fig. A shows one of those plants 12 years later (in 2017) with mature fruits. A few spontaneous juveniles of *P. fortuneana* were present at this site in 2005, and were presumably generated from a reproductively mature plant of *P. fortuneana* that was cultivated at the location. D. Close-up view of leaves of the naturalized plant discovered in 2017, for comparison.

Voucher specimens of *Pyracantha koidzumii*: **Arkansas.** Clark Co.: One spontaneous/ escaped plant, less than 1 m tall, at edge of disturbed, semi-wooded greenbelt, adjacent to residential area, off Walnut St., just S of intersection of Walnut St. and 29th St., Arkadelphia, 3 Nov 2017, *Serviss 8603* (HEND); one plant on well-drained, upper slope of hill, disturbed woods, clayey-rocky soil, off Mt. Zion Rd., off AR Hwy 8, about 3 mi W of I–30, 34.1137 N, 93.1268 W, 28 Jan 2016, *Tumlison 22* (HEND). Garland Co.: Eleven naturalized plants scattered in upland, rocky soils of open, mixed-pine hardwood, edge, and adjacent open area, Hot Springs National Park, off Sleepy Valley Rd., immediately E of intersection of Sleepy Valley Rd. and Gulpha Gorge Rd, 15 Sep 2017, *Serviss 8594* (HEND); one plant growing near fencerow, disturbed, open roadside, plant with mature fruits, off Hwy 270, just N of exit 5B (W side of 270), Hot Springs, 13 Dec 2012, *Serviss 7767* (HEND); one large, multi-trunked, arborescent plant growing on steep, rocky, semi-wooded slope of hillside, off Central Ave., 4500 block, Hot Springs, 15 Nov 2008, *Serviss 7398* (HEND).

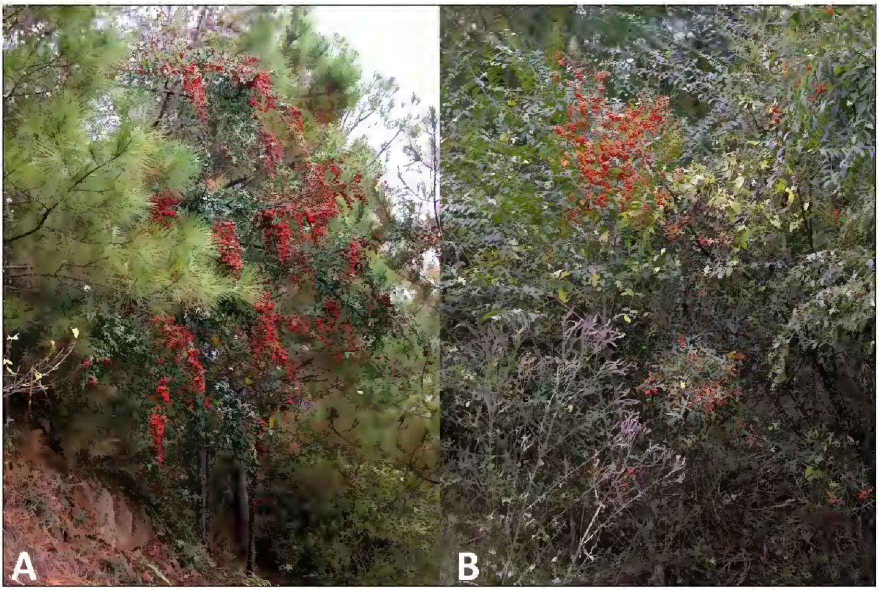

Figure 3. Naturalized plants of *Pyracantha koidzumii* in Garland County. A. Large, arborescent plant on steep, semi-wooded, rocky bluff in Hot Springs. B. Naturalized plant about 3 m tall growing at edge of thicket in rocky, upland soils in Hot Springs National Park. Ten other *P. koidzumii* plants were present at this location; several had nearly mature fruits similar to those shown here.

In Arkansas, *Pyracantha* species appear to favor well-drained, rocky soils of bluffs, slopes, and hillsides, but sometimes plants also are present in areas with little to no gradient. Naturalized plants have been documented within wooded and open habitats. The presence of escaped/naturalized individuals appears often to correlate with the presence of cultivated *Pyracantha* plants in proximity, although this is not always the case, as one *P. koidzumii* plant documented from Clark County in 2016 (Fig. 5B) apparently was not near to any cultivated plants of the species (Serviss et al. 2016). Bird-mediated dispersal is the presumed mode of spread and establishment, as the fruits are fed on by at least a few native bird species (Lance & Zika 2014). Both *P. fortuneana* and *P. koidzumii* should be expected elsewhere in the state's flora, especially in disturbed sites, waste places, greenbelts, and other urban/suburban natural areas that occur in proximity to where plants of these species are cultivated.

Pyracantha fortuneana and *P. koidzumii* are morphologically similar and sometimes easily confused (see Figs. 6–7 for a comparison of the two species). Nesom (2010) and Lance and Zika (2014) have provided keys and descriptions adequate for separation of the *Pyracantha* species naturalized and/or regularly cultivated in the southeastern USA. In Arkansas, *P. fortuneana* may typically be distinguished from *P. koidzumii* by its leaves with serrulate or crenulate-serrate margins (the leaves of *P. koidzumii* generally have entire to mostly entire margins). However, distinguishing the two species may at times be more difficult, especially among juvenile plants. Some individuals of *P. koidzumii* will produce some leaves with teeth toward the apex (generally five or fewer per margin), and occasionally plants of *P. fortuneana* will have at least some leaves that are sparsely toothed. Additionally, juvenile plants of *P. fortuneana*, and apparently *P. koidzumii*, both have toothed leaf margins (Figs. 2B–D, 7D).

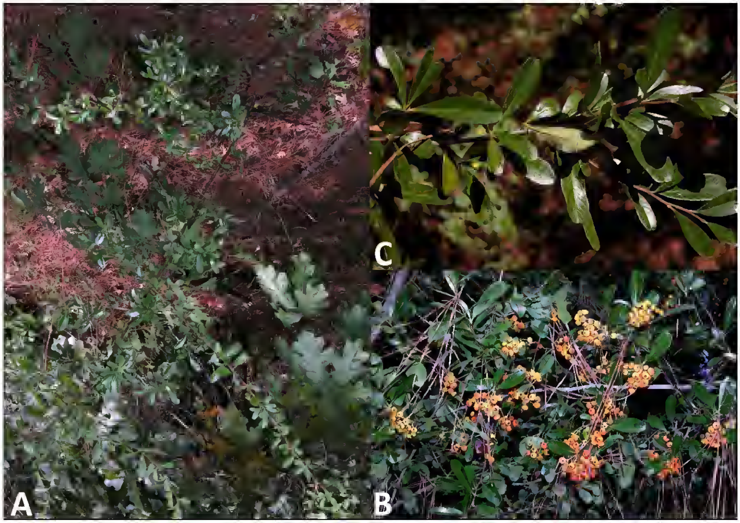

Figure 4. *Pyracantha koidzumii* naturalized in Garland County. A. Small plant, ca. 2 m tall, growing at the edge of a disturbed, upland, mixed-pine hardwood; a few similar-sized juveniles, along with several larger, reproductive-age plants, were naturalized at this site. B–C. Leaves, stems, and nearly mature fruits from one of the larger *P. koidzumii* plants. Plants at this location have some leaves with a few widely spaced teeth and others with completely entire margins.

Figure 5. *Pyracantha koidzumii* naturalized in Clark County. A. Small plant, less than 2 m tall, growing at the edge of a disturbed, semi-wooded greenbelt. Cultivated plants of the species were present in an adjacent residential area. B. Another naturalized *P. koidzumii* plant from a rocky woods west of Arkadelphia (photo credit: Renn Tumlison, Henderson State University). No cultivated plants were observed in the vicinity of this plant. Bird-mediated dispersal of seeds is the presumed method that led to the presence of both plants.

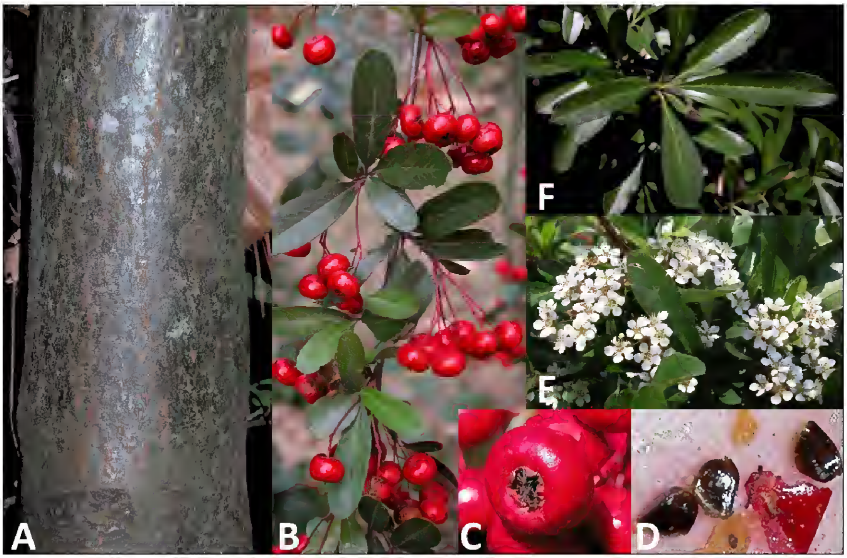

Figure 6. *Pyracantha fortuneana* plant and habit. A. Bark. B. Plant with mature fruits. C. Close-up of mature fruit. D. Seeds. E. Flowers. F. Leaves.

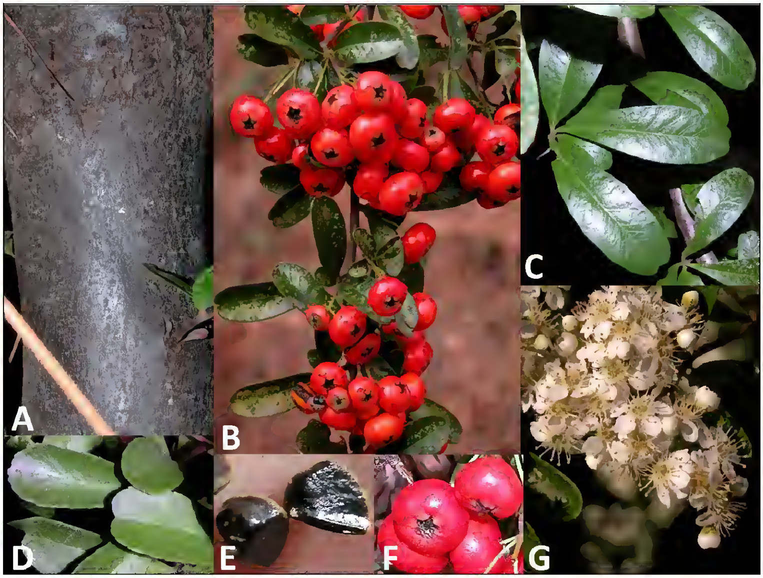

Figure 7. *Pyracantha koidzumii* plant and habit. A. Bark. B. Plant with mature fruits. C. Leaves (notice the margins are entire). D. Leaves from a naturalized juvenile plant from Clark County to show teeth. E. Seeds. F. Close-up of fruits. G. Flowers.

Difficulty in determining species identifications with escaped and naturalized *Pyracantha* plants also may arise from the fact that numerous cultivars and hybrids of both species exist, many of which are cultivated in the southeastern USA (Bailey 1949; Bailey & Bailey 1976; Krüssmann 1978; Meyer et al. 1994; Egolf & Andrick 1995; Nesom 2010). Additionally, spontaneous intermediates occasionally are encountered where cultivated species or hybrids are grown in proximity; no barrier to hybridization is apparent (Lance & Zika 2014).

ACKNOWLEDGEMENTS

We are grateful to Mr. Ron Lance, North American Land Trust, for his review and comments regarding this paper. We would like to thank Dr. Renn Tumlison, Henderson State University, for use of his photograph of *P. koidzumii*, Ms. Kristen Benjamin, Henderson State University, for technical assistance, and Ms. Katrina Rogers, Henderson State University, for assistance with acquisition of literature data. We also thank Dr. Guy Nesom for examining photographs of *P. koidzumii*. Additionally, we are grateful to the Henderson State University Department of Biological Sciences and the Ellis College of Arts and Sciences for supporting this work.

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HETERANTHERA PEDUNCULARIS (PONTEDERIACEAE) EN TAMAULIPAS, MÉXICO

ARTURO MORA-OLIVO, JOSÉ GUADALUPE MARTÍNEZ-ÁVALOS, EDILIA DE LA ROSA-MANZANO
Instituto de Ecología Aplicada
Universidad Autónoma de Tamaulipas
División del Golfo 356
Cd. Victoria, Tamaulipas 87019, México
amorao@uat.edu.mx

RESUMEN

Se registra por primera vez para la flora de Tamaulipas, México a *Heteranthera peduncularis,* una planta acuática propia de zonas montañosas. De esta manera, se amplía el rango de distribución de esta especie en la que las poblaciones más cercanas se encuentran a 300 km de distancia. Se presentan claves para la identificación de las especies del género en Tamaulipas.

ABSTRACT

Heteranthera peduncularis, an aquatic plant of montane habitats, is recorded for the flora of Tamaulipas, Mexico, for the first time. The distribution range of this species is extended from the nearest populations 300 kilometers away. Keys for identification of species of *Heteranthera* in Tamaulipas are presented.

La flora vascular acuática, aún es desconocida en muchas regiones del mundo. Aunque en México se han realizados esfuerzos para dar a conocer la diversidad y distribución de las hidrófitas, aún existen zonas que requieren de mayor exploración (Lot et al., 1999; Mora-Olivo et al., 2013). Esto debido en parte a que los esfuerzos de colecta se han concentrado en las zonas bajas y costeras, descuidando frecuentemente las zonas montañosas.

En el estado de Tamaulipas se localizan porciones de la Sierra Madre Oriental, la cual incluye una discontinuidad conocida como Sierra de Tamaulipas (INEGI 2001). Por sus condiciones de aislamiento y situación geográfica, esta sierra posee una alta diversidad biológica que incluye la presencia de especies endémicas, razón por la cual se ha propuesto como reserva de la biósfera. Durante los recorridos de campo para elaborar el inventario florístico actualizado de esta área, se colectaron ejemplares de una planta creciendo en una charca temporal. Después de identificar el material, se determinó como *Heteranthera peduncularis* Benth., una hidrófita de la familia Pontederiaceae que no había sido reportada para la Sierra de Tamaulipas por Puig (1968) ni para el resto de la entidad (Figura 1).

El género *Heteranthera* comprende 11 especies distribuidas en regiones cálidas y templadas de América y África (Olvera y Lot 2013). En México se conocen nueve especies y en Tamaulipas se han registrado cuatro: *H. dubia* (Jacq.) MacMill, *H. limosa* (Sw.) Willd., *H. mexicana* S. Wats., y *H. rotundifolia* (Kunth) Griseb. (Mora-Olivo y Villaseñor 2007; Mora-Olivo et al. 2013). Ahora con *H. peduncularis* son cinco las especies del género que se han documentado para Tamaulipas.

Heteranthera peduncularis es nativa de América, y aunque la mayor parte de los registros corresponden a México, existen algunos pocos en Guatemala y una sola colecta en Estados Unidos (Arizona) de alrededor de 1900 (Horn 2002). En Japón se le reporta como una especie naturalizada e invasora (Anónimo, 2004). En México se distribuye usualmente en cuerpos de agua temporales en las zonas altas y montañosas y anteriormente se había registrado en Aguascalientes, Chihuahua, Distrito Federal, Durango, Guanajuato, Hidalgo, Jalisco, Estado de México, Michoacán, Morelos, Nayarit, Oaxaca, Puebla, Querétaro, San Luis Potosí, Veracruz y Zacatecas (Novelo 1996; Novelo y Ramos 1998; Mora-Olivo et al. 2013; Olvera y Lot 2013).

Figura 1. Ejemplar fértil de *Heteranthera peduncularis* asociada a *Eleocharis* sp. Foto de Arturo Mora.

La población de *Heteranthera peduncularis* encontrada en Tamaulipas se localiza en la porción sur de la Sierra de Tamaulipas. El hábitat es una depresión inundable durante la época de lluvias, rodeada por bosques de encino y rocas calizas. El cuerpo de agua tiene una extensión aproximada de 500 m^2 y una profundidad que varía de 10 a 40 cm. Las especies asociadas son *Heteranthera rotundifolia* (Kunth) Griseb., *Ludwigia peploides* (Kunth) P.H. Raven, *Eleocharis montana* (Kunth) Roem. & Schult., *Eleocharis* sp., y *Juncus* sp.

Material examinado. México. Tamaulipas. Mpio. de Casas: Sierra de Tamaulipas, 7 km al sur de El Almagre, 23° 06’ 03’’ LN, 98° 20’ 15’’ LO, 763 msnm, 16 sep 2011, *Mora-Olivo 12744* (UAT).

Descripción botánica (basada en Novelo y Ramos 1998)

Plantas acuáticas anuales, enraizadas, tallos delicados, simpodiales, erectos o flotantes, ramificados. Hojas alternas, peciolos de 2 a 30 cm de largo, no inflados, láminas emergiendo o flotando sobre el agua, las de las hojas flotantes lanceoladas, hasta de 10 cm de largo y 4 cm de ancho, las de las hojas emergentes ampliamente ovadas a lanceoladas, de 2 a 6 cm de largo y 1 a 5.5 cm de ancho, ápice agudo a obtuso, base cordada. Inflorescencia espiciforme, con 6 a 13 flores solitarias, alternas a lo largo del pedúnculo, éste de 4 a 8(15) cm de largo, delgado, glabro. Flores zigomorfas, de 7 a 11 mm de largo, perianto morado, de color violeta, azul o lila, glandular-piloso. Cápsulas de 1.2 a 1.5 cm de largo; semillas de 0.7 a 1 mm de largo y 0.4 a 0.5 mm de ancho, con 8 a 10 costillas.

Clave para la identificación de las especies de *Heteranthera* en Tamaulipas (basada en Novelo 1996; Novelo y Ramos 1998; Olvera y Lot 2013)

1. Inflorescencia con 4 o más flores.

    4. Hojas sésiles, láminas linear lanceoladas, emergentes .... **Heteranthera mexicana**
    4. Hojas pecioladas, láminas lanceoladas a ovadas y cordadas .... **Heteranthera peduncularis**

1. Inflorescencia con una sola flor.

    2. Flores amarillas; hojas sésiles, alternas, usualmente sumergidas .... **Heteranthera dubia**
    2. Flores moradas a lilas o blancas, hojas alternas o en roseta basal.

        3. Tallos flotantes, hojas alternas, flores zigomorfas .... **Heteranthera rotundifolia**
        3. Tallos emergentes, hojas basales, flores actinomorfas .... **Heteranthera limosa**

Se considera importante reportar la presencia de *Heteranthera peduncularis* en Tamaulipas tomando en cuenta que salvo una colecta de Chihuahua, no existían registros en el norte del país. La nueva localidad también es la primera del noreste de México (Coahuila, Nuevo León, Tamaulipas) y se encuentra aproximadamente a 300 km al noreste y norte de los registros más cercanos en los estados de San Luis Potosí e Hidalgo respectivamente (Novelo, 1996). Por el momento no se puede asegurar el motivo de la presencia de esta hidrófita en Tamaulipas; sin embargo, es posible que se deba a causas históricas o a la dispersión a larga distancia que llevan a cabo las aves acuáticas (Santamaría y Klaassen, 2002). En cualquiera de los casos, es evidente que aún se requiere de una mayor exploración de la flora acuática en México, especialmente en las zonas montañosas y templadas de difícil acceso.

AGRADECIMIENTOS

Al Programa de Mejoramiento del Profesorado que apoyó este trabajo a través del proyecto “Ecología, conservación y manejo sustentable de los recursos naturales en la Sierra de Tamaulipas, México.” Al CONACYT que patrocinó a los autores mediante el apoyo al Doctorado en Ecología y Manejo de Recursos Naturales.

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SOLANUM TAMPICENSE (SOLANACEAE) IN TEXAS

JASON R. SINGHURST
Wildlife Diversity Program
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

MAXWELL B. PONS, JR.
The Nature Conservancy of Texas
Southmost Preserve
10,000 Southmost Rd.
Brownsville TX 78521

MELISSA C. JONES
State Parks Division
World Birding Center
1000 New Carmen Blvd.
Brownsville, Texas 7852

WALTER C. HOLMES
Department of Biology
Baylor University
Waco, Texas 76798-7388

ABSTRACT

Solanum tampicense, an invasive weed currently known in the United States only from Florida, is native to southern Mexico, Belize, Guatemala, El Salvador and the West Indies. It is here reported as new to Texas. The species has been confirmed to occur in in Resaca De La Palma State Park in Cameron County in the eastern Rio Grande Valley. This wetland species is considered to have great potential to alter wetland sites and spread northward through the Gulf Prairies and Marshes of eastern Texas.

Solanum tampicense Dunal (commonly called wetland nightshade or soda apple) is considered native to southern Mexico, Guatemala, El Salvador, Belize, and the West Indies (Fox & Bryson 1998). The species was first collected in the United States from Garden Key, Dry Tortugas, Florida. The name has been included in the checklist of the flora of the Dry Tortugas National Park since 1974 (Reimus and Robertson 1995). Currently the species is known from southwest and west-central peninsula Florida and the eastern portion of the panhandle of that state (Kartesz 2017). It is listed as a noxious weed in various states, such as Texas (Texas Invasives 2017), but this listing is more toward concern and prevention than confirmation of the presence of the species in the state. The species is considered to have great potential as a noxious weed and to have the ability to alter wetlands.

Based on the following specimen collected in the Lower Rio Grande Valley of south Texas, we report *Solanum tampicense* as new to the flora of Texas. Cameron Co.: Resaca De La Palma State Park, along Ebony Trail, 0.15 mi S of park headquarters, along edge of resaca, 5 Dec 2016, *Singhurst, Jones, Kallejo*, and *Wagner 21,050* (BAYLU). Figure 1.

The *Solanum tampicense* population in Cameron County (Figures 1-3) consisted of one well established and several lesser developed plants in the understory of native thorn scrub thicket. Associated flora included *Celtis laevigata, C. pallida, Chiococca alba, Chromolaena odorata, Condalia hookeri, Cyperus odoratus, Ebenopsis ebano, Echinodorus berteroi, Ehretia anacua, Mikania scandens, Mimosa pellita, Parkinsonia aculeata, Passiflora filipes, Petiveria alliaceae, Pluchea* sp., *Polygonum* *hydropiperoides*, *Rivina humilis*, *Sabal mexicana*, *Setaria* sp., *Spermoacoce glabra*, *Stachys drummondii*, *Triadica sebiferum*, and *Xylosma flexuosa.*

Plants of *Solanum tampicense* are sprawling shrubs with stems woody at base and herbaceous-prickly above. Stems may attain a length of 5 m and 1.5 cm in diameter. The flowers are white and range from 3 to 11 in number. The fruits are spherical berries to 1 cm in diameter, shiny solid green when immature but burnt orange then bright red at maturity. *Solanum tampicense* spreads by seeds and rhizomes. Fox and Bryson (1998) mentioned that dispersal is by water, but the soft, red fruits suggest to us that dispersal may also be by birds, mammals, and possibly locally by fish.

Figure 1. *Solanum tampicense*, Cameron Co., Texas, 9 December 2016. Photo by Jason Singhurst.

Figure 2. Fruits of *Solanum tampicense*, Cameron Co., Texas, 9 December 2016. Photo by Jason Singhurst.

Figure 3. Resaca [habitat] of *Solanum tampicense*. Photo by Jason Singhurst.

ACKNOWLEDGEMENTS

The authors thank Pablo Deyturbe, superintendent of Resaca De La Palma State Park, for his assistance and for supporting botanical studies in this park under his management.

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TRES NUEVAS ESPECIES DE *BURMEISTERA* (CAMPANULACEAE: LOBELIOIDEAE) DE COSTA RICA Y PANAMA

ALEXANDER RODRÍGUEZ
Herbario Nacional de Costa Rica
Departamento de Historia Natural
Museo Nacional de Costa Rica
Apdo. 749-1000, San José, Costa Rica
arodriguez@museocostarica.go.cr,

DANIEL SOLANO PERALTA
San José, Costa Rica
solanodaniel@hotmail.com

RESUMEN

Tres especies nuevas de *Burmeistera* de Centroamérica son descritas e ilustradas aquí: **B. caudatifolia** Rodr. & Solano, **sp. nov.** y **B. flava** Rodr. & Solano, **sp. nov.**, de Costa Rica, y **B. maui** Solano & Rodr., **sp. nov.**, de Costa Rica y Panama. Se comentan sus afinidades, distribución, fenología y habitat.

ABSTRACT

Three new species of *Burmeistera* from Central América are described and illustrated here: **B. caudatifolia** Rodr. & Solano, **sp. nov.** and **B. flava** Rodr. & Solano, **sp. nov.**, from Costa Rica, and **B. maui** Solano & Rodr., **sp. nov.**, from Costa Rica and Panama. Their affinities, distribution, phenology, and habitat are discussed.

Burmeistera Triana (Campanulaceae: Lobelioideae) comprende 120 especies que se distribuyen desde Guatemala hasta Perú (Lammers 2007; Lagomarsino et al. 2015), aunque ausentes en Belice, El Salvador y Nicaragua.

Es un género Neotropical, con mayor diversidad y endemismo al norte de los Andes (Sur América), en Colombia y Ecuador, especialmente en elevaciones medias, entre 1500–2000 m (Jeppesen 1981; Garzón et al. 2014; Muchhala & Pérez 2015; Lagomarsino et al. 2016).

Burmeistera está constituido de especies típicas de bosques poco intervenidos, especialmente en regiones montañosas. En Costa Rica se distribuye en bosque húmedo, muy húmedo, páramo y principalmente pluvial (Hammel et al. 2004), entre 200–3300 m, y se ha registrado que el género es más diverso en la vertiente Caribe de la cordillera de Talamanca, entre 1500–2500 m (Rodríguez & Solano, en prep.).

Este género se encuentra cercanamente relacionado a *Centropogon* C. Presl y *Siphocampylus* Pohl, ambos igualmente endémicos del Neotrópico (Lammers 1998; Lammers & Maas 1998). *Burmeistera* se caracteriza por un limbo de la corola generalmente inflado, con un orificio dilatado en la antera, semillas que son mucho más largas que anchas y pedúnculos generalmente ebracteolados (Lammers 1998). Se distingue de *Centropogon* y *Siphocampylus* debido a que estos últimos tienen anteras ventrales con un penacho de tricomas setosos o apéndices triangulares en el ápice (vs. anteras ventrales con el ápice glabro a esparcidamente piloso), el estilo, la corola y los estambres son tardíamente deciduos y con frecuencia persistentes en los frutos (vs. estilo, corola y estambres tempranamente deciduos y ausentes cuando en frutos), los pedúnculos son usualmente bibracteados (vs. usualmente ebracteados) y las semillas son oblongas a fusiformes y lenticulares (vs. elipsoides y foveoladas o alveolado-reticuladas); además, al menos en Costa Rica son especies terrestres (vs. epífitas a ocasionalmente terrestres). A la vez, *Siphocampylus* se diferencia de *Burmeistera* por sus frutos capsulares (loculicidas), apicalmente dehiscentes por dos valvas (vs. frutos abayados, carnosos o esponjosos e indehiscentes) (Lammers 1998, Muchhala & Pérez 2015). Adicionalmente en *Burmeistera* predomina la polinización por murciélagos (Phyllostomidae) con una aparente reversión a polinización por colibríes en *Burmeistera rubrosepala* (E. Wimm.) E. Wimm., mientras que en *Centropogon* y *Siphocampylus* predomina la polinización por colibríes (Muchhala 2006).

A como es de esperar, desde la gran obra de Wimmer (1943), con 77 especies, hasta el checklist de Lammers (2007), con 102, el número de especies reconocido para *Burmeistera* aumentó significativamente. Adicionalmente aportes realizados en algunas floras locales han resultado fundamentales en el entendimiento del género, tal es el caso de las realizadas en Guatemala (Nash 1976), Honduras (Lammers & Maas 1998), Costa Rica (Standley 1937; Wilbur 1976) y Panamá (Wilbur 1976, 1981), y en América del Sur las revisiones de Ecuador (Jeppesen 1981) y Perú (Stein 1987).

En Costa Rica el número de especies desde la Flora de Standley (1937), con 13 especies reconocidas, hasta hoy (Rodríquez & Solano, en prep.), con 14, no parece haber aumentado significativamente. Sin embargo, seis de las especies reconocidas por Standley ahora se consideran sinónimos de otras existentes en el país.

Recientes exploraciones botánicas y una nueva revisión de la familia Campanulaceae para Costa Rica, ha resultado en la descripción de tres especies nuevas de *Burmeistera* nativas y endémicas de la Cordillera de Talamanca.

BURMEISTERA CAUDATIFOLIA Al. Rodr. & D. Solano, **sp. nov**. TIPO: **Costa Rica. Limón.** Talamanca, Cordillera de Talamanca, Parque Internacional La Amistad, Bratsi, sendero Transtalamanca, entre Ujarrás y San José Cabécar, alrededores de quebrada Lari, tributaria del río Coén, 09°25'40"N, -83°11'59"W, 1600–1700 m, 6 Mar 2007 (flores y frutos), *A. Rodríguez & D. Solano 11037* (holotipo: CR-INB0004070391!; isotipos: para ser distribuidos-INB0004070392!, INB0004070393!, INB0004070394!). Figuras 1A–J, 4A-C.

Burmeistera caudatifolia is distinguished by its glabrous vegetative parts, linear-lanceolate, lanceolate to lanceolate-elliptic leaves, 2.5–10 times longer than wide, with long-caudate apex, with 7–13 pairs of secondary veins, evident submarginal vein and margin spread denticulate, with 1–3 teeth/cm, by its green corolla, stained red-purple in the tube, and by its globose to obconical fruits, white-pink when maturing. This species is similar to *B. chiriquiensis* Wilbur and *B. maui* sp. nov. *Burmeistera chiriquiensis* is distinguished by its leaves (10–) 11–21.5 times longer than wide, usually more numerous secondary veins, 11–21 pairs. *Burmeistera maui* is distinguished by its leaves usually with more secondary veins, 10–21 pairs, and the margin usually with more teeth, 1–9 teeth/cm, and by its calyx with wider lobes, 1–2.5 mm (vs. 0.4–0.75 mm wide) and subentire to 1–4-dentate (vs. entire). Other similar species are *B. cyclostigmata* Donn. Sm. and *B. monroi* D. Santam. & Lagom., although both entities have leaves only 1.7–4 times longer than wide.

Hierba epífita y colgante; tallo sufruticoso, 1–2.5 mm de diámetro, meduloso a ligeramente fistuloso, terete, glabro, en material vivo verde, a veces esparcidamente teñido de fucsia, cuando seco verde pajizo a verde grisáceo, entrenudos 0.9–4 cm de largo. **Hojas** dística a casi espiralmente arregladas; peciolos 0.7–2 cm de largo, glabros, generalmente ascendentes; **lámina** 6–12 cm de larga y 0.7–3.5 cm de ancha, linear-lanceolada, lanceolada a lanceolado-elíptica, 2.5–10 veces más larga que ancha, distales con lámina que se reduce gradualmente en tamaño, base obtusa a cortamente cuneada, ápice largamente caudado, margen denticulado, con 1–3 dientes por cm (en hojas maduras); **nervadura** con 7–13 pares de nervios secundarios, el nervio submarginal evidente, haz y envés glabros, concoloros a ligeramente discoloros, con el lado abaxial ligeramente más pálido. **Flores** solitarias, axilares en nudos subterminales; **pedúnculo** 3–4 cm de largo, glabro, ebracteado, ascendente y péndulo; **hipantio** en la antesis obcónico, 4–5 mm de largo y ca. 3 mm de ancho, glabro, verde y apenas escasamente teñido de fucsia, con 10 nervios longitudinales conspicuos y levemente carinado; **cáliz** 5-lobulado, lóbulos erectos, ligeramente más cortos que el hipantio, 2.5–5 mm de largo y 0.4–0.75 mm de ancho, subiguales en tamaño, en ocasiones desiguales, lineares a linear-oblongos, ápice agudo, enteros, inconspicuamente nervados, glabros; **corola** 23–26 mm de largo, esparcida e inconspicuamente pubescente, verde, teñida de rojo púrpura en el tubo, ventricosa en la antesis, tubo de 12–14 mm de largo (hasta lóbulo ventral) y 1.5–2 mm de ancho, lóbulos oblongo-falcados, con el ápice largo-agudo o acuminado, dorsales 11–12 mm de largo, laterales 6.5–8 mm de largo, ventral 4–5 mm de largo; **columna estaminal** 19–20 mm de largo (no incluye las anteras) y 1–1.2 mm de ancho, subigual en largo a la corola, en los 2/3 basales glabrescente, en el 1/3 distal esparcida y cortamente blanco pubescente, filamentos connatos, aunque libres cerca de la base, adnatos a la base de la corola; **anteras** con el tubo 2.5–4.5 mm de largo y 2.5–3 mm de ancho, esparcidamente blanco pilosulas, especialmente las dorsales, las 2 anteras ventrales 2.5–3 mm de largo, el ápice esparcidamente penicilado, con tricomas de 0.5–0.8 mm de largo, las 3 anteras dorsales 4–4.5 mm de largo. **Frutos** 0.6–1 cm de largo y 0.5–0.8 cm de ancho, globosos a obcónicos, rosados, luego blanco rosados al madurar, glabros, exocarpo de consistencia membranácea; **semillas** 0.6–0.8 mm de largo y 0.3–0.5 mm de ancho, obovoides a oblongo-obovoides, biconvexas, diminutamente alveolado-reticuladas, pardo pálidas a casi pajizas.

Fenología. Flores y frutos recolectados en marzo.

Distribución y hábitat. Endémica de Costa Rica. Crece en los bosques pluviales en la vertiente Caribe de la Cordillera de Talamanca, dentro del Parque Internacional La Amistad, entre 1600–1700 m. Esta especie se conoce de un único especimen, que fue observado creciendo en un bosque primario sobre el tronco de un árbol a orilla de una quebrada.

Etimología. El epíteto latino *caudatifolia* se refiere a la presencia de hojas con el ápice aprupta y largamente acuminado.

Discusión. *Burmeistera caudatifolia* se caracteriza por sus partes vegetativas glabras, hojas con la lámina linear-lanceolada, lanceolada a lanceolado-elíptica, entre 2.5–10 veces más larga que ancha, con el ápice largo-caudado, nervadura con 7–13 pares de nervios secundarios, el nervio submarginal evidente y el margen esparcidamente denticulado, con 1–3 dientes/cm, por sus flores con la corola verde, teñida de rojo púrpura en el tubo, y por sus frutos globosos a obcónicos, blanco-rosados al madurar.

En Centroamérica, por la forma de sus hojas y el tamaño y color de las flores, esta especie es similar a *Burmeistera chiriquiensis* Wilbur, de Costa Rica y Panamá, y a *B. maui* sp. nov. (aquí descrita y endémica de Costa Rica y Panamá). *B. chiriquiensis* se distingue por sus hojas comunmente más estrechas, con nervios secundarios a menudo más numerosos, y margen por lo general con dientes más dispersos, y por sus flores (maduras) con lóbulos del cáliz subenteros a dentados (vs. enteros). En tanto, *B. maui* se diferencia por sus hojas con nervios secundarios por lo general más numerosos, margen con dientes comunmente más conspicuos y densos, pedúnculo con frecuencia más alargado, y flores (maduras) con lóbulos del cáliz más anchos y con el margen subentero a dentado (vs. entero), y con una columna estaminal (sin incluir anteras) a menudo más alargada.

Otras especies con similitud vegetativa y floral son *Burmeistera cyclostigmata* Donn. Sm. y *B. vulgaris* E. Wimm., de Costa Rica a Ecuador, y *B. monroi* D. Santam. & Lagom., endémica de Costa Rica y Panamá. Estas especies se distinguen por sus hojas apenas 1.7–5 veces más largas que anchas, con el ápice acuminado o agudo (vs. largo-caudado), el margen con dientes por lo general más dispersos, y anteras dorsales más alargadas. En el Cuadro 2 se comparan *B. caudatifolia* y *B. maui* con las especies mencionadas, donde además se pueden notar algunas diferencias adicionales.

Carácter	*B. caudatifolia*	*B. chiriquiensis*	*B. cyclostigmata*	*B. mcvaughii*	*B. maui*	*B. monroi*	*B. serratifolia*	*B. vulgaris*
Tallos: indumento	Glabros	Glabros	Esparcido-puberulentos, glabrescentes a glabrados	Puberulentos a glabrescentes	Glabros a glabrados	Esparcido-vilosulos a glabrescentes	Esparcido-puberulentos	Glabrados, puberulentos a glabrescentes
Peciolos: largo (cm)	0.7–2	0.2–1	0.5–4	2–3	0.3–1.3	0.4–1.6	0.6–1.5	0.5–2.5
Hojas: largo y ancho (cm) de lámina	6–12 × 0.7–3.5	6–11.5 × 0.4–0.6	3.2–19 × 1.3–9	6–12(16) × 3–5(–7)	2–10.5 × 0.7–2.5	2–12.1 × 1–3.4	10.2–15 × 1–1.7	3–15 × 1–5.5
Hojas: relación del largo vs. el ancho	2.5–10	(10–)11–21.5	1.7–4	1–2(–3)	1.9–10.75	1.9–3.1	6.5–9.75	2.3–5
Hojas: ápice	Largo-caudado	Estrecho-acuminado	Acuminado	Agudo o acuminado	Estrecho-acuminado	Agudo o acuminado	Acuminado	Acuminado
Hojas: margen	Denticulado, 1-3 dientes/cm	Dentado a denticulado, 1-8 dientes/cm	Subentero, ondulado, denticulado a dentado, 3-8 dientes/cm	Denticulado, disecto, 1-2-pinnatífido, 6-8 diente/cm	Denticulado a grueso-dentado, crenado a pinnatífido, 1-9 dientes/cm	Dentado a denticulado, 1-5 dientes/cm	Fuerte e irregularmente dentado, 15–17 dientes/cm	Subentero, ondulado, denticulado a dentado, 3-6 dientes/cm
Hojas: pares de nervios secundarios	7–13	11–21	8–17	6–11	10–21	4–8(–12)	13–20	7–13
Pedúnculo: largo (cm)	3–4	3.2–7	1–13.5	4–7	3–11	1.9–5.7	7–11.2	2–13
Lóbulos del cáliz: largo y ancho (mm), margen	2.5–5 × 0.4–0.75, entero	2.5–5.5(–9) × 0.6–1, subentero a 1–3-dentado	3–20(–22) × 1–8, entero a 2–10-denticulado	6–8(–9) × 1–2, denticulado	2.5–10.5 × 1–2.5, subentero a 1–4-dentado	2.5–6 × 1–2, entero a 4–10-dentado o denticulado	3–4.5 × 1–4.5, 6–10-dentado	10–30 × 1–8 mm, entero a 4–8-denticulado
Corola: forma	Ventricosa	Ventricosa	Ventricosa	Ventricosa	Ventricosa	No ventricosa	Ventricosa	Ventricosa

Corola: largo de lóbulos dorsales (mm)	11–12	8–13	12–22	10–13	10–14	8–13	13–15	12–20
Corola: largo de lóbulos laterales (mm)	6.5–8	6–10	8–12	6–7	6–10	(5–)7–10	Ca. 14	7–10
Columna estaminal: largo (mm)	19–20	Ca. 8(–23)	25–32	22–27	19–29	18–21	Ca. 31	25–32
Anteras dorsales: largo (mm)	4–4.5	4.5–5	4.5–8	3–5	5–7	6–7	Ca. 5	7–11
Frutos: largo y ancho (cm)	0.6–1 × 0.5–0.8	Ca. 0.9 × 0.7	1.5–3 × 1–2.5	Ca. 15 × 10–12	1–1.7 × 0.8–1.7	Ca. 0.8 × 0.9	Ca. 1.8 × 0.6 (posiblemente inmaduros)	2.5–4.5 × 2.5–4.2 cm
Frutos: apariencia	Carnosa (esponjosa)	Carnosa (esponjosa)	Carnosa (esponjosa)	Carnosa (esponjosa)	Carnosa (esponjosa)	Carnosa (esponjosa)	Carnosa (esponjosa)	Hinchada (inflada)
Frutos: color cuando maduros	Rosado a blanco-rosado	Lila a violeta	Rosado a blanco o blanco-rosado	Rosado pálido	Rosado a púrpura	Desconocido	Desconocido	Verde

Cuadro 1. Características diferenciales entre *B. caudatifolia* y *B. maui* con especies similares. Medidas y carácteres de *B. mcvaughii* fueron tomados de Wilbur (1981) y *B. serratifolia* de Lagomarsino *et al.* (2015).

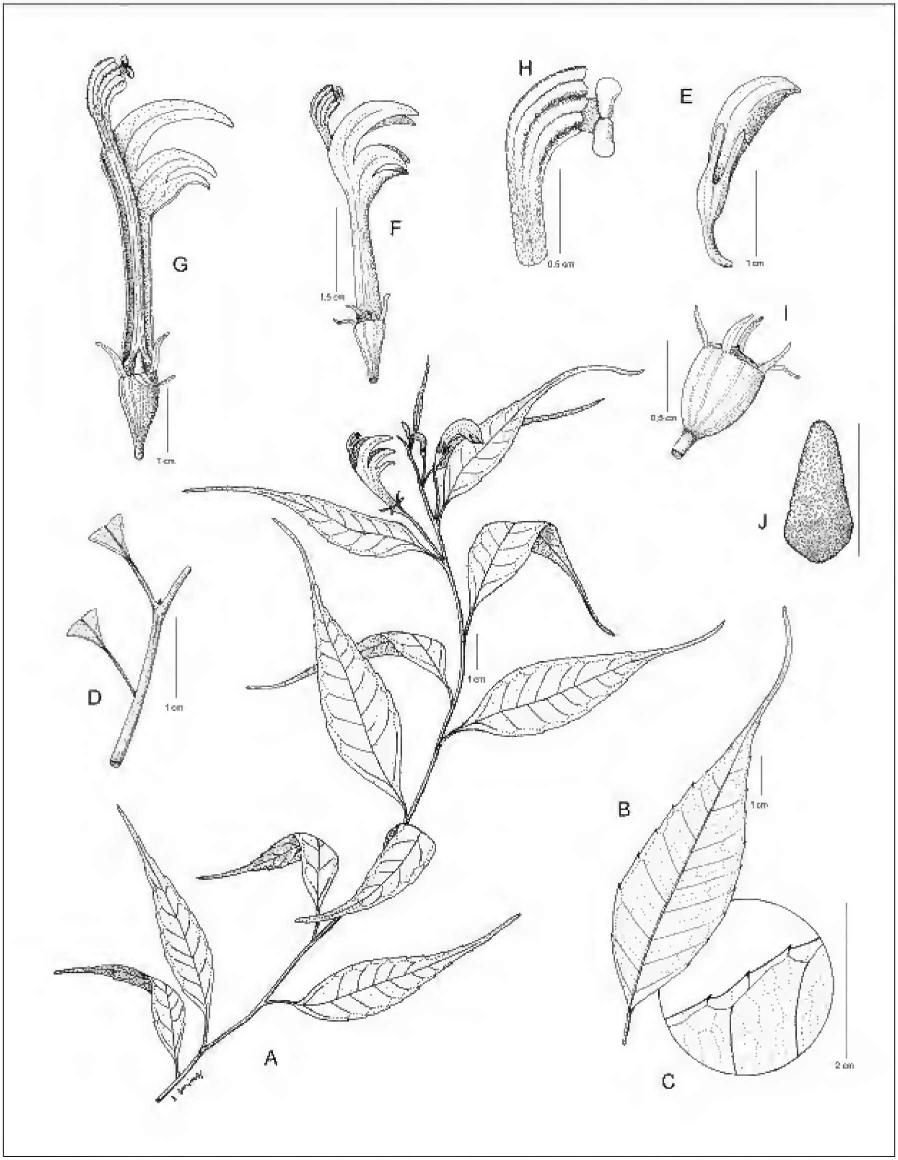

Figura 1. *Burmeistera caudatifolia* (A-I de *Rodríguez & D. Solano 11037, CR*). A. Hábito con flores. B. Hoja. C. Detalle del margen y la nervadura de la hoja. D. Detalle del tallo y base de la hoja. E. Botón floral. F. Flor en vista lateral. G. Flor en vista longitudinal del lado interno. H. Estambres y estigma. I. Fruto. J. Semilla.

BURMEISTERA FLAVA Al. Rodr. & D. Solano, **sp. nov.** **TIPO: Costa Rica. Limón.** Parque Nacional La Amistad, cuenca del Estrella, Valle La Estrella, Fila Matama, cerca 11 km suroeste del pueblo de Aguas Zarcas, sitio Helechal, 09°48'10.8"N, -83°10'48.6"W, 1300–1400 m, 27 Oct 2007 (flores), *D. Solano et al. 4757* (holotipo: CR-INB0004123974!; isotipo: para ser distribuido-INB0004123975!). Figuras 2A–K, 4D-F.

Burmeistera flava is distinguished by being a terrestrial herb, with whitish scales in the leaves, stems and fruits, by its leaves 8–27 times longer than wide and by its flowers with yellow corolla. This species is similar to *B. parviflora* E. Wimm. ex Standl., but the latter has leaves 2–6.5 times longer than wide, margin usually with more teeth, 5–11 teeth/cm (vs. 1–6 teeth/cm), and by its corolla usually with longer dorsal lobes, 6–12 mm (vs. 2.5–7 mm), and often the shortest ventral lobes, 4–6 mm (vs. 5.5–10 mm). Other similar species are *B. chiriquiensis* Wilbur which is distinguished by the absence of whitish scales in leaves, stems, flowers and fruits and by its green corolla, stained purple; *Burmeistera antioquensis* Garzón & J.M. Vélez which is distinguished by its shorter leaves, 2.7–6.2 cm long, and by its bright red corolla, at least externally; and *B. minutiflora* Garzón & F. González, which is also distinguished by its shorter leaves, (1.5–) 1.8–2.8 (–3.8) cm long (vs. 5–16 cm long), and bright red corolla, with yellow lobes.

Hierba 0.5–0.8 m, terrestre; tallo sufruticoso, 2–3.5 mm de diámetro, meduloso a fistuloso, subterete y generalmente con 5 carinas inconspicuas que salen a ambos lados de la base del peciolo, glabrescente a esparcida e inconspicuamente pardo pubescente en las partes terminales, con diminutas, esparcidas y blanquecinas escamas, en material vivo verde, cuando seco pajizo, entrenudos 0.5–4.5 cm de largo. **Hojas** espiralmente arregladas; peciolos 0.3–1 cm de largo, glabros, en ocasiones poco diferenciados, generalmente ascendentes, a menudo divaricados; **lámina** 5–16 cm de larga y 0.3–1.4 cm de ancha, linear a linear-elíptica, 8–27 veces más larga que ancha, distales con lámina que se reduce ligeramente en forma y tamaño, base atenuada, ápice corto-acuminado, margen fina a gruesamente dentado o denticulado, dientes calloso-glandulares, con 1–6 dientes por cm (en hojas maduras); **nervadura** con 6–20 pares de nervios secundarios, el nervio submarginal indistinto a ligeramente diferenciado, haz y envés glabros, ligeramente discoloros, con el lado abaxial más pálido, usualmente con diminutas, esparcidas y blanquecinas escamas sobre ambas superficies. **Flores** solitarias, axilares en nudos subterminales; **pedúnculo** 3–4 cm de largo, glabro, con diminutas, esparcidas y blanquecinas escamas, ebracteado, ascendente a casi péndulo; **hipantio** en la antesis urceolado a obcónico, 2–4 mm de largo y 2–4 mm de ancho, glabro, con diminutas, esparcidas y blanquecinas escamas, verde a verde amarillento, con 10 nervios longitudinales ligeramente impresos, ecarinado; **cáliz** 5-lobulado, lóbulos ascendentes, más cortos que el hipantio, 1–1.75 mm de largo y 0.75–1 mm de ancho, subiguales en tamaño, deltados, rojo púrpura, ápice agudo, enteros, enervios, glabros; **corola** 8–16 mm de largo, glabra, externa e internamente con diminutas, esparcidas y blanquecinas escamas, amarilla, ventricosa en la antesis, tubo de 3.5–5 mm de largo (hasta lóbulo ventral) y 1–3 mm de ancho, lóbulos oblongo-falcados, con el ápice agudo, dorsales 2.5–7 mm de largo, laterales 5–8 mm de largo, ventral 5.5–10 mm de largo; **columna estaminal** 8–10 mm de largo (no incluye las anteras) y 0.8–1 mm de ancho, subigual en largo a la corola, glabra, filamentos connatos hasta cerca de la base, adnatos a la base de la corola; **anteras** con el tubo 1.5–3 mm de largo y 1.5–1.7 mm de ancho, glabrescentes a esparcidamente blanco pilosulas, las 2 anteras ventrales 1–1.5 mm de largo, el ápice corto-penicilado,con tricomas blancos y pilosos de 0.4–0.7 mm de largo, las 3 anteras dorsales 2–3 mm de largo. **Frutos** 0.4–0.7 cm de largo y 0.5–0.8 cm de ancho, urceolados a obcónicos, verdes al madurar, glabros, con diminutas, esparcidas y blanquecinas escamas, exocarpo de consistencia membranácea; **semillas** 0.6–0.8 mm de largo y 0.3–0.5 mm de ancho, obovoides a oblongo-obovoides, biconvexas, diminutamente foveoladas, pardo pálidas a pajizas.

Fenología. Flores y frutos recolectados en abril y octubre.

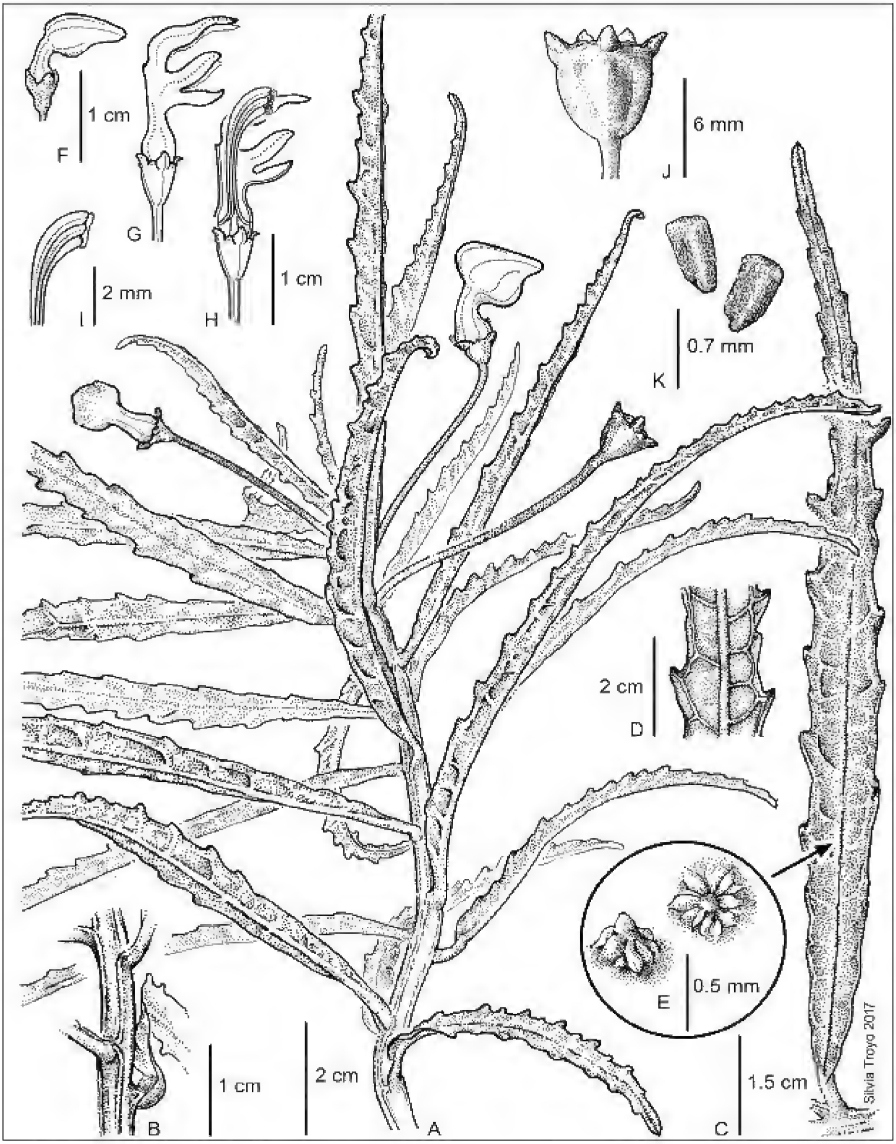

Figura 2. *Burmeistera flava* (A-K de *Solano et al. 4757*, CR). A. Hábito con flores y fruto inmaduro. B. Detalle del tallo. C. Hoja. D. Detalle del margen y la nervadura de la hoja. E. Detalle de escama en la hoja. F. Botón floral. G. Flor en vista lateral. H. Flor en vista longitudinal interna. I. Estambres y estigma. J. Fruto. K. Semilla.

Distribución y hábitat. Endémica de Costa Rica. Crece en los bosques pluviales y nubosos, en la vertiente Caribe de la Cordillera de Talamanca, en Fila Matama, entre 1200–1600 m.

Etimología. El epíteto latino *flava* se refiere al color amarillo de la corola.

Discusión. *Burmeistera flava* se caracteriza por mostrar hábito herbáceo y terrestre, escamas blanquecinas en hojas, tallitos, pedúnculos, flores y frutos, por sus hojas con la lámina 8–27 veces más larga que ancha y por sus flores con corola amarilla.

En Centroamérica esta especie es similar a *Burmeistera parviflora* E. Wimm. ex Standl., de Costa Rica y Oeste de Panamá, por su hábito herbáceo y terrestre, escamas blanquecinas en hojas, tallitos, flores y frutos, y por sus flores con corola amarilla; y tambien a *B. chiriquiensis* Wilbur por la similitud en tamaño y forma de hojas. *Burmeistera parviflora* se distingue por mostrar hojas apenas entre 2–6.5 veces más larga que ancha (vs. 8–27), margen generalmente con mayor número de dientes, lóbulos del cáliz a menudo más grandes, corola con lóbulos dorsales comunmente más alargados, aunque ventral con frecuencia más corto, y por sus anteras dorsales más alargadas. En tanto, *B. chiriquiensis* se diferencia por la ausencia de escamas blanquecinas, por sus flores maduras con lóbulos del cáliz más alargados, y por su corola verde, teñida de morado o púrpura (vs. amarillas) y más alargada.

Otras especies similares en aspectos como hábito herbáceo y terrestre, largo de peciolos y por la forma y el tamaño de la corola y de los frutos son *Burmeistera antioquensis* Garzón & J.M. Vélez y *B. minutiflora* Garzón & F. González, ambas endémica de Colombia. Entre otras diferencias, *B. antioquensis* se distingue por sus hojas más cortas, flores con lóbulos del cáliz más grandes y corola rojo brillante, al menos externamente (vs. amarilla). En tanto, *B. minutiflora* tiene hojas con la lámina distintivamente más cortas y con menor número de nervios secundarios, y flores con la corola rojo brillante, con lóbulos amarillo. En el Cuadro 2 se compara *B. flava* con las especies mencionadas, donde además se pueden notar algunas diferencias adicionales.

Carácter	***B. antioquensis***	***B. chiriquiensis***	***B. flava***	***B. minutiflora***	***B. parviflora***
Escamas blanquecinas en tallitos, hojas, flores y frutos	Ausentes	Ausentes	Presentes	Ausentes	Presentes
Peciolos: largo (cm)	0.3–0.9	0.2–1	0.3–1	0.3–1	0.7–2
Hojas: largo y ancho (cm) de lámina	2.7–6.2 × 0.7–2.5	6–11.5 × 0.4–0.6	5–16 × 0.3–1.4	(1.5–)1.8–2.8(–3.8) × (0.6–)1–1.5	5–17.5 × 2–5.5
Hojas: relación del largo vs. el ancho	1.5–4.6	(10–)11–21.5	8–27	2–3.2	2–6.5
Hojas: margen	Denticulado, 1–4 dientes/cm	Dentado a denticulado, 1–8 dientes/cm	Dentado a denticulado, 1–6 dientes/cm	Dentado a denticulado, 2–7 dientes/cm	Denticulado o dentado a subfimbriado, 5–11 dientes/cm
Hojas: pares de nervios secundarios	6–8	11–21	6–20	4–6	6–10

Lóbulos del cáliz: largo y ancho (mm), forma y margen	3–7 × 0.7–2.5, lanceolados, 6–8-denticulados	2.5–5.5(–9) × 0.6–1, oblongos a oblongo-lanceolados, subenteros a 1–3-dentados	1–1.75 × 0.75–1, deltados, enteros	1.5–2 × 1.5–2, triangulares, enteros	1.25–4 × 0.75–2 mm, oblongo-lanceolados a lanceolados, enteros a 4-dentados
Corola: largo (mm)	15–20	15–20	8–16	8–11	9–16
Corola: color	Rojo brillante, con el interior generalmente blanco	Verde, teñida de morado o púrpura	Amarilla	Rojo brillante, con lóbulos amarillo brillante	Amarilla
Corola: largo de lóbulos dorsales (mm)	9–13	8–13	2.5–7	4.5–5.5	6–12
Corola: largo de lóbulo ventral (mm)	6.9–9.2	4–5(–10)	5.5–10	4–5	4–6
Anteras dorsales: largo (mm)	Ca. 3.4	4.5–5	2–3	4–4.5	3–4.5

Cuadro 2. Características diferenciales entre *B. flava* con especies similares. Medidas y carácteres de *B. antioquensis* fueron tomados de Garzón *et al.* (2013) y *B. minutiflora* de Garzón *et al.* (2012).

Material examinado. **COSTA RICA. Limón**. Limón, El Progreso, siguiendo la fila a Cerro Matama, área de suelos inundados, Fila Matama, Valle de la Estrella, 09°47'20"N, -83°07'30"W, 1600 m, 23 abr 1989 (flores y frutos), *Herrera & A. Chacón 2738* (CR); Limón, Parque Nacional La Amistad, cuenca del Estrella, Valle La Estrella, Fila Matama, cerca 11 km suroeste del pueblo de Aguas Zarcas, punto 21, 09°48'14.4"N, -83°10'22.4"W, 1300–1400 m, 25 oct 2007 (flores), *Rodríguez et al. 11489* (CR); Limón, Zona Protectora Río Banano, cuenca del Banano, Valle La Estrella, Fila Matama, cerca 11 km suroeste del pueblo de Aguas Zarcas, sobre la fila hacia el punto 21, 09°48'36.5"N, -83°10'05.41"W, 1200–1300 m, 25 oct 2007 (flores), *Santamaría et al. 6640* (CR).

BURMEISTERA MAUI D. Solano & Al. Rodr., **sp. nov. TIPO: Costa Rica. Limón.** Talamanca, Parque Nacional La Amistad, Tararia, estación Valle del Silencio, colectado a orillas de la estación, 09°06'45"N, -82°57'15"W, 2500 m, 21 Jun 2003 (flores y frutos), *E. Alfaro & M. Alfaro 4634* (holotipo: CR-INB0003788475!; isotipo: CR-INB0003788473!, MO–2726051!). Figuras 3A–J, 4G-I.

Burmeistera maui is distinguished by its linear-lanceolate to lanceolate leaves, 1.9–10.75 times longer than wide, with the apex narrowly acuminate, the evident submarginal vein, the denticulate, coarse-dentate, crenate to pinnatifid margin, by its vegetative parts glabrous to glabrate, by its green corolla, stained purple and its globose to obconic fruits. This species is similar to *B. caudatifolia* sp. nov., *B. chiriquiensis* Wilbur, and *B. serratifolia* Lagom. & D. Santam. *Burmeistera caudatifolia* differs by its leaves generally with less secondary veins, 7–13 pairs (vs. 10–21 pairs), and the denticulate margin, with fewer teeth, 1–3 teeth/cm (vs. 1–9 teeth/cm), and by its calyx with narrower lobes, 0.4–0.75 mm wide (vs. 1–2.5 mm wide), and entire (vs. subentire to 1–4-toothed); *B. chiriquiensis* is distinguished by its leaves (10–) 11–21.5 times longer than wide; and *B. serratifolia* is differentiated by leaf margin with 15–17 teeth/cm (vs. 1–9 teeth/cm). Other similar species are *B.*

cyclostigmata Donn. Sm. and *B. monroi* D. Santam. & Lagom.; both species are distinguished by leaves only 1.7–4 times longer than wide.

Hierba suberecta a lianiforme, 0.4–1 m, terrestre o epífita y colgante; tallo sufruticoso, 2–4 mm de diámetro, meduloso a fistuloso, terete, glabro a glabrado, en material vivo rojizo, cuando seco pardo grisáceo a pajizo, entrenudos 0.3–3 cm de largo. **Hojas** espiralmente arregladas; peciolos 0.3–1.3 cm de largo, glabrados a esparcido e inconspicuo-pubescentes, generalmente ascendentes, en ocasiones divaricados o descendentes; **lámina** 2–10.5 cm de larga y 0.7–2.5 cm de ancha, linear-lanceolada a lanceolada, 1.9–10.75 veces más larga que ancha, distales con lámina que se reduce gradualmente en tamaño y generalmente lineares, base obtusa a corto-cuneada, ápice estrechamente acuminado, margen denticulado, grueso-dentado, crenado a pinnatífido, con 1–9 dientes por cm (en hojas maduras), **nervadura** con 10–21 pares de nervios secundarios, el nervio submarginal evidente, haz y envés glabros, concoloros a leve-discoloros, con el lado abaxial más pálido, el margen en ocasiones inconspicuamente ciliado. **Flores** solitarias, axilares en nudos subterminales; **pedúnculo** 3–11 cm de largo, glabro, ebracteado, ascendente a difuso; **hipantio** en la antesis obcónico a urceolado, 6–9 mm de largo y 4–7 mm de ancho, glabro a glabrado, verde teñido de púrpura, con 10 nervios longitudinales conspicuos, ecarinado; **cáliz** 5-lobulado, lóbulos erectos, más cortos, subiguales a generalmente más largos que el hipantio, 2.5–10.5 mm de largo y 1–2.5 mm de ancho, subiguales en tamaño, en ocasiones desiguales, lanceolados, oblongos a oblongo-lanceolados, ápice agudo, subenteros a 1–4 dentados, leve a inconspicuamente nervados, glabros a glabrados; **corola** 23–30 mm de largo, glabra, glabrada a esparcida e inconspicuo-pubescente, verde, teñida de morado púrpura, ventricosa en la antesis, tubo de 7–14 mm de largo (hasta lóbulo ventral) y 2–3.5 mm de ancho, lóbulos oblongo-falcados, con el ápice agudo, dorsales 10–14 mm de largo, laterales 6–10 mm de largo, ventral 4–10 mm de largo; **columna estaminal** 19–25 mm de largo (no incluye las anteras) y 1–1.5 mm de ancho, subigual en largo a corola o excediéndola hasta 5 mm, entre 1/3–3/4 basales glabrescente, entre 1/3–2/3 distales esparcida a densamente blanco pilosula, filamentos connatos, aunque libres cerca de la base, adnatos a la base de la corola; **anteras** con el tubo 4–7 mm de largo y 3–4 mm de ancho, esparcidamente pilosulas, las 2 anteras ventrales 3–5 mm de largo, el ápice esparcido y cortamente penicilado, con tricomas blanco pilosos de 0.2–0.8 mm de largo, aunque pronto-deciduos, las 3 anteras dorsales 5–7 mm de largo. **Frutos** 1–1.7 cm de largo y 0.8–1.7 cm de ancho, globosos a obcónicos, rosados a púrpura al madurar, glabros a glabrados, exocarpo de consistencia subcoriácea; **semillas** 0.6–1 mm de largo y 0.3–0.5 mm de ancho, oblongo-obovoides a oblongo-elípsoides, teretes a bicovexas, diminutamente alveolado-reticuladas, pardo pálidas a pajizas.

Fenología. Flores y frutos recolectados en marzo, abril, junio, julio, setiembre y noviembre.

Distribución y hábitat. Costa Rica y Panamá. Crece en los bosques pluviales y nubosos sobre ambas vertientes de la cordillera de Talamanca, entre 2000—2600(–2900) m.

Etimología. Esta especie está nombrada en honor a Mauricio Alberto Solano Peralta (“Maui”) (año de nacimiento: 1981), hermano de Daniel Solano y coautor de esta publicación, es un Ingeniero Industrial que con frecuencia lo ha acompañado a diferentes excursiones de campo, que incluye la expedición en la que fue fotografiada la especie.

Discusión. *Burmeistera maui* se caracteriza por sus hojas con la lámina linear-lanceolada a lanceolada, 1.9–10.75 veces más larga que ancha, con el ápice estrechamente acuminado, el nervio submarginal evidente, y el margen denticulado, grueso-dentado, crenado a pinnatífido, por sus partes vegetativas glabras a glabradas, por sus flores con la corola verde, teñida de morado o púrpura, y por sus frutos globosos a obcónicos. El margen de las hojas es muy variable en esta especie, a menudo incluso pinnatífido, especialmente en hojas proximales o en plantas juveniles.

En Centroamérica, por la forma de sus hojas y por el tamaño y color de sus flores, esta especie muestra similaridad con *Burmeistera caudatifolia* sp nov., endémica de Costa Rica y aquí descrita, y *B. chiriquiensis* Wilbur, de Costa Rica y Panamá. *B. caudatifolia* se diferencia por sus hojas con nervios secundarios por lo general menos numerosos, margen con dientes comunmente más esparcidos y menos pronunciados, pedúnculo con frecuencia más corto, y flores (maduras) con lóbulos del cáliz más estrechos y con el margen entero (vs. subenteros a 1–4-dentados), y con una columna estaminal comunmente más corta. *Burmeistera chiriquiensis* tiene hojas más estrechas, con nervadura poco diferenciada (vs. conspicua) y anteras dorsales más pequeñas.

Otras especies fenotípicamente similares son *Burmeistera cyclostigmata* Donn. Sm., distribuida de Costa Rica a Ecuador, *B. monroi* D. Santam. & Lagom., de Costa Rica y Panamá, y *B. mcvaughii* Wilbur y *B serratifolia* Lagom. & D. Santam., ambas endémicas de Panamá. Se presentan similitudes en forma de hojas, tamaño y color de flores, y en la forma y tamaño de frutos. Estas especies se distinguen por mostrar hojas con la lámina apenas 1.7–4 veces más largas que anchas (vs. 1.9–10.75 veces más larga que ancha). Diferencias adicionales se pueden notar en el Cuadro 1.

Burmeistera maui, por sus hojas con el margen a menudo pinnatífido, se podría semejar a *Burmeistera quercifolia* Gómez-Laur. & L.D. Gómez, endémica de Costa Rica; sin embargo, en otros aspectos son especies muy distintas, esta última tiene hojas con lámina a menudo más ancha, 1.5–4.5 cm (vs. 0.7–2.5 cm), y el envés densamente hirsutulo-puberulento, en especial sobre los nervios principales (vs. glabro), las flores (maduras) tienen lóbulos del cáliz más alargados, entre 15–21 mm (vs. 2.5–10 mm) y columna estaminal (no incluye las anteras) igualmente más alargada, entre 30–35 mm (vs. 19–25 mm), y los frutos son más grandes entre, 2.5–3.1 cm de largo y 2–2.2 cm de ancho, e hinchados (vs. 1–1.7 cm de largo y 0.8–1.7 cm de ancho, y no hinchados). En el Cuadro 1 se comparan *B. maui* con las especies mencionadas, donde además se pueden notar algunas diferencias adicionales.

Material examinado: **COSTA RICA. Limón.** Talamanca, Sabanas Dúrika, Río Kuk y Cerro Karo, 09°26'10"N, -83°19'10"W, 2450 m, 19 oct 1989 (flores), *Chacón 578* (CR); Cordillera de Talamanca, headwaters of the unnamed western branch of the Rio Teribe, between the Rio Sini and the continental divide at Cerro Bekom, 09°10'45"N, -83°03'30"W, 2500–2600 m, 21 mar 1984 (flores y frutos), *Davidse et al. 25732* (CR), *25809* (CR); Cordillera de Talamanca, Atlantic slope, Valle del Silencio, area just N of Cerro Hoffman, 4.5 km airline W of the Costa Rican-Panamanian border, 09°08'N, -82°58'W, 2350–2450 m, 08 set 1984 (flores y frutos), *Davidse et al. 28626* (CR); Cordillera de Talamanca, Atlantic slope, Kamuk massif, ridge between the Rio Tararia and the northeastern-most Kamuk paramo, 09°15'-09°16'N, -82°59'W, 2400–2900 m, 17 set 1984 (flores), *Davidse & Herrera 29244* (CR); Talamanca, Parque Nacional La Amistad, Tararia, Valle del Silencio, sendero a cerro Tararia, 09°07'43"N, -82°57'51"W, 2400 m, 24 abr 1997 (flores), *Gamboa et al. 1226* (CR); Talamanca, Parque Nacional La Amistad, Tararia, Valle del Silencio, 2 km antes del albergue, 09°06'10"N, -82°58'25"W, 2400–2500 m, 18 nov 2004 (flores), *Soto & González 293* (CR). **Puntarenas.** Buenos Aires, Parque Nacional La Amistad, cuenca Térraba-Sierpe, sendero a Kamuk, de Tres Colinas a Laguna Seca, 09°08'49.2"N, -83°04'04.7"W, 2000–2300 m, 19 jul 2000 (flores y frutos), *Alfaro 3205* (CR). **PANAMÁ.** Bocas del Toro: Valle del Silencio, 09°05'N, -82°56'"W, 8–10 ago 1979 (flores y frutos), *Antonio 1608A* (DUKE[imagen])

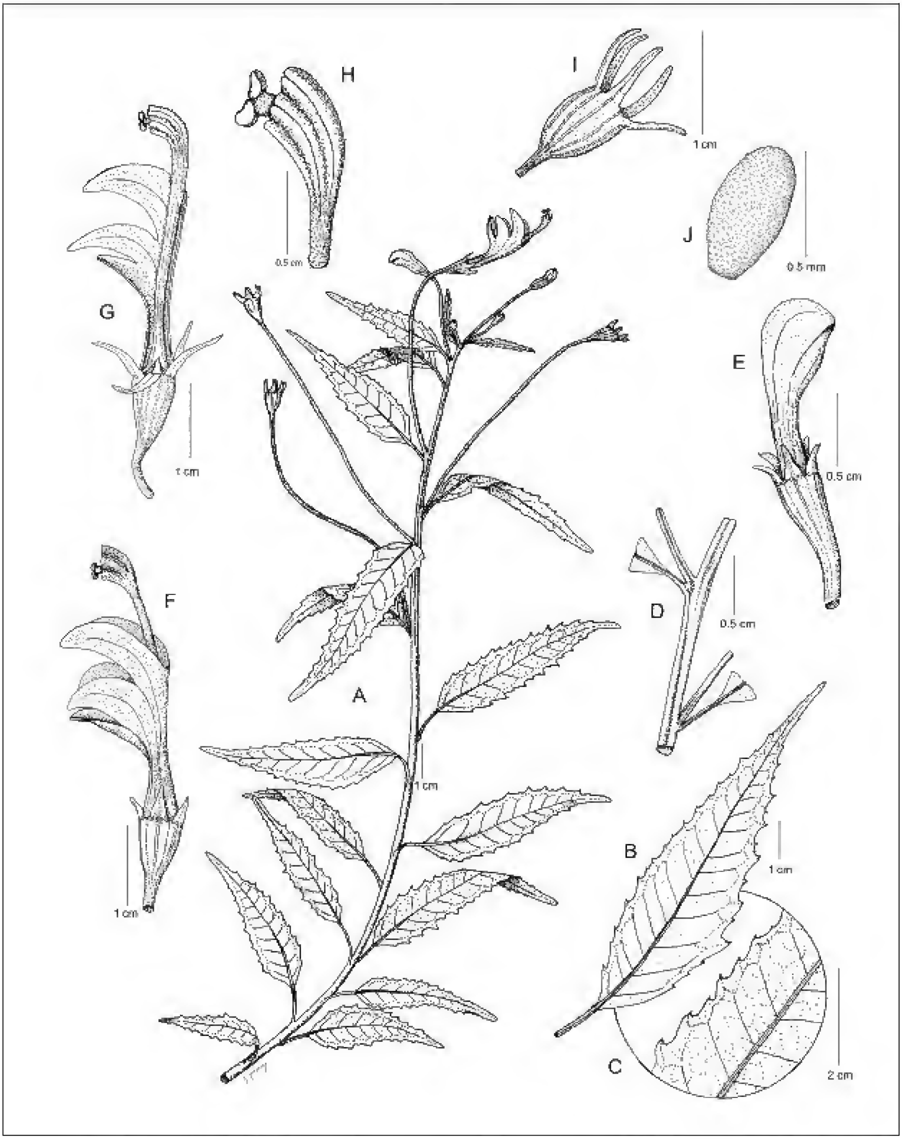

Figura 3. *Burmeistera maui* (A-J de *Alfaro & Alfaro 4634,* CR). A. Hábito con flores y frutos inmaduros. B. Hoja. C. Detalle del margen y la nervadura de la hoja. D. Detalle del tallo y base de la hoja. E. Botón floral. F. Flor en vista lateral. G. Flor en vista longitudinal interna. H. Estambres y estigma. I. Fruto. J. Semilla.

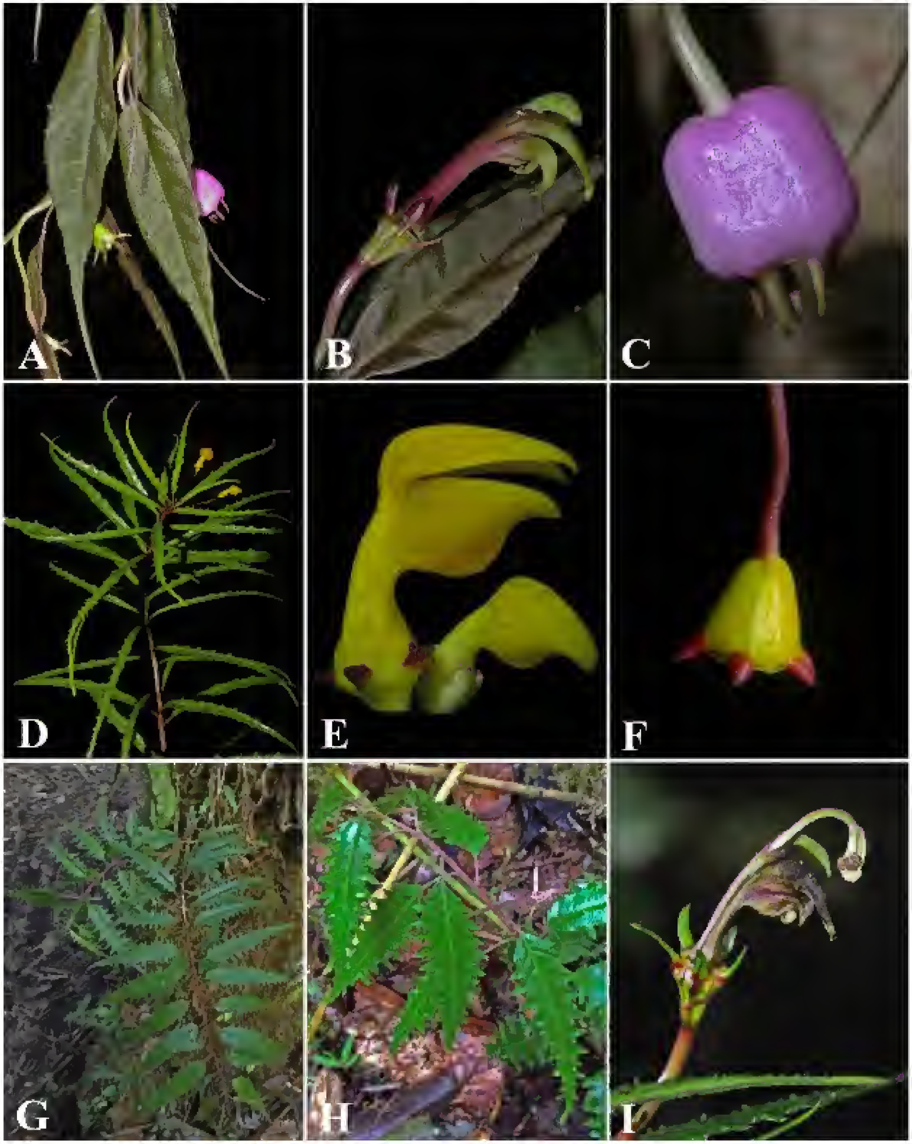

Figura 4. A–C. *Burmeistera caudatifolia*. A. Hojas y frutos. B. Flor y hoja. C. Fruto. Fotografías por D. Solano, de *Rodríguez & Solano 11037* (holotipo). D–F. *Burmeistera flava*. D. Hábito. E. Flor. F. Fruto. Fotografías D y F por A. Rodríguez, de *Rodríguez et al. 11489*, fotografía E por D. Solano, de *Solano et al. 4757* (holotipo). G–I. *Burmeistera maui*. Fotografías G y H por D. Solano, *s.n.*, I por M. Peralta, *s.n.*

AGRADECIMIENTOS

Los autores desean agradecer al Herbario Nacional de Costa Rica por permitir el uso de las colecciones para realizar este proyecto. A Jessica Jiménez y Silvia Troyo por las ilustraciones, a Barry Hammel, Francisco Morales, José Esteban Jiménez, Armando Ruiz y Xinia Peralta por la revisión de los textos y a Manrique Peralta por el aporte de fotografías.

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PRIMARY PRODUCTION OF THE CUMBERLAND RIVER IN CLARKSVILLE, TENNESSEE

JEFFERSON LEBKUECHER[1], SANDRA BOJIC, COOPER BREEDEN, SAMANTHA CHILDS, MATHEW EVANS, BAILEY HAUSKINS, ZACH IRICK, JOSH KRAFT, JONATHAN KRAUSFELDT, AND NICOLE SANTOYO

Biology Department
Austin Peay State University
Clarksville, Tennessee 37044
[1]lebkuecherj@apsu.edu

ABSTRACT

The Cumberland River in the Lower Cumberland River Watershed in Middle Tennessee is listed as impaired by nutrient enrichment by the Tennessee Department of Environment and Conservation and the United States Environmental Protection Agency. We evaluated the impact of nutrient enrichment on habitat quality by examining biotic characteristics of periphyton growth and characteristics of the water column. Periphyton production on artificial substrate, rates of oxygen metabolism, and pigment concentrations of the water demonstrate the negative effects of nutrient enrichment. The results suggest that best management practices to reduce nutrient input within the Lower Cumberland River Watershed may improve habitat quality.

Knowledge of the effects of nutrient concentration on the biomass of phytoplankton is essential to understand the impact of eutrophication of lentic systems. Nutrient enrichment and sediments from nonpoint sources are most responsible for the biological impairment of United States waters (Irvine & Murphy 2009). Assessments of nutrient pollution are prerequisites to developing watershed management plans to monitor aquatic systems (Smucker & Vis 2013). Biological evaluations are required to characterize and quantify the influences of water quality. Water sampling for chemical analyses alone may not reveal the impact of nonpoint-source pollution because pollutants from nonpoint sources often enter waterways in pulses. In addition, chemical analyses do not reveal the impacts of pollution on biological integrity (Taylor et al. 2007).

Phytoplankton are the most important primary producers in the majority of lentic systems and large rivers. Nutrient enrichment changes primary production characteristics and affects whole-system ecological relationships. The biomass and production rates of phytoplankton are excellent indicators of water quality and are used universally to follow changes in the quality of aquatic environments (Lind et al. 1992). High concentrations of chlorophyll (chl) *a* and high rates of primary production in the euphotic zone are hallmarks of eutrophication (Harris & Piccinin 1977).

The reach of the Cumberland at Clarksville, Tennessee is part of the Lower Cumberland River Watershed. The Lower Cumberland River Watershed is in the Western Pennyroyal Karst (71e) and Western Highland Rim (71f) Level IV Ecoregions. The geologic base of the watershed is Mississippian-age limestone and includes some chert, shale, siltstone, sandstone, and dolomite. The soils are a thin loess mantle, highly erodible, and very fertile (Baskin et al. 1997). Forests are Western Mesophytic and consist largely of *Quercus* and *Carya* species (Baskin et al. 1997). The watershed encompasses approximately 2,338 square miles and has an estimated population of 155,000 people (TNCT 2015). Over 50% of the watershed is used to produce agriculture products including tobacco, corn, soybean, and livestock (TDEC 2012). The cumulative effects of erosion, agricultural runoff, livestock access to streams, and poorly functioning sewage systems result in poor quality water in the lower reaches of all the major tributaries in the watershed as well as the Cumberland River. The reach of the Cumberland River in Clarksville, Tennessee is listed as impaired by nutrient enrichment by the Tennessee Department of Environment and Conservation and the United States Environmental Protection Agency (TDEC 2012). The primary objective of this research was to characterize the water quality of the reach of the Cumberland River at Clarksville, Tennessee such that changes in water quality can be followed. We used multiple approaches to document water quality including determinations of the light extinction coefficient, pigment concentrations of water, seston oxygen metabolism, and evaluations of primary production on artificial substrate.

Methods

Water-quality characteristics of the Cumberland River at Clarksville, Tennessee were determined on 25 September 2017. Photosynthetic photon flux density (PPFD) was measured with a spherical underwater quantum sensor coupled to a Li-Cor quantum meter (Li-Cor Cooperate, Lincoln, Nebraska). PPFD is a measurement of the amount of photosynthetically active radiation (PAR; light of wavelengths between 400 and 700 nm) that reaches a surface and is expressed as µmol photons$\cdot$m$^{-2}\cdot$s^{-1}. These data were used to determine the depth of the euphotic zone (defined here as the portion of the water column receiving $\geq$ 1% of the surface illumination) and the vertical extinction coefficient of light. The vertical extinction coefficient (n") was calculated using the equation (Kirk 1994): n" = (ln $\mathrm{PPFD}_{\mathrm{surface}}$ - ln $\mathrm{PPFD}_{\mathrm{depth}}$)/Depth.

Chlorophyll (chl) *a* concentration, phycocyanin concentration, and turbidity at a 0.25-m depth were determined using a portable fluorometer and turbidity (nephelometry) probe (AlgaeChek Ultra portable fluorometer and nephelometer, model RS232, Modern Water Incorporated, New Castle, Delaware). The fluorometer measures the intensity of fluorescence at 685 nm emitted from chlorophyll (chl) *a* and phycocyanin upon excitation by low emission diodes. The excitation wavelengths for induction of chl-*a* and phycocyanin fluorescence is 470 nm and 530 nm, respectively. The intensity of fluorescence is directly proportional to the concentration of the pigments. The turbidity probe (nephelometer) component of the AlgaeChek meter measures the concentration of suspended particulates by employing a source beam (685 nm) and a light detector beam (685 nm). Particle density is a function of the intensity of the scattered light reflected from the particles into the detector and is displayed as nephelometric turbidity units.

The rate of colonization of photoautotrophic periphyton on glass microscope slides is a standard method for measurement of primary production because it provides standardization which allows comparisons among different studies (Lowe and Pan 1996). A periphytometer holding glass microscope slides (25- by 75-mm) vertically 5 cm below the surface was deployed on 18 September, 2017 and retrieved 25 September 2017. Periphyton was scraped from both sides of slides using a razor blade. The periphyton were suspended in water by swirling and concentrations of chl *a* and phycocyanin were determined using the AlgaeChek portable fluorometer probe described above.

Phytoplankton productivity was examined on 25 September 2017 using the bottle-oxygen method (APHA 2017). This method was chosen because it provides community metabolism estimates of gross-productivity, net-productivity, and the whole-sample respiration rates (including bacteria, zooplankton, and phytoplankton). Water samples were retrieved from a depth of 0.25 m using a Van Dorn sampler. Samples were transferred to three borosilicate-glass bottles with ground-glass stoppers: a clear bottle, a darkened bottle, and a bottle used to determine the initial dissolved-oxygen concentration using a portable dissolved oxygen meter (model MW600, Milwaukee Instruments Incorporated, Rocky Mount, North Carolina). Transfers utilized a rubber delivery tube to prevent aeration. Clear and darkened sample-containing bottles were suspended at 0.25 m, the same depth from which the samples were collected. At the end of the 6-h incubation period, concentrations of bottle dissolved oxygen were measured. The increase in concentration of dissolved oxygen in clear bottles was used to determine net-productivity rate. The reduction of dissolved-oxygen concentration during incubation of darkened bottles was used to determine whole-sample respiration rate. Gross primary production was determined by adding the loss of dissolved oxygen resulting from whole-sample respiration to the net primary production rate. Rate calculations and conversions from oxygen to carbon used the equations of APHA (2017).

Results and Discussion

The physical characteristics of the Cumberland River at Clarksville, Tennessee (Table 1) are typical of large rivers and reservoirs in Tennessee. For example, the basic pH is similar to other aquatic systems in the ecoregion given the limestone geologic base. Measurements of the photosynthetic photon flux density at varying depths reveal a shallow euphotic zone (4.5 m) on 25 September 2017. The light extinction coefficient (n") is an expression of the PPFD-depth slope on a logarithmic axis: the higher the n" value, the greater the vertical extinction rate of light as it penetrates the water column. The majority of the light-extinction studies from a variety of natural freshwater lakes and reservoirs with different morphologies and chemistries report n" values near 1.3, a value which has been adopted as typical for purposes of comparison (Renolds, 1990). Although the rate of light extinction is affected by water chemistry, rates of extinction which are described as high (i.e., n" $\geq$ 1.8) are indicative of high concentrations of suspended matter (Luettich et al., 1990). The relatively low n" of the Cumberland River on September 25, 2018 most likely reflects the lack of significant precipitation, thus sediment runoff during the previous 2 weeks. The unusually low n" results in a relatively deep euphotic zone compared to many large rivers and reservoirs in the central region of the Interior Plateau Level III Ecoregion. For example, Kentucky Lake, considered to be mesotrophic to eutrophic, has euphotic-zone depths of approximatively 2.4 m in July and August (Lebkuecher et al. 1996). The low concentration of suspended particles is verified by the low turbidity of the water. For example, a clear mountain stream might have a turbidity near 1 nephelometric turbidity units (NTU), whereas a large river with good quality water may have a turbidity of approximately 10 NTUs. Values above 25 indicates the water column contains an unhealthy concentration of suspended particles (USEPA 1986).

Table 1. Physical characteristics of the Cumberland River at Clarksville, Tennessee.

Temperature (^{o}C) at 0.25 m at 8:00 AM CST	23.5
pH at 0.25 m at 8:00 AM CST	7.7
Photosynthetic photon flux density$_{surface}$ at 8:00 AM (μmol photons$\cdot$m$^{-2}\cdot$s^{-1})	450
Photosynthetic photon flux density$_{surface}$ at 12:30 PM (μmol photons$\cdot$m$^{-2}\cdot$s^{-1})	1820
Photosynthetic photon flux density$_{0.25\ m}$ at 8:00 AM (μmol photons$\cdot$m$^{-2}\cdot$s^{-1})	381
Photosynthetic photon flux densit$_{0.25\ m}$ at 12:30 PM (μmol photons$\cdot$m$^{-2}\cdot$s^{-1})	1350
Euphotic zone depth (m)	4.5
Light extinction coefficient (n")	1.00
Nephelometric turbidity units	5.3

The rate of colonization of photoautotrophic periphyton on glass microscope slides is a routine method for measurement of primary production because it provides standardization which allows comparisons among different studies and accurately portrays trophic state (Lowe and Pan. 1996). Values $\leq$ 0.3 mg chlorophyll (chl) a $\cdot$ m^{-2} $\cdot$ day are typical of rivers with good quality water in Middle Tennessee (Flynt et al. 2001, Lebkuecher et al. 2009). The rates of photoautotrophic periphyton production of the Cumberland River (Table 2) are substantially greater than rates considered healthy and demonstrate the river is eutrophic.

The high rates of phytoplankton production and community respiration measured using the bottle-oxygen method (Table 2) support the conclusions from the evaluations of primary production measured using a periphytometer that the river is eutrophic. In Kentucky Lake, rates of gross primary production and community respiration during the middle of the day may be as high as 116 mg C $\cdot$ m^{-3} $\cdot$ h^{-1}, and 19 mg C $\cdot$ m^{-3} $\cdot$ h^{-1}, respectively (Lebkuecher et al. 1996). The high value for the ratio of gross primary production to respiration in the Cumberland River indicate a high concentration of heterotrophs, thus a high concentration of dissolved organics typical of poor-quality water (Atkinson et al. 2008).

Table 2. Biological characteristics of the Cumberland River at Clarksville, Tennessee.

Chlorophyll *a* (mg $\cdot$ m^{-2} $\cdot$ day^{-1})	1.14
Phycocyanin (mg $\cdot$ m^{-2} $\cdot$ day^{-1})	0.52
Gross primary production (mg O_2 $\cdot$ m^{-3} $\cdot$ h^{-1})	375 ± 0.00
Gross primary production (mg C $\cdot$ m^{-3} $\cdot$ h^{-1})	140.63 ± 0.00
Respiration (mg O_2 $\cdot$ m^{-3} $\cdot$ h^{-1})	100 ± 25
Respiration (mg C $\cdot$ m^{-3} $\cdot$ h^{-1})	37.5 ± 9.375
Net primary production (mg O_2 $\cdot$ m-^{3} $\cdot$ h^{-1})	275 ± 25
Net primary production (mg C $\cdot$ m^{-3} $\cdot$ h^{-1})	103.125 ± 9.375
Ratio of gross primary production to respiration	4.0 ± 1.0
Chlorophyll *a* (µg $\cdot$ L^{-1})	25.0
Phycocyanin (µg $\cdot$ L^{-1})	5.3

Seston refers to particles suspended in the water column including phytoplankton. Concentrations of seston chlorophyll *a* > 8 µg/L are indicative of eutrophic conditions in large rivers and lakes (Dodds 2006). The concentration of seston phycocyanin is indicative of the concentration of cyanobacteria. The eutrophic concentration of seston chl *a* of the Cumberland River (Table 2) support conclusions from analyses of photoautotrophic periphyton production and oxygen metabolism that the Cumberland River at Clarksville, Tennessee is eutrophic. The results suggest that best management practices which reduce nutrient enrichment of water in the Lower Cumberland River Watershed may improve habitat quality.

ACKNOWLEDGEMENTS

The research was funded by the Department of Biology at Austin Peay State University, Clarksville, Tennessee.

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Phytoneuron 2018-11: 1–120. Published 26 February 2018. ISSN 2153 733X

FLORA OF NORTHERN ALABAMA, PART 3.
PRIMITIVE ANGIOSPERMS

DANIEL D. SPAULDING
Senior Curator
Anniston Museum of Natural History
800 Museum Drive
Anniston, Alabama 36206
dspaulding@annistonmuseum.org

T. WAYNE BARGER
Alabama Dept. of Conservation and Natural Resources
State Lands Division, Natural Heritage Section
64 North Union Street
Montgomery, Alabama 36130
wayne.barger@dcnr.alabama.gov

HOWARD E. HORNE
Barry A. Vittor and Associates, Inc.
8060 Cottage Hill Road
Mobile, Alabama 36695
hhorne@bvaenviro.com

ABSTRACT

This paper is a guide to native and naturalized primitive angiosperms of northern Alabama occurring in the Appalachian Highlands and Interior Plains physiographic regions. The families included in this treatment are Cabombaceae, Nymphaeaceae, Illiciaceae, Schisandraceae, Saururaceae, Aristolochiaceae, Magnoliaceae, Annonaceae, Calycanthaceae, and Lauraceae. Photographs, maps, identification keys, habitats, distributional data, and comments are provided for each taxon.

Angiosperms (flowering plants) are the most successful group of land plants in terms of overall biomass, ecological and morphological diversity, and total number of species (Crepet & Niklas 2009; Katz 2017). With a recent estimate of 295,383 species (Christenhusz & Byng 2016), the angiosperms represent approximately 90% of all land plants and over 95% of vascular plant species (Crepet & Niklas 2009; Katz 2017). Their rich diversity stands in contrast to the group's apparent young age, with the first angiosperm fossils appearing during the early Cretaceous, approximately 125 million years ago (Zeng et al. 2014). This apparent contradiction confounded Charles Darwin (1871), leading him to declare the dilemma of rapid diversification an "abominable mystery" (Crepet & Niklas 2009; Friedman 2009; Zeng et al. 2014; Katz 2017).

Monophyly of the angiosperms is strongly supported, based on a large number of phylogenetic studies utilizing multiple nuclear, chloroplast, and mitochondria DNA sequences (Stevens 2001; Judd et al. 2015). Morphological and anatomical synapomorphies (characteristics present in an ancestral species and shared exclusively by its evolutionary descendants) uniting the angiosperms include the presence of double fertilization, triploid endosperm, an extremely reduced female gametophyte (typically consisting of eight nuclei and seven cells), and the production of seeds enclosed within a carpel structure that possesses a stigmatic region for pollen reception and germination (Donoghue & Doyle 1991; Stevens 2001; Judd et al. 2015).

Historically, the angiosperms were divided into two major groups that were believed to represent fundamental natural taxa based on numerous shared reproductive and morphological features. These two groups were first recognized by John Ray in his *Methodus Plantarum Nova* (Ray 1682) and later treated taxonomically as classes (Takhtajan 1980; Cronquist 1981). The "dicots" (Magnoliopsida) were plants that possessed two cotyledons, pollen grains with three pores (tricolpate), reticulated leaf venation, and had their perianth parts typically occurring in multiples of four or five. The "monocots" (Liliopsida) were characterized by having a single cotyledon, pollen grains with a single furrow (monosulcate), generally parallel leaf venation, and three-merous floral parts. Other features separating the two groups include differences in stem vascular bundles (scattered in monocots and occurring in distinct rings in dicots), root origin (adventitious roots in monocots versus developing from a radical, or embryonic root, in the dicots), and the common occurrence of secondary growth (i.e. true woody tissue) in dicots, with monocots lacking true secondary growth (Judd et al. 2015).

Although the flowering plants as a group are clearly monophyletic, their traditional classification into the monocots and dicots is not phylogenetically supported (Judd et al. 2016). Deciphering the primary relationships within the angiosperms was long hindered by the existence of non-conforming plants that exhibited typical dicot-like features (such as two cotyledons, vascular bundles in rings, secondary growth, and net venation), but also possessed other characters that aligned them more with monocots, such as non-tricolpate pollen. These primitive non-monocot, non-tricolpate angiosperms were sometimes misleadingly classified as belonging to a single superorder, the Annonanae (Thorne 1992), or in the subclass, Magnoliidae (Cronquist 1988, cited in Judd et al. 2015). Additional terms such as "paleodicot" and "paleoherb" were sometimes used to refer to the primitive flowering plants that are classified as neither a eudicot nor a monocot (Leitch et al. 1998). The problem with these classification approaches is that the "primitive dicots" are actually a disparate assemblage of early divergent flowering plants, exhibiting pleisomorphic features (ancestral traits) that evolved earlier in the phylogenetic history of vascular plants (Judd et al. 2015).

Modern phylogenetic studies (Zeng et al. 2014; Judd et al. 2015; APG 2016) have now greatly clarified the backbone of angiosperm relationships, identifying eight main clades of flowering plants (Fig. 1). The basal-most members of the angiosperms are represented by a grade of three well-supported evolutionary lineages. These three lineages are collectively known as the ANA grade based on the first letter of each member's order: the Amborellales, Nymphaeales, and Austrobaileyales (Judd et al. 2015; APG 2016). This basal assemblage was also commonly called the ANITA grade in the early literature, when some plant families, like the Illiciaceae and Trimeniaceae, were unplaced to order; however, these families are now placed in the Austrobaileyales (Stevens 2001; Judd et al. 2015; APG 2016).

The order Amborellales is represented by the single species *Amborella trichopoda*, known only from New Caledonia, which is in the southwest Pacific Ocean (Stevens 2001; Judd et al. 2015). Current evidence shows *Amborella* to be the first branching extant angiosperm lineage, basal to all other flowering plants (Stevens 2001; Soltis & Soltis 2004; Judd et al. 2015). However, other phylogenetic analyses alternatively suggest the Amborellales and the Nymphaeales are closely related sister clades (Barkman et al. 2000).

The next two lineages in the ANA grade are the Nymphaeales and Austrobaileyales (Fig. 1), both having members found within the northern Alabama study region. The Nymphaeales comprises the families Hydatellaceae, Nymphaeaceae, and Cabombaceae (APG 2016), of which the Nymphaeaceae and Cabombaceae are represented in this flora. The Angiosperm Phylogeny Group (APG 2016) recognizes three families in the Austrobaileyales: Austrobaileyaceae, Trimeniaceae, and Schisandraceae, the latter broadly defined to include the Illiciaceae. In our present treatment, the

Illiciaceae is treated separately from the Schisandraceae, following the recommendation of Reveal (2012b).

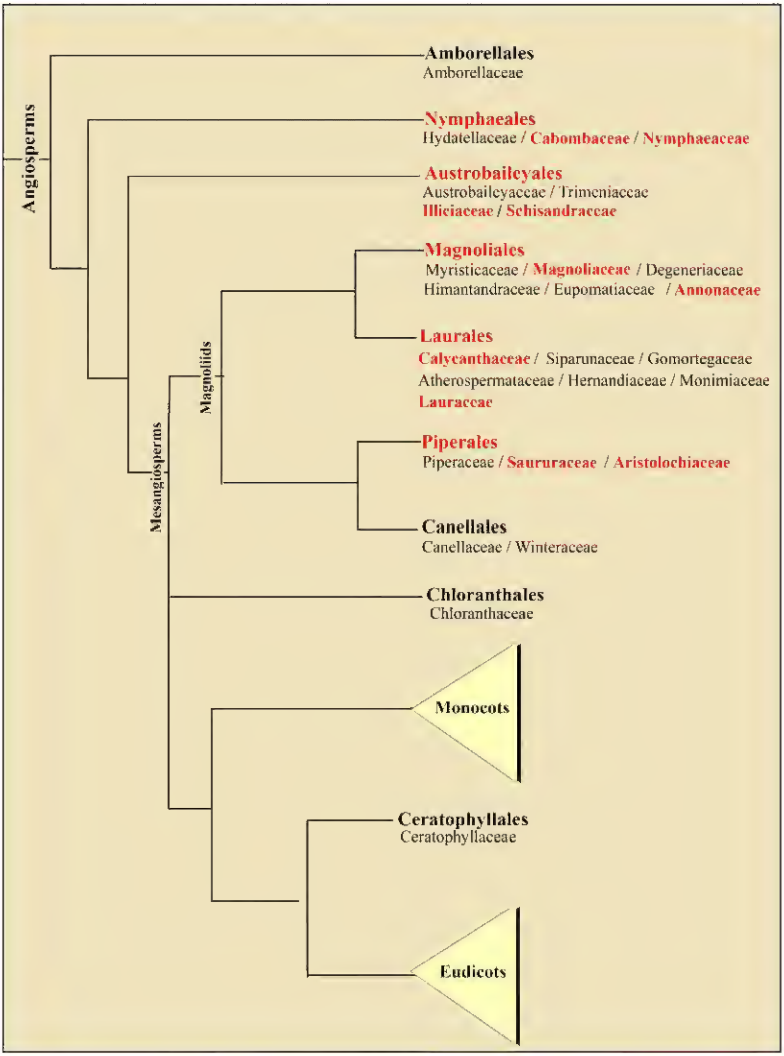


Figure 1. Relationships of the major angiosperm clades. Primitive angiosperms in this treatment are labeled in red (adapted and modified from APG 2016).

The remaining extant members of angiosperms, which constitute 99.95% of flowering plants (Zeng et al. 2014), form a highly-supported clade collectively known as the Mesangiospermae (Cantino et al. 2007). This clade contains five major lineages: eudicots, monocots, magnoliids, Chloranthales, and Ceratophyllales (Fig. 1). The eudicots and monocots are the two largest clades in the Mesangiospermae and contain 75% and 20% of the angiosperm species, respectively (Zeng et al. 2014). These two lineages plus the Ceratophyllaceae and the Chloranthales are not covered in this present treatment.

The "magnoliids" represent the remaining clade and consist of four orders: Magnoliales, Laurales, Piperales, and Canellales. The Canellales, which includes two families, Canellaceae and Winteraceae, are not present in North America. The Magnoliales comprises six families (APG 2016; Reveal 2012b), of which the Magnoliaceae and Annonaceae have members in the study area. Seven families make up the Laurales, with only the Lauraceae and the Calycanthaceae being present in northern Alabama. Finally, the Piperales sometimes has three families (APG 2016) or includes five families (Reveal 2012b) of which the Saururaceae and the Aristolochiaceae are treated here.

METHODS AND FORMAT OF FLORA

The concept for this flora began in the 1990's when the senior author was in graduate school at Jacksonville State University (JSU). The first project included fellow JSU graduate student, Mark Ballard, and our major professor, Dr. David Whetstone. The treatment was called the *Flora of Northeast Alabama and Adjacent Highlands*, which included twenty-eight counties in northern Alabama. Part 1, the Pteridophytes (Spaulding et al. 2000a, 2000b, 2001a, 2001b 2001c) and part 2, the Gymnosperms (Spaulding et al. 2002) were published in the *Journal of the Alabama Academy of Science.*

This recent floristic project is a continuation of the flora of northeast Alabama project, except it includes six additional counties in order to encompass the area Johnston (1930) defined as northern Alabama (Fig. 2). This region contains counties that occur within the Appalachian Highlands and Interior Plains, which comprises four physiographic provinces (Fenneman 1938): Interior Low Plateaus (Highland Rim section); Appalachian Plateaus (Cumberland Plateau section); Ridge & Valley (Tennessee section); and Piedmont Plateau (Piedmont Upland section).

County distribution maps with physiographic regions (Fig. 3) are provided for each species occurring in northern Alabama. A symbol is used to document its occurrence and is placed within the physiographic province, so there may be more than one symbol per county. Specimens were examined from various herbaria and searches were made online from the following sites: Alabama Plant Atlas (Keener et al. 2017); Floristic Synthesis of North America (Kartesz 2017); and the Southeast Regional Network of Expertise and Collections Data Portal (SERNEC 2017). All vouchered specimens were verified and are deposited in the following herbaria: A, ALNHS, AMAL, AUA, BRIT, EKU, GAS, GH, JSU, KE, NBYC, NCSC, NCU, NY, TENN, TROY, UNA, UNAF, USCH, UWAL, UWFP, US, VSC, and VDB. Herbarium acronyms follow those found in *Index Herbariorum* (Thiers 2016).

Taxonomic nomenclature generally follows Weakley (2015). Families are in arranged taxonomic order, however, genera and species are organized alphabetically. Each genus includes its author and date of publication; below is its derivation in brackets and sometimes remarks about the genus. The format for common names follows Kartesz (2017) and Kartesz & Thieret (1991). Information on taxa is set up in the following arrangement: **Name** author(s) {derivation of specific and infraspecific epithet}. VERNACULAR NAME(S). [*Synonyms*]. Habit/duration. Habitat(s); flowering dates; fruiting dates (listed only if significantly different from flowering times); frequency of occurrence in Alabama provinces. Overall range and distribution. Comments.

Frequency of occurrence is defined as follows, ranging in descending order: *Common* (occurring in abundance throughout a province), *frequent* (occurring throughout a province, but not abundant), *uncommon* (occurring in scattered localities in a province), *rare* (known only from a small number of populations, 6 to 20 occurrences, often restricted to specific localities or habitats), and *very rare* (known only from a few populations, 5 or fewer occurrences, often narrow endemics, disjuncts, or peripheral taxa, at the edges of their ranges).

The following publications were utilized in creating keys: Blomquist 1957; Clark 1971; Clewell 1985; Cronquist 1981; Elias 1980; Fernald 1950; Flora of North America 1997; Gaddy 1987b; Godfrey 1988; Godfrey & Wooten 1981; Hardin 1972; Horn 2015; Jones 2005; Kral 1960; Latowski et al. 2014; Radford et al. 1968; Small 1933; Smith 1994; Spongberg 1974; Tennessee Flora Committee 2015; Weakley 2015; Wiersema & Haynes 1983; Wilbur 1970; Wofford 1989; Wood 1958, 1959, 1971; Xia & Brach 1997. Specimens from various herbaria of the Southeast, as well as recent collections in the field, were also examined to assist in construction of the keys.

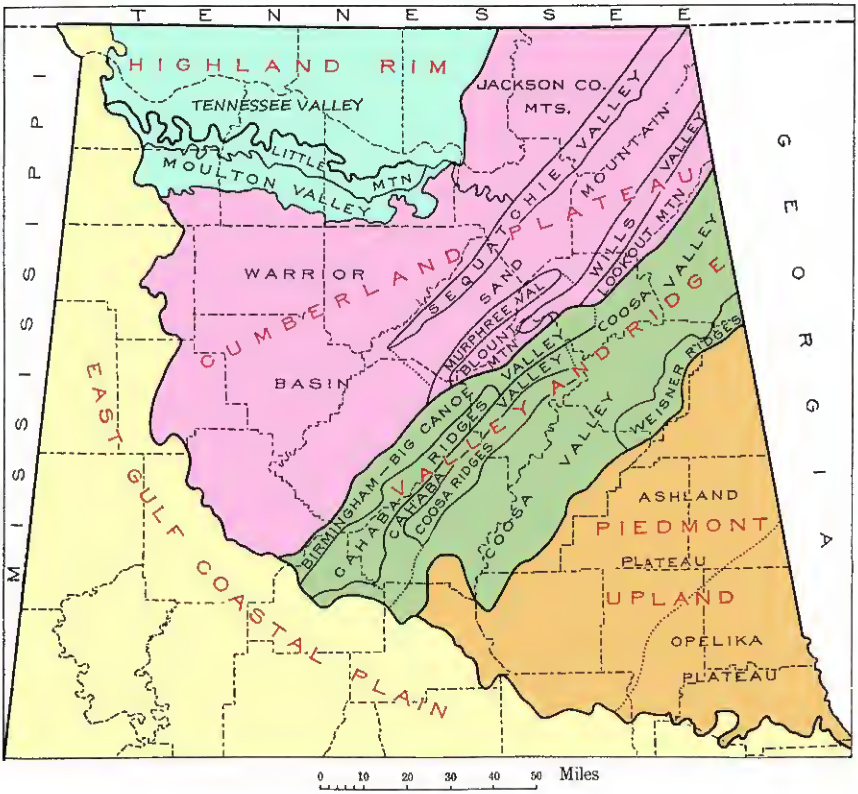
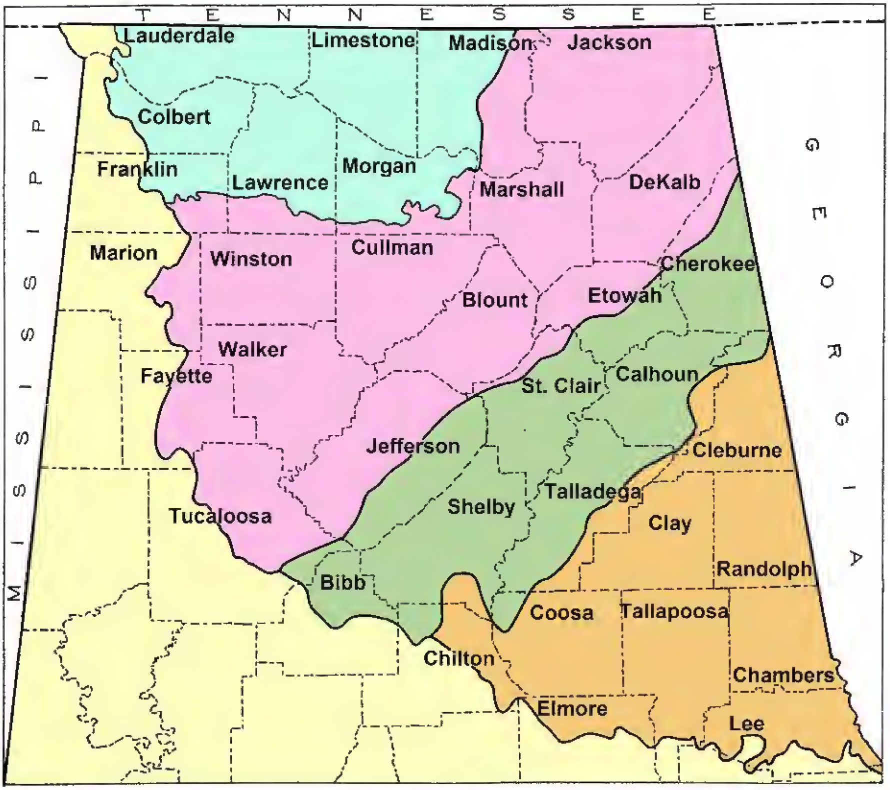


Figure 2. Map of the physical divisions of northern Alabama (adapted and modified from Johnston 1930).



MAP KEY	
●	Native taxon, present in physiographic area of county
✪	Sensitive species, listed as imperiled or rare in Alabama
◉	Introduced in region, but native to southeastern USA
▼	Exotic taxon, adventive or naturalized in Alabama
✱	Waif; cultivated escape, likely not persisting in wild

Figure 3. Counties of study area and map key to symbols.

KEY TO PRIMITIVE ANGIOSPERM FAMILIES

1. Plant woody (tree, shrub, or woody vine).

    2. Plant a woody vine.

        3. Plant glabrous; leaves elliptic and pinnately veined; leaf apices acuminate; flowers unisexual (monoecious); perianth consisting of 9–12 tepals (often pinkish to red); fruit a fleshy, red berry (when ripe) .... **4. Schisandraceae**
        3. Plant tomentose; leaves broadly ovate and palmately veined; leaf apices blunt; flowers bisexual; perianth a bent (S-shaped), tubular calyx with 3-lobes (tube is usually yellowish to green with a purple ring around opening of throat); fruit a dry, green capsule (cylindrical to elliptical) .... **6. Aristolochiaceae** (*Isotrema*)

    2. Plant a tree or shrub.

        4. Leaves opposite; nodes distinctly swollen; flowers with numerous tepals (9–12) and have a fruity/spicy aroma; fruit an oblong, semi-woody, bag-like structure (a pseudocarp) up to 8 cm long; shrubs .... **9. Calycanthaceae**
        4. Leaves alternate; nodes not distinctly swollen; flowers various; fruit not a pseudocarp; shrub or tree.

            5. Stipules present, but caducous (shed early), stipular line scars evident as a ring all the way around the twig at the nodes of younger branches; flowers relatively large (≥ 2.5 cm, in diameter), solitary; tepals white, yellowish, pink or greenish (marked with an orange blotch in *Liriodendron*); fruit cone-like .... **7. Magnoliaceae**
            5. Stipules and encircling stipular scars absent; flowers smaller (≤ 2.5 cm, in diameter), either solitary or in multi-flowered inflorescences; tepals white, yellowish, greenish or maroon; fruit not cone-like.

                6. Leaves membranous and deciduous.

                    7. Leaves simple and long-obovate to long-oblanceolate; crushed leaves smell like green peppers; leaves and leaf scars 2-ranked (alternating on each side of stem); flowers with maroon tepals, 1–2.5 cm long, bisexual, and solitary; fruits stubby, greenish to yellowish, banana-like berries, 3–15 cm long .... **8. Annonaceae**
                    7. Leaves lobed or all simple and elliptic, ovate, lanceolate to short-obovate; crushed leaves smell spicy or fruity; leaves and leaf scars more than 3-ranked (spiraling up the stem); flowers with small yellow tepals, 2–5 mm long, unisexual (monoecious), and in multi-flowered inflorescences; fruits blue-black to red drupes, 6–10 mm long .... **10. Lauraceae** (*Lindera, Sassafras*)

                6. Leaves thick and evergreen.

                    8. Plant glabrous; leaves punctate (gland-dotted) beneath; upper and lower surface of leaf blade with only midvein evident, lateral veins faint; flowers solitary with numerous red-maroon tepals, 1.5–2.5 cm long; fruit a woody, star-shaped aggregate of follicles, 25–40 mm in diameter .... **3. Illiciaceae**

8. Plant pubescent; leaves not punctate beneath; upper and lower surface of leaf blade with lateral veins and midvein clearly evident; flowers in clusters (stalked cymes) with 6 small yellow tepals, up to 2 mm long; fruit a blackish-blue, globose drupe, 8–10 mm long .... **10. Lauraceae** (*Persea*)

1. Plant herbaceous.

9. Plant aquatic, uppermost leaves floating or all leaves emersed.

10. Floating or emersed leaves orbicular or broadly ovate and with a basal sinus (petiole attached at base of notch in leaf blade); flowers more than 3 cm in diameter with numerous tepals (more than 10); carpels united with many seeds in each locule .... **2. Nymphaeaceae**
10. Floating leaves elliptic to linear-elliptic and peltate, lacking a basal sinus (petiole attached in middle of leaf blade), in *Cabomba* submersed leaves fan-like and finely dissected (all leaves floating in *Brasenia*); flowers less than 3 cm in diameter with 6 to 8 tepals; carpels not united (free) with 1–3 seeds in each locule .... **1. Cabombaceae**

9. Plant terrestrial or emergent aquatic (portions of stem above surface of water); leaves not floating.

11. Flowers lacking a perianth and are borne in a crowded terminal raceme or spike (*Houttuynia* has white, petaloid bracts at base of inflorescence); plants caulescent wetland or terrestrial herbs (with aerial stems bearing leaves and flowers at above-ground nodes) .... **5. Saururaceae**
11. Flowers with a conspicuous fleshy, tubular calyx that is borne at ground level; plants terrestrial herbs, either caulescent or acaulescent (leaf petioles and flower stalks arising separately from base of the plant)........ **6. Aristolochiaceae** (*Asarum, Endodeca, Hexastylis*)

FAMILY 1. CABOMBACEAE (Water-Shield Family)

1. All leaves floating, conspicuous (3.5–11 cm long), and broadly elliptic, not divided; plants coated with a sticky, mucilaginous jelly; stamens 18–36.. ***1. Brasenia***
1. Most leaves submersed, fan-like, and divided into linear segments, floating leaves smaller (0.6–3 cm long) and ovate-rhombic to linear-elliptic (present when flowering); plants not mucilaginous; stamens 3–6... ***2. Cabomba***

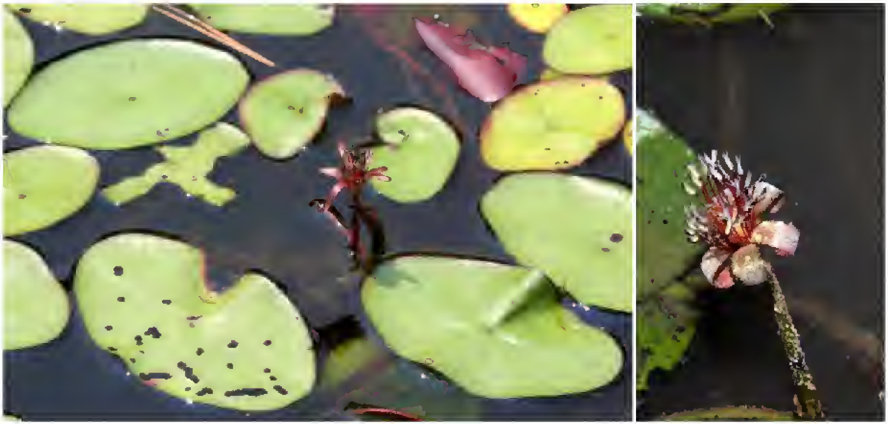
1. BRASENIA Schreber 1789

[For Christoph Brasen, 1738–1774, a Moravian surgeon, missionary, and plant collector]

1. Brasenia schreberi J.F. Gmel. {Johann von Schreber, 1739–1810, a German botanist} — WATERSHIELD; DOLLAR-BONNET; WATER-SNOT; WATER-TARGET; PURPLE WEN-DOCK (Fig. 4a–b). [*Brasenia purpurea* (Michx.) Casp.]

Perennial, aquatic herb. Ponds, marshes, lakes, impoundments, sluggish streams, oxbows, and back water sloughs; June–October; uncommon in the Highland Rim, Ridge & Valley, and Piedmont; rare in the Cumberland Plateau; common in the Coastal Plain (Fig. 5). *Brasenia* is a monotypic genus found worldwide, except in Europe. It is sporadically distributed in Asia, Australia, Africa, northern South America, Central America, Mexico, West Indies, and the eastern half of the USA from Florida to Texas, north to Canada, and is disjunct in Western North America from Alaska south to California (Wood 1959).

Wiersema and Haynes (1983) indicated that Watershield is "common in stagnant or slow-moving water throughout the Coastal Plain in Alabama, but rare elsewhere in the state." But since the time of their publication this floating aquatic species has become more frequent outside the Coastal Plain. Collections made in the Highland Rim and Cumberland Plateau (Marshall County) are associated with the Tennessee River.



(4a) Photo: T. Wayne Barger. (4b) Photo: Brian Finzel.

Figure 4. *Brasenia schreberi.* A. Leaves and flower, Bullock Co., Alabama, 18 Aug 2007. B. Close-up of flower with elongated stamens, Cumberland Co., Tennessee, 9 Jun 2011.

Wiersema and Haynes (1983) stated that "*Brasenia* often vigorously inhabits beaver ponds and small artificial impoundments, and in the latter situation is normally viewed as a weed." Very dense populations of Water-Shield can inhibit the growth of other plants, as well as impacting recreational use by impeding small boat navigation, but it provides good habitat for fish and other aquatic organisms.

The hard spherical seeds are a valuable food for waterfowl (Martin et al. 1951). Watershield has also been utilized by humans. The tuberous "roots" (rhizomes) were consumed by Native Americans and the young leaves and stems were eaten as salad greens by the Japanese (USDA 2010). In Japan, *Brasenia* is called *Junsai*, and is an ingredient of *Miso-shiru* (the traditional *miso* soup), *Suimono* (clear soup), and in other Japanese recipes and dishes. The plant is gathered from small boats in spring or early summer, then dried and sold loose (in plastic bags) or in bottles (Hosking 1996).

Brasenia schreberi differs from other floating aquatics by its peltate, oval-shaped leaves (the petiole is attached in middle of leaf and lacks a notch or slit). The underside of leaves, as well as stems, are heavily coated with a clear jelly-like material (Fig. 6). The flowers of *Brasenia* are wind pollinated (Cook 1988). Osborn & Schneider (1988) observed that the flowers are emergent over a three-day period. The unopened flower bud emerges on the first day and then opens diurnally over the next two days. When the flower first opens, only the stigmas are receptive. At the end of the second day, the flower closes, and the peduncle (flower stalk) bends and is submersed overnight. The next morning, on the third day, the flower emerges and opens again, but the stamens now elongate and shed their pollen (Fig. 4b); the stigmas are not receptive at this time, which assures cross pollination. The aggregate fruit (with separate carpels containing 1 to 2 seeds) is formed below the surface of the water.

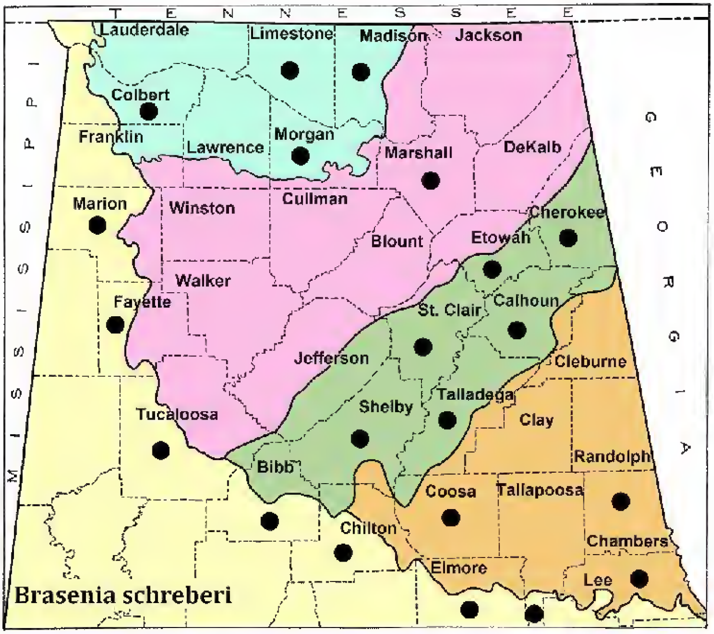


Figure 5. Distribution of *Brasenia schreberi* in northern Alabama.

Figure 6. *Brasenia schreberi*, Catahoula Ranger District, Kisatchie National Forest; Bossier Parish, Louisiana, Sept 2010. Photo: Shannon Sharp.

2. CABOMBA Aublet 1775

[Possibly a Native American name]

1. **Cabomba caroliniana** A. Gray {of Carolina} — CAROLINA FANWORT (Fig. 7a–b). [*Cabomba caroliniana* var. *pulcherrima* R.M. Harper; *C. pulcherrima* (R.M. Harper) Fassett]

(7a) Photo: Chris Taylor. (7b) Photo: Dan Spaulding.

Figure 7. *Cabomba caroliniana*. A. Fan-shaped submersed leaves and flower, pond in Montgomery Co., Alabama, 29 Aug 2017. B. Floating, peltate leaves with flowers, slow-moving stream by Tennessee River in Limestone Co., Alabama, 4 Jul 2017.

Perennial, aquatic herb. Ponds, swamps, lakes, and slow-moving streams; May–September; rare in the Highland Rim, Cumberland Plateau, and Piedmont; uncommon in the Coastal Plain (Fig. 8). Originally native to Brazil, Paraguay, Uruguay, Argentina and the USA from Virginia west to eastern Missouri south to Texas and Florida (Ørgaard 1991). *Cabomba caroliniana* is often used as an aquarium plant and is introduced elsewhere in the USA, Canada, Australia, Asia, and Europe (Vukov et al. 2013).

Northern populations in Alabama are found in the Tennessee River drainage system. Wiersema and Haynes (1983) reported that the Tennessee Valley Authority (TVA) attempted to eliminate this species from TVA reservoirs. Even though Carolina Fanwort is a native species, it is sometimes treated as an aquatic weed. Unlike *Brasenia*, the flowers of *Cabomba* are insect-pollinated (Cook 1988).

Typically, *Cabomba caroliniana* has white flowers and green stems, but Harper (1903) discovered a purple-tinted population in South Georgia that he named *C. caroliniana* var. *pulcherrima*. He wrote "the purple stem and petals are the most striking features…I find no mention of a purple-flowered *Cabomba* in botanical literature." He was so impressed that he stated "further study may show this to be a distinct species." Fassett (1953), in his monograph on *Cabomba*, elevated this taxon to *C. pulcherrima* and also noted that the perianth segments were emarginated (notched) at the summit, instead of rounded as in *C. caroliniana.* He maps its distribution in the lower Coastal Plain of South Carolina, southwest Georgia, and adjacent Florida Panhandle. Most treatments sink *C. pulcherrima* in synonymy, though Weakley (2015) believes this entity needs further evaluation.

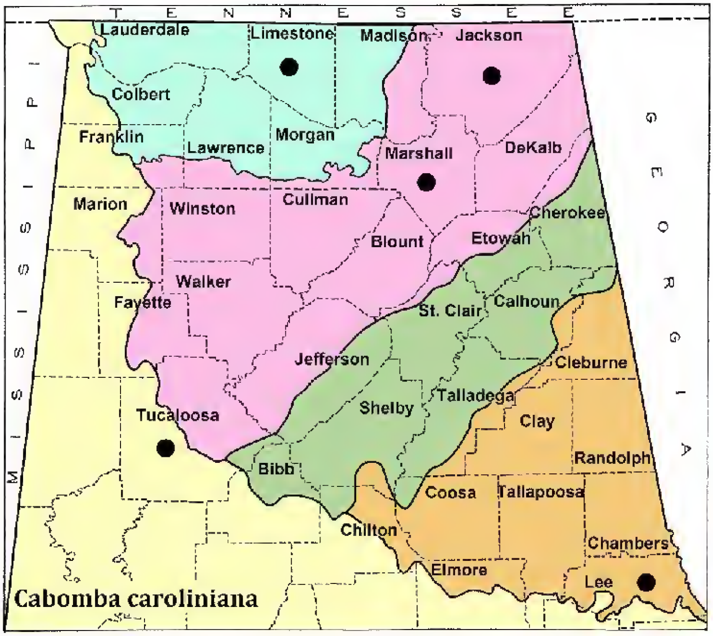


Figure 8. Distribution of *Cabomba caroliniana* in northern Alabama.

FAMILY 2. NYMPHAEACEAE (Water-Lily Family)

1. Flowers yellow, somewhat closed and ball-like (globose), usually protruding above water level; leaves floating and emersed (borne above surface of water) or occasionally submersed; leaf surfaces green on both sides; leaf blade with pinnate venation and basal lobes are broadly rounded (obtuse) .... **1. *Nuphar***
1. Flowers white (or occasionally pink), conspicuously open and usually floating on the water; all leaves floating; leaf surfaces green above (sometime purplish) and usually purplish underneath; leaf blade with palmate venation and basal lobes are pointed (acute) .... **2. *Nymphaea***

1. NUPHAR J.E. Smith 1809

[Ancient name; from Greek *nouphar,* the flowers from a medicinal plant mentioned by Dioscorides]

1. Nuphar advena (Aiton) W.T. Aiton {immigrant; first thought to be the European species, *N. lutea*} — YELLOW POND-LILY; BROADLEAF POND-LILY; SPATTERDOCK (Fig. 9). [*Nuphar lutea* (L.) Small ssp. *advena* (Aiton) Kartesz & Gandhi; *Nuphar lutea* ssp. *macrophyllum* (Small) E.O. Beal; *Nuphar puteorum* Fernald; *Nymphaea advena* Aiton; *Nymphaea chartacea* G.S. Miller & Standl.; *Nymphaea fluviatilis* R.M. Harper; *Nymphaea macrophylla* Small]

Perennial, aquatic herb. Swamps, ponds, lakes, impoundments, marshes, and sluggish streams or rivers; April–October; frequent in the Highland Rim; uncommon in the Cumberland Plateau, Ridge & Valley, and Piedmont; common in the Coastal Plain (Fig. 10).

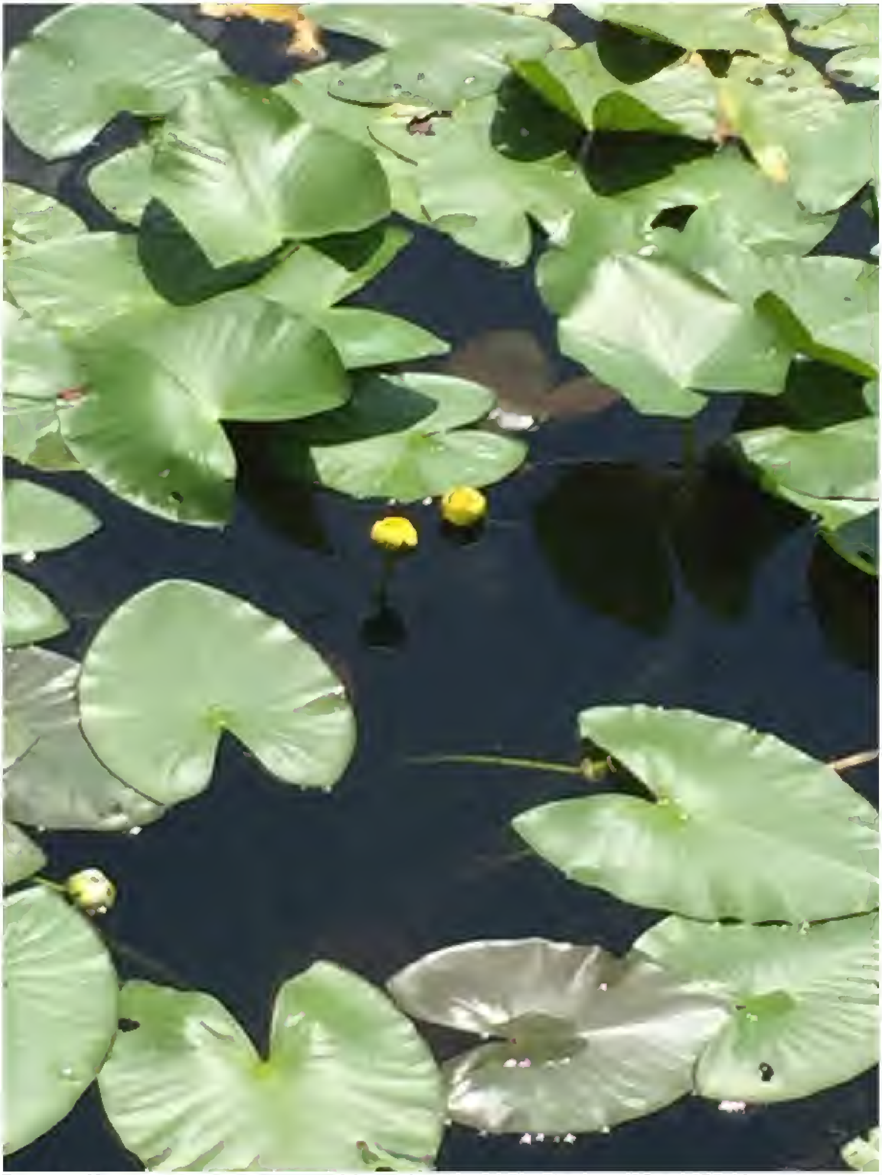


Figure 9. *Nuphar advena*, roadside pond, Marion Co., Alabama, 20 Aug 2017. Photo: Dan Spaulding.

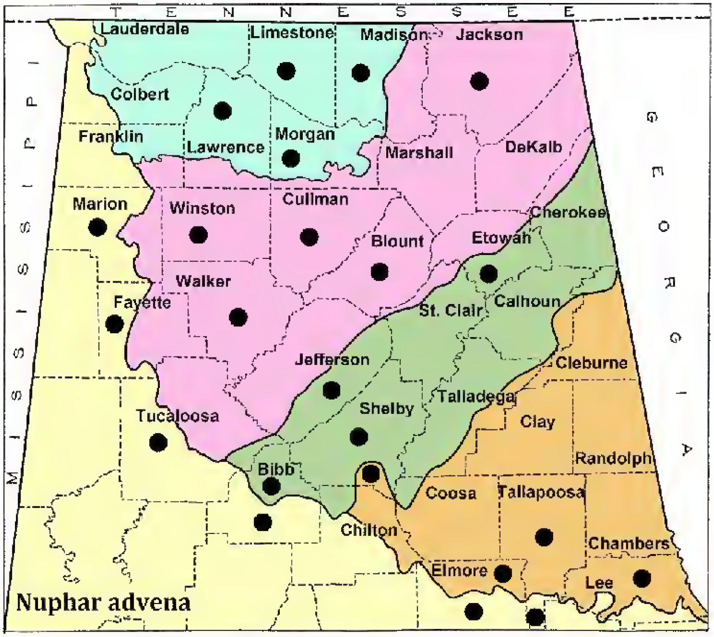


Figure 10. Distribution of *Nuphar advena* in northern Alabama.

The flowers (Fig. 11a) are pollinated by sweat bees, flies, and beetles (Wood 1959). The fruit (Fig. 11b) is slightly constricted toward the apex and splits open to release its seeds. Plants often possess flowers and fruits at the same time (Fig. 11c). Shosteck (1974) wrote that the "large seeds are edible if parched for ten minutes to loosen the kernels, then pounded lightly and winnowed to remove the shells. The starchy rootstock can be boiled, baked, or roasted as a vegetable. Remove the rind before eating."

(11a) Flower. (11b) Fruit. (11c) Flower and fruit together.

Figure 11. *Nuphar advena*. A. Elmore Co., Alabama, 17 Jun 2009. Photo: T. Wayne Barger. B–C. Marion Co., Alabama, 20 Aug 2017. Photos: Dan Spaulding.

2. NYMPHAEA Linnaeus 1753

[Greek and Latin for water-lily; for *Nympha,* goddess of waters, meadows, and forests]

1. **Nymphaea odorata** Aiton {fragrant; referring to flowers} — FRAGRANT WATER-LILY; AMERICAN WHITE WATER-LILY (Fig. 12). [*Castalia odorata* (Aiton) W. Wood var. *odorata*; *C. odorata* var. *rosea* (Pursh) Britton; *Nymphaea odorata* var. *gigantea* Tricker; *N. odorata* var. *minor* Sims]

Figure 12. *Nymphaea odorata*, swamp in Cherokee Co., Alabama, 16 Jul 2017. Photos: Dan Spaulding.

Perennial, aquatic herb. Ponds, swamps, marshes, and sluggish streams; June–September; uncommon in the Highland Rim, Cumberland Plateau, Ridge & Valley, and Piedmont; common in the Coastal Plain (Fig. 13). The species is found throughout North America from Canada south to Central America, but it is introduced in the western USA (Wiersema 1997).

The flowers of this water-lily are very fragrant and typically white. The leaves are usually green above and reddish-purple beneath. However, the flowers are occasionally pink and leaves are sometimes purplish on their upper surface (Fig. 14). Other characters that separate *Nymphaea* from *Nuphar* (not found in the key above) are that the perianth of *Nymphaea* has 4 greenish sepals and numerous showy petals; the fruit is roughened with traces of the perianth; the stigmatic disk lacks a stalk, therefore the fruit has a spherical shape (Latowski et al. 2014); the fruits are borne on curved peduncles and ripen under water (Wiersema 1997); the seeds are arillate (Wood 1959); and rhizomes have circular or rounded leaf scars (Conrad 1905).

Wiersema (1997) recognized only two subspecies: *Nymphaea odorata* subsp. *odorata* and *N. odorata* subsp. *tuberosa* (Paine) Wiersema & Hellq., which occurs chiefly in northern portions of eastern USA and adjacent Canada. It differs by its purple-brown striped petioles and leaves that are usually green or rarely faintly purple underneath. Wiersema (1997) acknowledged that these taxa represent the extremes in a morphologic continuum and intermediate plants may be difficult to identify. Weakley (2015) suggests that other entities with larger leaves and flowers (*N. odorata* var. *gigantea*) or with smaller leaves and flowers (*N. odorata* var. *minor*) may warrant further evaluation.

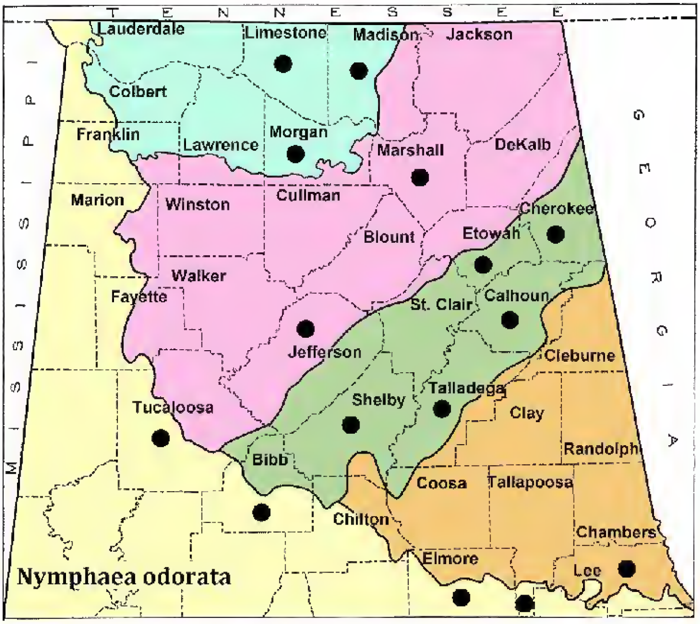


Figure 13. Distribution of *Nymphaea odorata* in northern Alabama.

Figure 14. *Nymphaea odorata* population with pink and white flowers, also with leaves purple or green on the upper surface. Bullock Co., Alabama, 25 Sep 2012. Photo: T. Wayne Barger.

FAMILY 3. ILLICIACEAE (Star-Anise Family)

1. ILLICIUM Linnaeus 1759

[Latin *illicere*, to allure; in reference to the aromatic nature of the plants]

1. **Illicium floridanum** J. Ellis {of Florida} — FLORIDA STAR-ANISE; FLORIDA ANISE-TREE; ANISE STINKBUSH; POLECAT-TREE; PURPLE-ANISE; FLORIDA ANISE (Fig. 15).

Figure 15. *Illicium floridanum*, Wilcox Co., Alabama, 14 Apr 2007. Photo: Brian Finzel.

Evergreen shrub (2–3 meters tall). Alluvial woods, acid stream margins, wooded creeks, shaded seepage slopes, swamps, moist ravines, and bottomland forests; flowers March–June; fruits May–November; rare in the Cumberland Plateau and Ridge & Valley (found in the southern portions bordering the Fall Line Hills district); uncommon in the Piedmont; common in the Coastal Plain (Fig. 16). *Illicium floridanum* is chiefly native to the Coastal Plain of the southeastern USA from southern Georgia and northern Florida, west to Louisiana, but introduced elsewhere (Kartesz 2017). A related species, *I. parviflorum* Michx. ex Vent., is found in peninsular Florida and adjacent Georgia (Vincent 1997). It differs from *I. floridanum* by its yellow-green flowers and rounded to acute leaf tips.

The crushed leaves of *Illicium* have a pleasant fragrance that is reminiscent of licorice or root beer. Native Americans in Florida used the leaves of *I. floridanum* to make a tea (Wood 1958). The showy, deep red to purple-red flowers (Fig. 17), unlike the leaves, have a rancid odor. Small (1933) described the flowers as having the smell of decaying fish. The color and unpleasant odor of the flowers suggests pollination by carrion flies (Wood 1958).

Florida Star-Anise is a popular ornamental shrub in the Southeast. Chinese Star-Anise, *Illicium verum* J.D. Hook., is another economically important species (Wood 1958). It is cultivated for medicines, perfume, and as a culinary spice to flavor food (Xia & Saunders 2008), but this species is occasionally confused with Japanese Star-Anise, *I. anisatum* L., which is toxic (Vincent 1997).

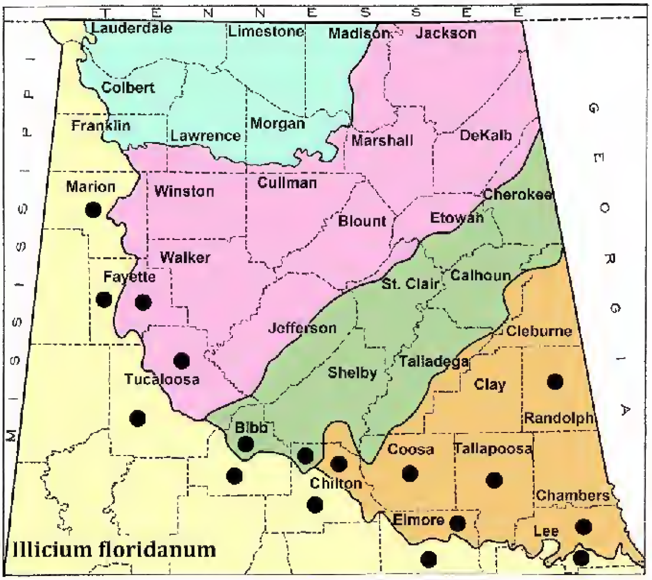


Figure 16. Distribution of *Illicium floridanum* in northern Alabama.

Figure 17. Flowers of *Illicium floridanum*, Tallapoosa Co., Alabama, 16 Apr 2016. Photo: T. Wayne Barger.

Illiciaceae, which contains a single genus of 42 species, is sometimes placed in the Schisandraceae; however, the family is retained in other treatments (Vincent 1997; Weakley 2015). Wood (1958) separated *Illicium* from the Schisandraceae because of its shrubby habit and other characters, such as its bisexual flowers and star-shaped fruits consisting of a ring of follicles (Fig. 18a), which become somewhat woody when fully mature (Fig. 18b). The seeds are dispersed by ballistic explosion (Roberts & Haynes 1983). Ellis' type description of *I. floridanum* was made from specimens collected from a swamp in Pensacola, Florida (Smith 1947).

(18a) Ripe fruit. Photo: Floyd Griffith.

(18b) Dried fruit. Photo: Dan Spaulding.

Figure 18. *Illicium floridanum* fruits. A. Jackson Co., Florida, 17 Aug 2014. B. Cultivated at the Anniston Museum of Natural History, Calhoun Co., Alabama, 3 Nov 2017.

FAMILY 4. SCHISANDRACEAE (Starvine Family)

1. SCHISANDRA Michaux 1803

[Greek *schisis*, splitting, and *andro*, male; named for divided stamens]

1. **Schisandra glabra** (Brickell) Rehder {without hair; plant is smooth} — BAY STARVINE; CLIMBING-MAGNOLIA; MAGNOLIA-VINE; WILD SARSAPARILLA (Fig. 19). [*Schisandra coccinea* Michx.]

Figure 19. *Schisandra glabra*, Tallapoosa Co., Alabama, 8 Jun 2011. Photo: T. Wayne Barger.

Deciduous, twining, woody vine (to 20 m). Rich or calcareous woods, mesic woods, forested rocky slopes and bluffs, often along streams; flowers May–June, fruits late June–August; rare in the southern Ridge & Valley, lower Piedmont, and Coastal Plain (Fig. 20).

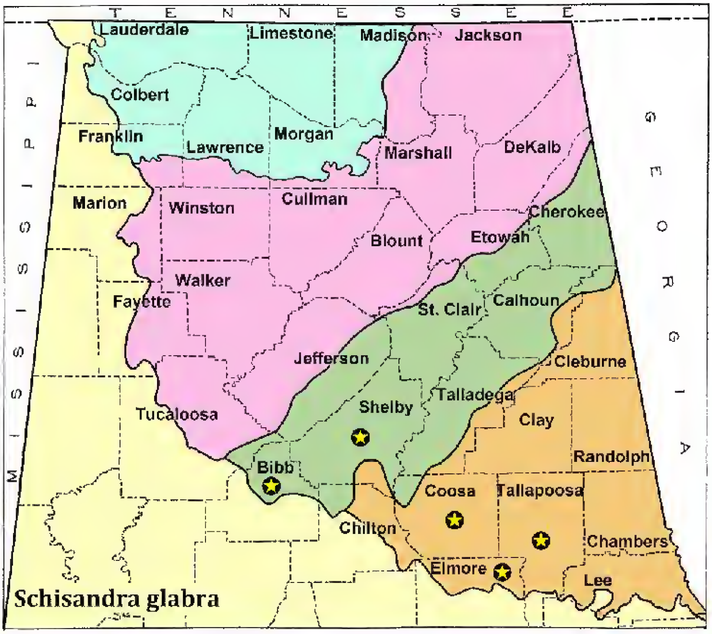


Figure 20. Distribution of *Schisandra glabra* in northern Alabama.

The genus *Schisandra* contains 25 species with *S. glabra* being the only American representative; with the other species ranging from Asia and Indonesia (Smith 1947). *Schisandra glabra* is native to the southeastern USA and occurs in Alabama, eastern Arkansas, northwestern Florida, Georgia, Louisiana, Mississippi, and southwestern Tennessee, with isolated populations in Kentucky and the Carolinas (Kartesz 2017). A fairly recent discovery of this species was made in a cloud forest of Hidalgo in east-central Mexico (Panero & Aranda. 1998).

Schisandra glabra occurs in Clarke, Houston, Marengo, and Monroe counties in the Coastal Plain of Alabama (Keener et al. 2017). The Alabama Natural Heritage Program (ALNHP 2017) lists it as imperiled (S2) in Alabama and globally rare (G3). Duncan (1967) stated that this species might be more common than records indicate because "individual leaves, although alternate, resemble those of the common *Decumaria* [Climbing Hydrangea] and, therefore, may be overlooked." He also noted that *Decumaria* [=*Hydrangea barbara* (L.) B. Schultz] climbs by aerial roots and *Schisandra* climbs by twining.

Bay Starvine is monoecious (staminate and pistillate flowers occur on the same plant). The flowers are solitary and borne on slender peduncles (2.5-5 cm long) attached at the base of petioles (Fig. 21). Wood (1958) stated that *Schisandra* shares many features with *Illicium*, but differs in its twining habit, unisexual flowers (Fig. 22a); and fruits (Fig. 22b), which are berries rather than an aggregate of radially arranged follicles.

Figure 21. *Schisandra glabra* flowers. Tallapoosa Co., Alabama, 8 Jun 2011. Photo: T. Wayne Barger.

(22a) Male flower left; female right.

(22b) Close-up of fruits.

Figure 22. *Schisandra glabra*. A. Cherokee Co., Georgia, 18 Jun 2012. B. Fulton Co., Georgia, 30 Sep 2010. Photos: Alan Cressler.

FAMILY 5. SAURURACEAE (Lizard's-Tail Family)

1. Plant of wetlands, usually in standing water; flowers in long, nodding racemes (5–35 cm), fruiting stalks erect; inflorescence lacking petaloid bracts at base of raceme; crushed leaves with a light, musky green-tea smell .... **2. *Saururus***
1. Plant not of wetlands; flowers in shorter, erect spikes (< 3 cm long); inflorescence with four white petaloid bracts at the base; crushed leaves with a strong citrus odor .... **1. *Houttuynia***

1. HOUTTUYNIA Thunberg 1783
[Named for Maarten Houttuyn, 1720–1798, a Dutch botanist]

1. Houttuynia cordata Thunb. {heart-shaped; leaves are cordate} — CHAMELEON-PLANT; RAINBOW-PLANT (Fig. 23).

Figure 23. *Houttuynia cordata*, naturalized in Madison Co., Alabama, 12 Jun 2017. Photo: Brian Finzel

Perennial, terrestrial herb. Disturbed areas; May–July; very rare in Cumberland Plateau and upper Coastal Plain (Fig. 24). *Houttuynia* is a monotypic genus native to Japan, Korea, southern China, and Southeast Asia, where it grows in moist, shady places (Xia & Brach 1997). It has naturalized in five states in the USA (Kartesz 2017). This ornamental groundcover has recently escaped cultivation and is an aggressive weed, spreading rapidly by rhizomes (Wood 1971).

The common names refer to cultivated plants that are often variegated with cream, bronze, scarlet or light green blotches (Fig. 25a), but plants often turn completely dark green over time. The inflorescence of *Houttuynia* is a terminal spike (Yamazaki 1978) with four prominent petal-like bracts at the base (Fig. 25b). The plant is easy to identify without flowers, because crushed leaves have a peppery-citrus scent. In China, the strongly flavored shoots are eaten as a vegetable and the leaves have been used in Chinese medicine (Wood 1971).

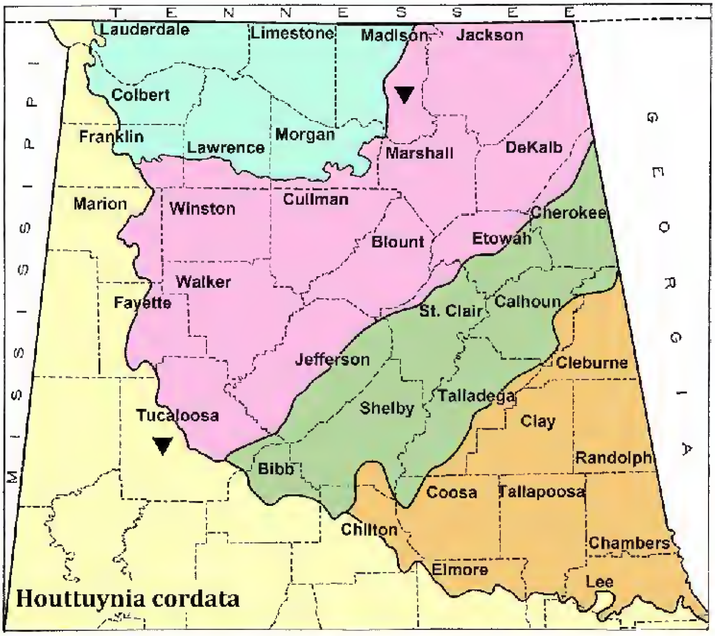


Figure 24. Distribution of *Houttuynia cordata* in northern Alabama.

(25a) Photo: Dan Spaulding.

(25b) Photo: Brian Finzel.

Figure 25. *Houttuynia cordata*. A. Cultivated specimen with mottled leaves at Anniston Museum of Natural History, Calhoun Co., Alabama, 13 Jun 2017. B. Flower close-up, disturbed woods in Madison Co., Alabama, 12 Jun 2017.

2. **SAURURUS** Linnaeus 1753

[Lizard tail; alluding to the long spike of flowers]

1. **Saururus cernuus** L. {nodding} — LIZARD'S-TAIL; WATER-DRAGON (Fig. 26).

Figure 26. *Saururus cernuus*, Tallapoosa Co., Alabama, 15 Jun 2007. Photo: T. Wayne Barger.

Perennial, wetland herb. Usually growing in shallow, standing or slow moving waters of streams, marshes, swamps, lakes, and forested wetlands, though sometimes stranded in mud; flowers May–July; fruits late July–September; frequent in the Highland Rim, Cumberland Plateau, Ridge & Valley, and Piedmont; common in the Coastal Plain (Fig. 27). Native to eastern North America from eastern Texas and Kansas, east to Florida, and north to Michigan and Rhode Island, New York and adjacent Ontario (Buddell & Thieret 1997). The genus is ditypic (contains only two members), with a second species, *Saururus chinensis* (Loureiro) Baillon, occurring in East Asia (Xia & Brach 1997).

Lizard's-Tail is a rhizomatous, wetland species that forms colonies in standing water or wet muddy soil. Plants are mostly erect, 30 to 60 cm tall (1 to 2 feet). Wood (1971) stated that "it may be weedy, and its dense growth may favor the breeding of anopheline [malaria transmitting] mosquitoes." The prominently veined arrowhead-shaped or heart-shaped leaves are arranged alternately on the stem. The inflorescence of *Saururus* is racemose and it lacks the white, petaloid bracts that are found in *Houttuynia*. Shosteck (1974) said the common name "lizard-tail" is in reference to the long, nodding bottlebrush-like inflorescence (Fig. 28a). The fruiting stalks become erect (Fig. 28b) after the fragrant, white flowers are pollinated.

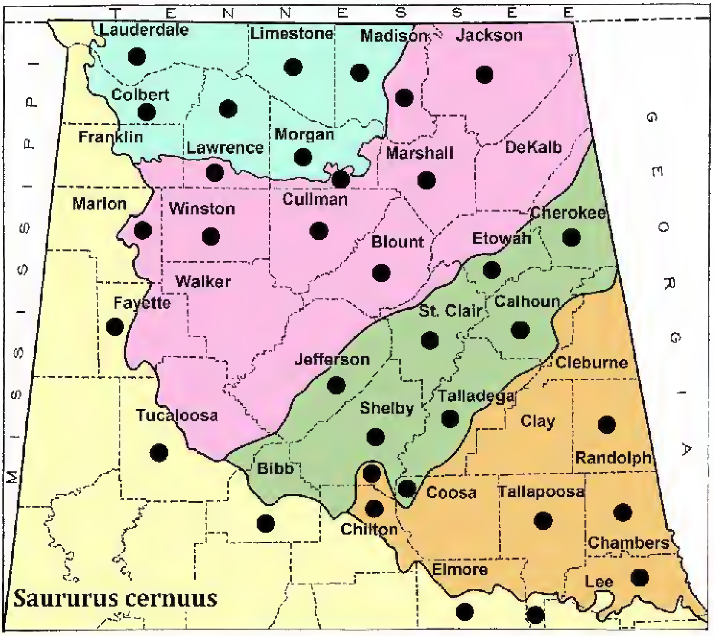


Figure 27. Distribution of *Saururus cernuus* in northern Alabama.

(28a) Photo: Brian Finzel.
(28b) Photo: Dan Spaulding.

Figure 28. *Saururus cernuus*. A. Nodding inflorescence, Limestone Co., Alabama, 15 Jun 2011. B. Plants with erect fruiting stalk, Ballplay Swamp, Cherokee Co., Alabama, 16 July 2017.

FAMILY 6. ARISTOLOCHIACEAE (Birthwort Family)

1. Woody, twining vine; leaves tomentose (velvety to the touch) .... **4. *Isotrema***
1. Herbaceous perennial, not a vine; leaves glabrous or pubescent, but not tomentose.

   2. Acaulescent herb (lacking aerial stem); apices of leaves blunt to round; calyx tube straight and radially symmetrical (flowers lack petals); crushed leaves and roots with a distinct ginger odor; stamens 12.

      3. Leaves deciduous, pubescent, paired but not mottled; sepals separate; anthers with prominent appendages; styles united.. **1. *Asarum***
      3. Leaves evergreen, glabrous, not paired and often mottled with different shades of green; sepals united into a tube for much of their length; styles separate......................... **3. *Hexastylis***

   2. Caulescent herb (with well-developed aerial stem); apices of leaves sharply acute to acuminate; calyx tube bent (S-shaped) and bilaterally symmetrical; crushed leaves nearly odorless, but roots have a strong turpentine-like smell; stamens 6 .... **2. *Endodeca***

1. ASARUM Linnaeus 1753

[Greek *asaron*, ancient name of an unknown plant in Dioscorides and Pliny]

The recognition of multiple species of *Asarum* in the eastern USA has been controversial and the multiple taxa are often sunk into synonymy under *A. canadense* (Radford et al. 1968; Whittemore et al. 1997). Kelly (2001), in his taxonomic treatment of *Asarum*, recognized only one widespread species, *A. canadense*, in eastern North America and wrote: "*Asarum canadense,* which has at times been divided into several species or infraspecific taxa, is here recognized as a single species based on a lack of reliable differences among the variants." Estes (2015), however, recognizes three distinct species (Fig. 29), including *A. acuminatum* (Ashe) E.P. Bicknell. Weakley (2015) stated that these "taxa recognized at varietal or specific level in the past have recently often been ignored, but have some merit; they deserve further attention."

Figure 29. Flower comparisons of the three species of *Asarum* from eastern North America. Flowers are not to scale; *Asarum acuminatum* tends to be the largest of the three (Estes 2015).

Estes (2015) stated that "most studies of wild ginger variation have relied heavily on examination of herbarium specimens and little on examination of living populations." He discusses the architectural complexity of plants that have complicated flower shapes or other parts that are destroyed upon pressing. Estes (2015) reasoned that "this architectural complexity has made these groups [like *Asarum*] difficult to study using herbarium specimens. Once their parts become smashed and dried the various species often look alike and differences that seem to exist when viewing living plants side-by-side in the field or garden seem to break down in the herbarium. This has led many botanists to do a lot of 'lumping' in some of these groups." Estes concluded the "evidence has been mounting that suggests relying too much on herbarium specimens for interpreting the taxonomy of architecturally complex plant groups may lead to serious underestimation of biodiversity. As such, we may be failing to protect critically endangered species that we don't realize exist."

1. Calyx lobes strongly reflexed, often more-or-less appressed against the calyx tube (lobes usually shorter than the tube); calyx lobes broadly triangular, mostly acute (5–12 mm long), the margins of the lobes convex to the base of the tubular tips, which are 0–4 mm long .... **2. *Asarum reflexum***
1. Calyx lobes spreading to ascending (almost as long as calyx tube); calyx lobes narrowly triangular, acuminate to short-caudate (10–25 mm long) with distinctly concave margins to the base of the tubular tips, which are 4–20 mm long .... **1. *Asarum canadense***

1. Asarum canadense L. {of Canada} — CANADIAN WILD GINGER (Fig. 30a–c).

(30a) Leaves and flower.

(30b) Top-view of flower.

(30c) Side-view of flower.

Figure 30. *Asarum canadense*. A. Leaves and flower, Jackson Co., Alabama, 13 Apr 2007. Photo: T. Wayne Barger. B–C. Close-up of flowers, Swain Co., North Carolina, 21 Apr 2007. Photos: Brian Finzel

Perennial, deciduous herb. Rich woods; April–May; very rare in the northeastern portion of the Cumberland Plateau (Fig. 30). Native to southern Manitoba and Ontario, south through Minnesota, eastern North Dakota, Michigan, Iowa and Illinois, with disjunct populations in Ohio, Missouri, Arkansas, Kentucky, North Carolina, northern Georgia, Tennessee, and northeast Alabama (Estes 2015).

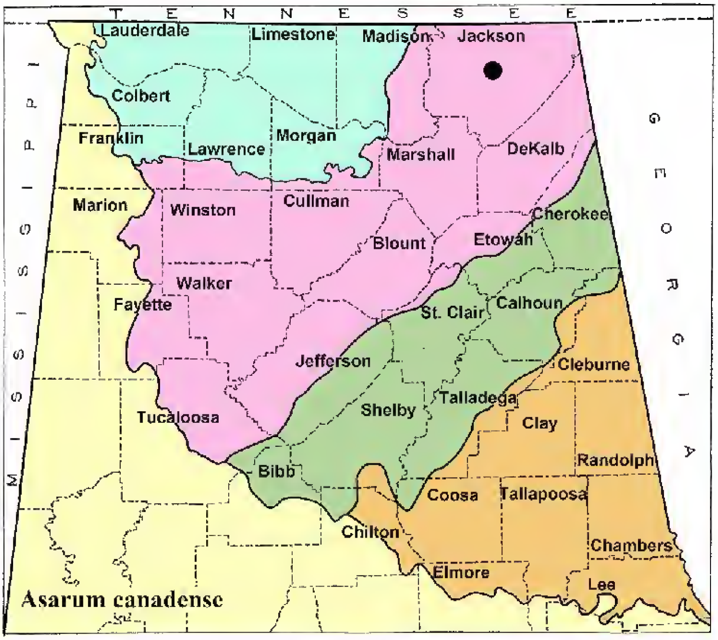


Figure 30. Distribution of *Asarum canadense* in northern Alabama.

The calyx lobes of *Asarum canadense* are somewhat similar to *A. acuminatum*, but are spreading or ascending (forward-directed) rather than long-caudate and mostly erect. The calyx tube of *A. acuminatum* is also larger than *A. canadense* (10–20 mm vs. 4–10 mm long). The leaves of the three eastern species of *Asarum* are roughly the same size while they are in flower, but leaves of *A. acuminatum* keep expanding, and by summer they are often as long as wide. In contrast, *A. reflexum* and *A. canadense* leaves are about the same size at maturity, remaining wider than long (Dwayne Estes pers. comm. 2017). *Asarum acuminatum* is native to southeastern Canada south through the Great Lakes and northeastern USA, mostly along the Appalachians to northeastern Georgia (Estes 2015).

2. Asarum reflexum E.P. Bicknell {reflexed; the calyx lobes} — REFLEXED WILD GINGER (Fig. 32). [*Asarum canadense* L. var. *ambiguum* (E.P. Bicknell) Farwell; *A. canadense* var. *reflexum* (E.P. Bicknell) B.L. Rob.]

Figure 32. *Asarum reflexum*, Lincoln Co., Tennessee, 9 Apr 2007. Photo: Brian Finzel.

Perennial, deciduous herb. Rich woods, often in calcareous soils; April–May; frequent in the Highland Rim, Cumberland Plateau, and Ridge & Valley; rare in the Coastal Plain (Fig. 33). Native to the eastern USA with the center of its distribution in mid-eastern and southeastern states. The species occurs from eastern Iowa and Wisconsin east to Connecticut, and south to Georgia and northeastern Louisiana (Estes 2015).

The flowers of *Asarum reflexum* (Fig. 34) help to separate it from other *Asarum* species in eastern North America. Bicknell (1897) stated that "while the determination of dried specimens is not always easy, living plants may always be distinguished instantly by a glance at the flowers (Fig. 35)." He noted that "the flat and reflexed lobes [of *A. reflexum*] are abruptly acuminate at the apex into a straight obtuse point." Harper (1936) wrote that *Asarum* was first found in the state in ravines along the Warrior River in Tuscaloosa County on April 12, 1933. He referred to Alabama plants as

A. reflexum and wrote "it differs from *A. canadense*, the commoner northern species, a little in the shape of its flowers, and also in odor."

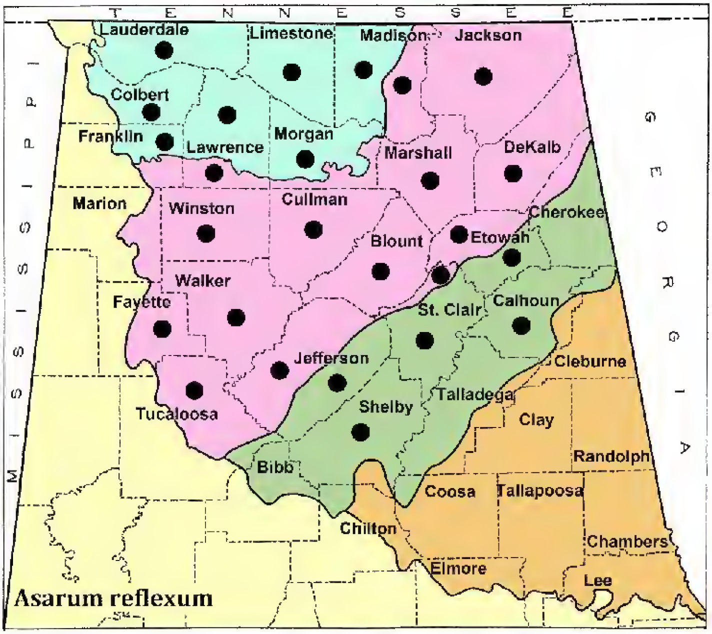


Figure 33. Distribution of *Asarum reflexum* in northern Alabama.

Figure 34. Close-up of *Asarum reflexum* flowers, Lincoln Co., Tennessee, 9 Apr 2007. Photo: Brian Finzel.

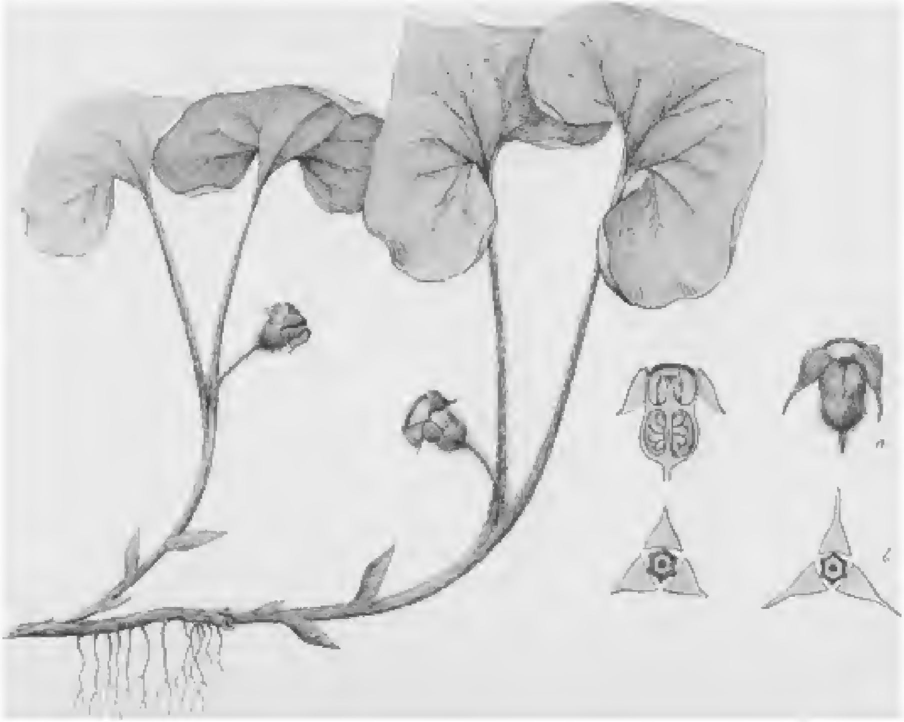


Figure 35. Illustration of *Asarum reflexum* from Bicknell (1897).

Crushed leaves of *Asarum* smell like ginger and the flowers are often hidden among the fallen leaves. Because the flowers are flesh-colored and have an unpleasant odor, it was thought that they were pollinated by carrion flies (Martin 1989). Recent research, however, has shown that *Asarum* is actually self-pollinated rather than insect pollinated, though flies do occasionally visit the flowers (Kelly 1997; Whittemore et al. 1997).

Asarum has been associated with true ginger (*Zingiber officinale*), because of the strong ginger-like odor of the rhizome, but the two species are not closely related. The rootstalk of *Asarum* was used as a seasoning to flavor cookies and cakes or cut up and boiled until tender, then dipped in a heavy sugar syrup to make a candy (Shosteck 1974). Native Americans dried the underground stems and steeped them in water to make a bitter liquid (an infusion), which they drank to relieve heart conditions or sometimes ingested as a contraceptive, believing the concoction prevented impregnation (Coffey 1993). Dwyer et al. (1986) wrote: "Pioneers used the plant to ease intestinal and stomach gas, to promote sweating to break a fever, and as a tonic and appetite stimulant."

Even though there is a long history of medicinal and edible uses of Wild Ginger, the U.S. Food and Drug Administration has banned the use of all plants within the Aristolochiaceae because the family contains aristolochic acid, "which is a substance known to result in serious adverse health effects when taken orally by humans or animals" (FDA 2017).

2. ENDODECA Rafinesque 1828

[Twelve inside; referring to 6 stamens and 6 styles]

1. **Endodeca serpentaria** (L.) Raf. {snake-like; in reference to the roots} — VIRGINIA SNAKEROOT; TURPENTINE-ROOT; VIRGINIA DUTCHMAN'S-PIPE (Fig. 36). [*Aristolochia convolvulacea* Small; *A. hastata* Nutt.; *A. nashii* Kearney; *A. sagittata* Muhl.; *A. serpentaria* L. var. *hastata* (Nutt.) Alph. Wood; *A. serpentaria* var. *serpentaria*; *Endodeca hastata* (Nutt.) Raf.]

Figure 36. *Endodeca serpentaria* with flower at base of plant (note that leaf litter has been removed), Madison Co., Alabama, 9 May 2015. Photo: Brian Finzel.

Perennial, deciduous herb. Mixed woods, low woods, forested slopes, and bluffs; flowers May–June; fruits June–July; frequent throughout Alabama (Fig. 37). Native to eastern USA from Connecticut west to Iowa, south to east Texas and Florida (Barringer 1997).

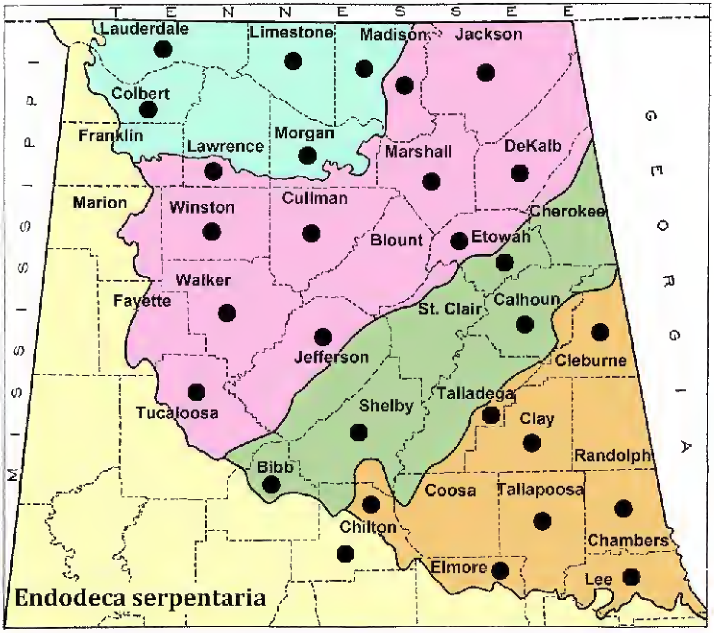


Figure 37. Distribution of *Endodeca serpentaria* in northern Alabama.

Virginia Snakeroot is often overlooked on the forest floor because it occurs in scattered populations or is sometimes solitary. The roots of *Endodeca* have a noticeable turpentine aroma. They contain toxic alkaloids that some southeastern tribes of Native Americans used as an antidote for snakebite (Gerard 2015).

This species was also called "birthwort" because the curved flowers were thought to resemble a human fetus (Stokes 1981) or a birth canal (Coffey 1993). Historically, it was thought to help with childbirth based on a discredited medieval theory called the Doctrine of Signatures, which purported that portions of a plant resembling various parts of the body were divined by God be used to treat ailments of those look-alike parts (Stokes 1981). The S-shaped, reddish calyx tubes of *Endodeca serpentaria* (Fig. 38) are usually hidden under leaf litter and smell like rotting meat. The flowers are pollinated by carrion flies that are attracted to the fetid odor of the flower (Dwyer et al. 1986). The globose fruits are usually pubescent and the capsule splits open apically into six segments to release its seeds (Fig. 39a–b).

Traditionally, *Endodeca serpentaria* has been placed within the genus *Aristolochia* (Fernald 1950; Radford et al. 1968; Barringer 1997). The genus *Aristolochia* sensu lato contains over 400 species, but new research has shown justification in dividing the genus into four genera (Ohi-Toma et al. 2006). Weakley (2015) notes that there is tremendous variation in *E. serpentaria* and believes further study is needed to determine if other taxa should be recognized. He stated that "plants with sparingly pubescent, thin-textured, linear to lanceolate leaves have been called *Aristolochia hastata* (Fig. 40). Plants with broadly ovate, densely pubescent leaves have been called *Aristolochia convolvulacea.* These may represent merely morphologic extremes of a polymorphic complex;

alternatively, some taxonomic recognition of such plants as distinct from *A. serpentaria* may be warranted."

Figure 38. *Endodeca serpentaria* flower, Madison Co., Alabama, 9 May 2015. Photos: Brian Finzel.

(39a) Photo: T. Wayne Barger.

(39b) Photo: Dan Spaulding.

Figure 39. *Endodeca serpentaria* fruit. A–B. Wooded bank along trail near Natural Bridge in the Bankhead National Forest, Lawrence Co., Alabama, 7 Jun 2017.

Figure 40. Narrow leaf "hastata" form, Lawrence Co., Alabama, 5 Aug 2017. Photo: Dan Spaulding.

3. HEXASTYLIS Rafinesque 1825

[Six styles; referring to the number of styles]

The genus *Hexastylis* is closely related to *Asarum* and some researchers are of the opinion that all the species should be combined under *Asarum* (Kelly 2001). For a detailed taxonomic history of *Asarum* and *Hexastylis*, see Parresol (2003). *Hexastylis* is pollinated by insects such as wasps, flies, and thrips. The seeds are dispersed by ants, which are attracted to the fleshy, nutritious eliasome that is attached to the seeds. The eliasome is consumed in their nest, leaving seeds to germinate (Niedenberger 2010).

1\. Leaf blades triangular-hastate or triangular-sagittate (younger leaf blades are occasionally cordate); calyx tube urceolate-campanulate, gradually contracted near summit and forming a flask-like structure; style extensions split down to stigma (bifid) .... **1. *Hexastylis arifolia***

1\. Leaf blades cordate to orbicular-cordate; calyx tube cylindrical to broadly urceolate-campanulate, forming a cup-like structure; style extensions (horns) only slightly notched at apex (not bifid to stigma).

  2\. Leaves scattered along the length of the rhizome, plant forming groundcover-like mats; species occurring chiefly in the Fall Line Hills section of the Coastal Plain (but is also found in adjacent Piedmont and Cumberland Plateau).. **2. *Hexastylis harperi***

  2\. Leaves clustered at the tip of the rhizome, plant in clusters, not mats; species not occurring in the Coastal Plain (found only in the Piedmont and Cumberland Plateau of Alabama).

    3\. Calyx tube large, 20–30 mm long, and usually urceolate-campanulate (urn-shaped to bell-shaped); in Alabama, the species is known only from the eastern and middle sections of the Cumberland Plateau .... **4. *Hexastylis shuttleworthii***

    3\. Calyx tube smaller, 8–15 mm long, and usually cylindrical to narrowly cylindro-urceolate; in Alabama, the species is known only from the mountainous portions of the upper Piedmont and western section of the Cumberland Plateau.............................. **3. *Hexastylis heterophylla***

1. Hexastylis arifolia (Michx.) Small {arrow-shaped leaves} — ARROWLEAF HEARTLEAF; ARROWLEAF GINGER; APPALACHIAN HEARTLEAF; LITTLE-BROWN-JUGS (Fig. 41). [*Asarum arifolium* Michx.; *A. callifolium* Small; *A. ruthii* Ashe; *Hexastylis callifolia* (Small) Small; *H. ruthii* (Ashe) Small]

Figure 41. *Hexastlis arifolia*, Shelby Co., Alabama, 27 Nov 2017. Photo: Floyd Griffith.

Perennial, evergreen herb. Mixed upland woods, alluvial woods, forested slopes, and bluffs; March–June; rare in the Highland Rim; common throughout all other provinces in Alabama (Fig. 44). Native to the southeastern USA from Virginia west to Kentucky, south to the southeastern portion of Louisiana and northern Florida (Kartesz 2017).

Hexastylis flowers have no petals; the fleshy, tubular structure is actually a calyx (fused sepals). The flask-shaped flowers of *H. arifolia* are sometimes called "little brown jugs." Harper (1936) wrote that "the whole plant is aromatic, with a characteristic odor suggesting some sort of medicine; and it was formerly supposed to have some medicinal properties."

Three varieties of *Hexastylis arifolia* are occasionally recognized, but difficult to identify when plants are pressed and dried, since the only real difference lies in the shape of the calyx. Only two varieties occur in northern Alabama: *H. arifolia* var. *arifolia* (Fig. 43), which has slightly spreading calyx lobes, and *H. arifolia* var. *ruthii* (Ashe) Blomq. (Fig. 44), which has erect calyx lobes. The third variety, *H. arifolia* var. *callifolia* (Small) Blomq. (Fig. 45), is found exclusively on the Coastal Plain, from Georgia to eastern Louisiana, and has widely spreading calyx lobes and a larger calyx tube (20–25 mm long x 10–12 mm wide vs. 13–18 mm long x 6–10 mm wide).

Hexastylis arifolia var. *arifolia* occurs throughout the state and *H. arifolia* var. *ruthii* is found in the northeastern portion of Alabama, north through the Appalachians to Virginia (Gaddy 1987b). Ashe (1897) treated all three varieties as separate species within the genus *Asarum.* Ashe (1897) stated *Asarum ruthii* was "named for Prof. Albert Ruth [1844–1932], who sent the species to me. At once separated from *A. arifolium* by its cylindrous calyx, and its tube not being contracted at the throat as is that of *A. arifolium*." Gaddy (1987b) noted that "along the boundaries of the three varieties, intermediate flowers are occasionally found."

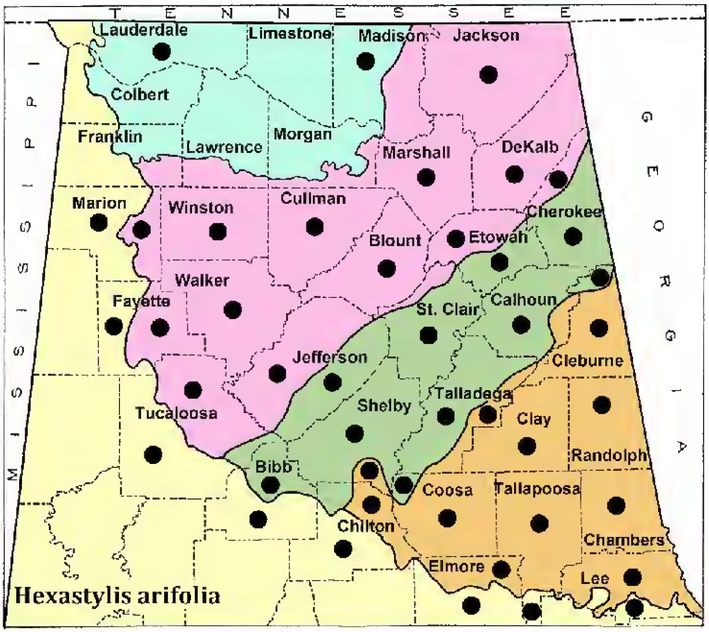


Figure 42. Distribution of *Hexastylis arifolia* in northern Alabama.

Figure 43. *Hexastylis arifolia* var. *arifolia* flowers, Russell Co., Alabama, 17 Mar 2007. Photo: Brian Finzel.

Figure 44. *Hexastylis arifolia* var. *ruthii* flowers, Swain Co., North Carolina, 21 Apr 2007. Photo: Brian Finzel.

Figure 45. *Hexastylis arifolia* var. *callifolia* flowers. Middle flower is mature, one on the left is closed, and calyx lobes on right are opening; Coastal Plain in Macon Co., Georgia, 12 Mar 2016. Photo: Alan Cressler.

Another similar species of *Hexastylis* with triangular-hastate to triangular-sagittate leaves, is *H. speciosa* Harper (Fig. 46), which was discovered and named by Roland Harper in Autauga County on May 19, 1924. This species is endemic to the Fall Line Hills section of the upper Coastal Plain of Alabama, occurring in two other counties: Chilton and Elmore. Kral (1983) was of the opinion that this species is perhaps the rarest species in the genus. Harper (1924) noted that "to the eye the leaves of the new plant are scarcely distinguishable from those of *H. arifolia*, being hastate-cordate…but they lack the characteristic 'medicinal' odor of *H. arifolia*, and we found the next day that we could distinguish the two species by their odor even when no flowers were present." Harper named the plant for its showy flowers and said that the calyx "is about an inch long, greenish purple outside (like the petioles and peduncles), and instead of being pitcher-shaped as in *H. arifolia*, is abruptly expanded near the middle." Weakley (2015) wrote that the calyx tube of *H. speciosa* has internal raised reticulations and *H. arifolia* is smooth internally. *Hexastylis speciosa* has been called Harper's Heartleaf, but Keener and Davenport (2015) suggested it should be named Alabama Heartleaf, since *H. harperi* is also known as Harper's Heartleaf.

Figure 46. *Hexastylis speciosa*, woods in Autauga Co., Alabama, 28 Apr 2008. Photo: T. Wayne Barger.

2. Hexastylis harperi (Gaddy) B.R. Keener & L.J. Davenport {for Roland Harper, 1878–1966, Alabama botanist} — HARPER'S HEARTLEAF; HARPER'S LARGE-FLOWER HEARTLEAF; HARPER'S GINGER; CALLAWAY GINGER; BOG HEARTLEAF (Fig. 47). [*Asarum harperi* (Gaddy) A. Diamond; *Hexastylis shuttleworthii* (Britten & Baker f.) Small var. *harperi* Gaddy]

Figure 47. *Hexastylis harperi*, upper Coastal Plain of Alabama, 27 May 2010. Photo: John Gwaltney.

Perennial, evergreen herb. Rocky or sandy slopes and bluffs along streams; sandy seeps, and bogs; May–July; very rare in the Cumberland Plateau and Piedmont; rare in the upper Coastal Plain (Fig. 48). *Hexastylis harperi* only occurs in adjacent Mississippi and Georgia (Kartesz 2017).

Hexastylis harperi is chiefly found in the upper Coastal Plain of Alabama, but also occurs in the Piedmont (Randolph County) and along the western edge of the Cumberland Plateau (Marion County). Gaddy (1987a) cites a Marion County specimen, deposited at the Gray Herbarium (GH), which was collected by Roland Harper on June 3, 1936 from "drier spots of a non-alluvial swamp west Guin." This area is located in the Fall Line Hills of the Coastal Plain. The other Marion County population occurs in the Cumberland Plateau portion of the county and was found by Roland Harper on June 16, 1935. Harper (1936) wrote that he discovered "a small colony of the plant on a sandstone rock shaded by hemlocks, in a ravine about six miles northeast of Hamilton, in Marion County .... I did not like to molest anything so rare, so I did not take the specimen or tear the flower open to study its structure."

Robert Kral made the first collection of this species at this site on May 17, 1973 (he originally identified it as *H. shuttleworthii* and later annotated the specimen to *H. shuttleworthii* var. *harperi*). While at Vanderbilt University (VDB), Dr. Kral was working on this genus and anticipated naming the new entity, but was preempted by the publication of Dr. L.L. "Chick" Gaddy, visiting professor at the University of Tennessee, who named the new variety (pers. comm., Robert Kral 1997).

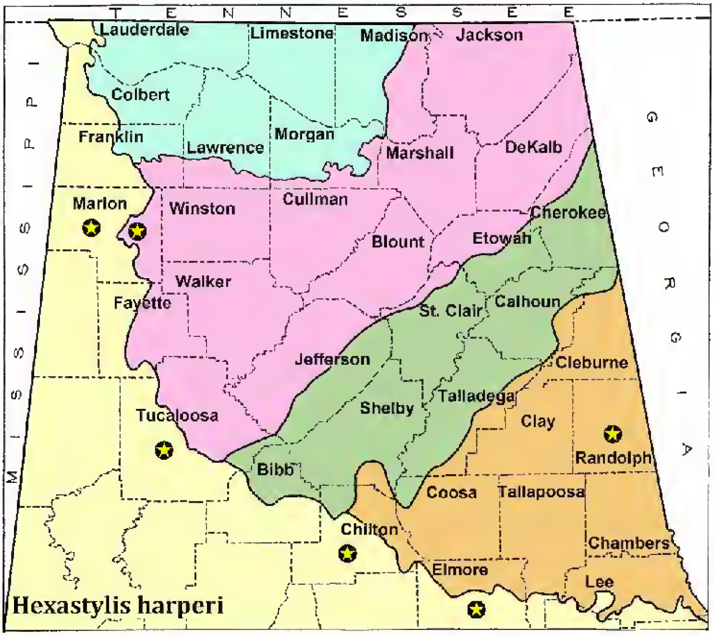


Figure 48. Distribution of *Hexastylis harperi* in northern Alabama.

Hexastylis harperi also occurs in Hale, Macon, and Perry counties (Keener et al. 2017). Two specimens collected in 1896 and 1898, housed at New York Botanical Gardens (NY), were thought to have been from Lee County, but their location (Vaughn's Mill) has been determined to be in Macon County. The Alabama Natural Heritage Program (ALNHP 2017) lists *H. harperi* as imperiled (S2) in Alabama and globally rare (G3). This taxon is perhaps more common in cultivation then in the wild because of efforts by the staff at Callaway Gardens in Pine Mountain, Georgia (Gaddy 1987a). The Director of Horticulture, Fred Galle, at Callaway was the first to cultivate it in 1965, and he later shared plants with other gardeners and nurserymen (Galle 1984).

Harper (1936) made the first collection of this taxon on June 5, 1927 in Autauga County, Alabama and "noticed that the plant usually grows in colonies connected by running rootstocks (Fig. 49), and covering a few square feet." Harper (1936) didn't think there were enough differences to separate it from *Hexastylis shuttleworthii* and said he was inclined to treat his discovery under that species. Gaddy (1987b), however, noted that the elongated and branched rhizomes convinced him that this entity represented a new variety of *H. shuttleworthii.* Gaddy (1987a) wrote that it "forms a nearly continuous ground cover where it is found," and he named it *H. shuttleworthii* var. *harperi* in honor of Roland Harper.

Keener and Davenport (2015) elevated the variety to species rank, stating that it "is distinct in morphology, habitat and distribution" and citing evidence that the two varieties "were polyphyletic rather than 'sister' to each other as would be expected." This is one of the few *Hexastylis* that can be identified in sterile condition because of its long rhizomes and groundcover-like habit (Fig. 50). The flowers of *H. harperi* (Fig. 51) and leaves are very similar to *H. shuttleworthii.* Gaddy (1987b) wrote: "The flowers were usually smaller (15–25 mm long) than those of *H. shuttleworthii* (15–40 mm long), but occasionally large flowers [of *H. harperi*] were found…The plant was different from *H. shuttleworthii* primarily in growth form."

Figure 49. *Hexastylis harperi* rhizomes, Randolph Co., Alabama, 27 Aug 2017. Photo: Dan Spaulding.

Figure 50. *Hexastylis harperi* colony, Randolph Co., Alabama, 30 Jul 2017. Photo: Dan Spaulding.

Figure 51. *Hexastylis harperi* flower, upper Coastal plain of Alabama, 27 May 2010. Photos: John Gwaltney.

3. **Hexastylis heterophylla** (Ashe) Small {variable-leaved} — VARIABLE-LEAF HEARTLEAF; ASHE'S GINGER (Fig. 52). [*Asarum heterophyllum* Ashe]

Perennial, evergreen herb. Dry to mesic wooded slopes, rich woods, and forested ravines; March–June; uncommon in the upper mountainous region of the Piedmont; rare in the western portion of the Warrior Basin section of the Cumberland Plateau (Fig. 53). Native to the southeastern USA from Virginia west to Kentucky, south to northern Alabama and north Georgia (Gaddy 1987b).

In Alabama, this taxon occurs at the western end of its range. It appears to be disjunct from other populations in the mountains centered in Virginia, North Carolina, and Tennessee (Kartesz 2017). In Alabama, the calyx tubes of *Hexastylis heterophylla* (Fig. 54) appear to have a different shape and color than populations further north. Blomquist (1957), as well Radford et al. (1968), state that the leaves of *H. heterophylla* are usually not variegated (Fig. 55); however, in Alabama, the leaves are always variegated and are sometimes strikingly mottled (Fig. 56).

Research is in progress to determine if the Alabama entity is a new species (pers. comm., Brian Keener 2017). Gaddy (1987b), in his treatment on *Hexastylis*, stated that *H. heterophylla* "is probably the most variable species in the genus." Blomquist (1957) did not list this species for Alabama in his revision of *Hexastylis* of North America, but Gaddy (1987b) mapped *H. heterophylla* as occurring in Alabama. *Hexastylis heterophylla* is very similar to *H. shuttleworthii*, but its calyx tubes are much shorter.

Figure 52. *Hexastylis heterophylla*, steep wooded slope above Jackson Creek in the Talladega National Forest, Cleburne Co., Alabama, 2 Jun 2017. Photo: Melanie Taylor Spaulding.

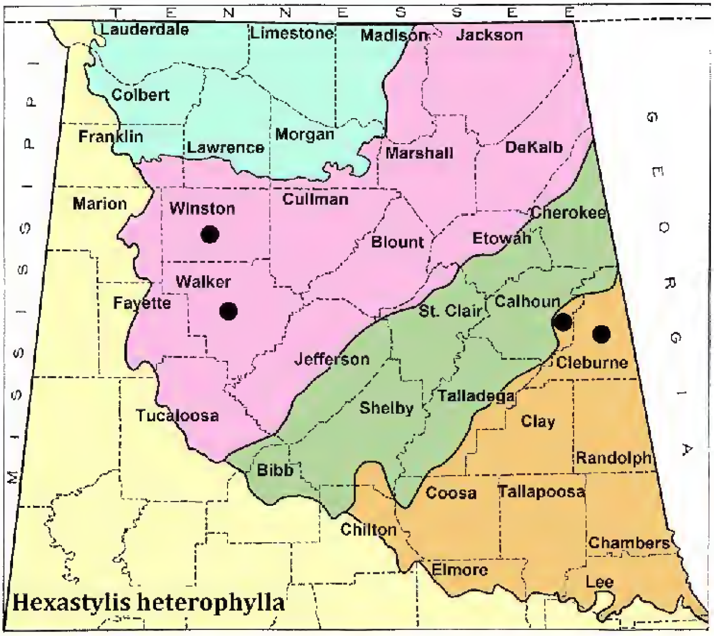


Figure 53. Distribution of *Hexastylis heterophylla* in northern Alabama.

Figure 54. *Hexastylis heterophylla* flowers, sloped woods above Jackson Creek in the Talladega National Forest, Cleburne Co., Alabama, 2 Jun 2017. Photos: Melanie Taylor Spaulding.

Figure 55. Unmottled leaves of *Hexastylis heterophylla* in Burke Co., North Carolina, 30 Jun 2016. Photo: Charles Bryson.

Figure 56. Strongly mottled leaves of *Hexastylis heterophylla*, sloped woods on Horseblock Mountain in the Talladega National Forest, Cleburne Co., Alabama, 16 Jul 2017. Photo: Dan Spaulding.

4. **Hexastylis shuttleworthii** (Britten & Baker f.) Small {for Robert J. Shuttleworth (1810–1874), an English botanist} — Large-Flower Heartleaf; Shuttleworth's Ginger (Fig. 57a–c). [*Asarum macranthum* (Shuttlew.) Small; *A. shuttleworthii* Britten & Baker f.]

Perennial, evergreen herb. Sloped, often rocky woods, bluffs, and ravines, often in acidic soils; April–June; uncommon in the Cumberland Plateau (Fig. 58). Native to the southeastern USA from North Carolina west to Tennessee, south to northeast Alabama and north Georgia (Gaddy 1987b).


(57a) Leaves with flower.


(57b) Side-view of flower

(57c) Top-view of flower.

Fig. 57. *Hexastylis shuttleworthii.* A–C. Rocky slope above West Fork of Little River, DeKalb Co., Alabama, 3 Jun 2017. Photos: Savannah Spaulding

The flowers of *Hexastylis shuttleworthii* are the largest of all our species in North America, and although they may vary in size, they are always larger than those of *H. heterophylla* (Fig. 59a–b). Blomquist (1957) wrote that "when not in flower, it is sometimes impossible to distinguish this species from *H. heterophylla*." In Alabama, *H. shuttleworthii* is known from the middle and eastern portion of the Cumberland Plateau, whereas *H. heterophylla* is found in the mountainous region of the upper Piedmont and western portion of the Cumberland Plateau.

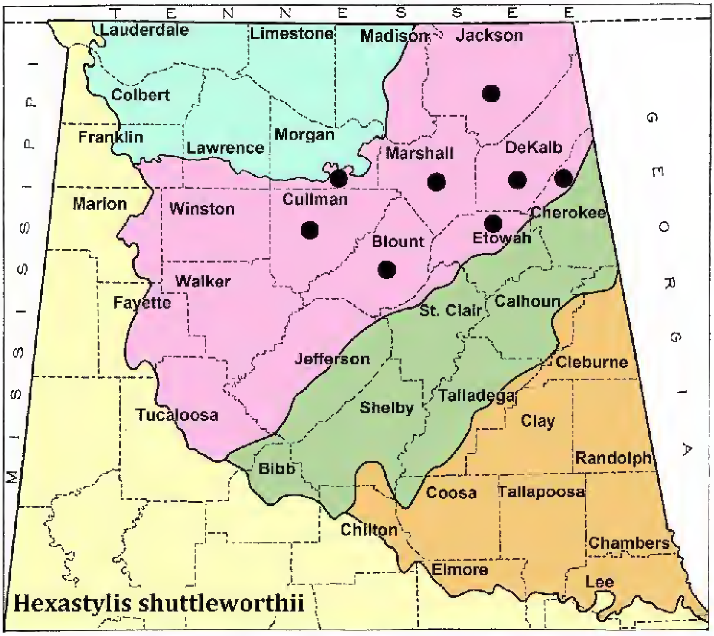


Figure 58. Distribution of *Hexastylis shuttleworthii* in northern Alabama.

(59a) *Hexastylis shuttleworthii* flowers. (59b) *Hexastylis heterophylla* flowers.

Figure 59. Size comparison of *Hexastylis shuttleworthii* and *Hexastylis heterophylla* flowers. A. DeKalb Co. Alabama; collected 3 Jun 2017. B. Cleburne Co., Alabama; collected 2 Jun 2017. Photos: Dan Spaulding.

4. ISOTREMA Rafinesque 1819

[From the Greek *isos* (equal) and *trema* (hole); for the regular calyx-limb around the flower]

1. **Isotrema tomentosa** (Sims) H. Huber {with velvety hairs} — WOOLLY DUTCHMAN'S-PIPE; WOOLLY PIPEVINE; HAIRY DUTCHMAN'S-PIPE (Fig. 60). [*Aristolochia tomentosa* Sims]

Figure 60. *Isotrema tomentosa* flowering vine, Madison Co., Alabama, 24 Apr 2007. Photo: Brian Finzel.

Deciduous woody vine (to 25 m). Alluvial woods, floodplain forests, and streambanks; flowers late March–June; fruits May–October; frequent throughout Alabama (Fig. 63). Native to the southeastern and south-central USA, from Kentucky west through southern Indiana to eastern Nebraska, south to east Texas and the Panhandle of Florida; adventive elsewhere in the USA (Weakley 2015).

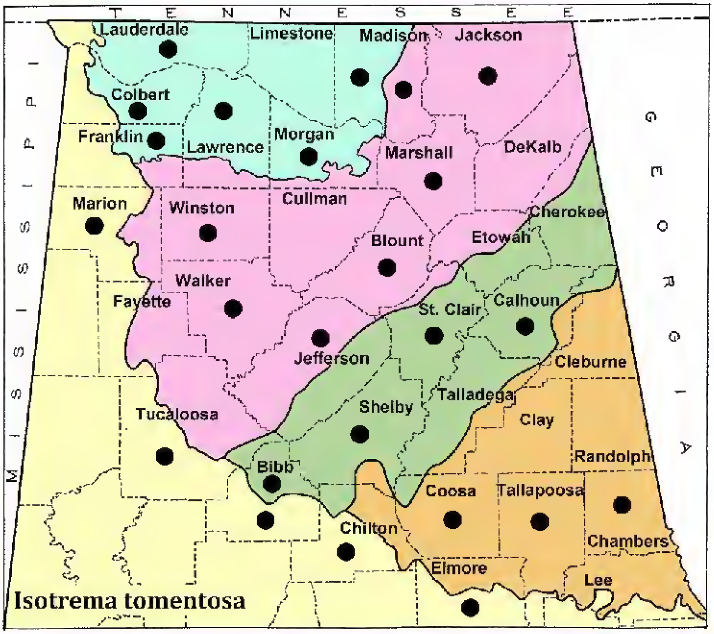


Figure 61. Distribution of *Isotrema tomentosa* in northern Alabama.

The vernacular names refer to the S-shaped flowers (Fig. 62a–b), which look like the curved Dutchman's pipe. The flowers (calyx tubes) have a purple-brown throat and a disagreeable odor that attracts carrion flies as pollinators (Stokes 1981). The fruit of *Isotrema tomentosa* (Fig. 62c) is large and cylindrical; Duncan (1967) said they "resemble those of *Yucca*, being a 6-ridged capsule and containing flat seeds arranged in tiers.

Isotrema is a large twining, woody vine (Fig. 63) and can easily be identified when sterile by its woolly, heart-shaped leaves. This species is a host species for Pipevine Swallowtail (*Papilio philenor*) caterpillars (Stokes 1981). Pipevine Swallowtails are poisonous because the caterpillars ingest toxins from the plant and incorporate the chemicals in to their bodies. The butterflies signal danger to would be predators with their metallic-blue underwings and bright orange spots (Ogard & Bright 2010).

A similar species of pipevine, *Isotrema macrophylla* (Lamarck) C.F. Reed, was reported by Mohr (1901) from Winston County, but no voucher is known. A University of Tennessee (TENN) collection from Monroe County, identified as *I. macrophylla* (SERNEC 2017), is most likely *I. tomentosa*. *Isotrema macrophylla* ranges from eastern Tennessee and northern Georgia north through the Appalachians. Its leaves are nearly glabrous with abruptly pointed tips and the calyx is purple or brown; whereas the leaves of *I. tomentosa* are hairy with blunt tips and the calyx is yellowish-green with a purple center.

(62a) Photo: Brian Finzel. (62b) Photo: T. Wayne Barger.

(62c) Photo: Eric Soehren.

Figure 62. *Isotrema tomentosa*. A. Flowering vine and tomentose leaves, Madison Co., Alabama, 24 Apr 2007. B. Flower, Jackson Co., Alabama, 22 Apr 2008. C. Fruit; Madison Co., Alabama, 14 Jun 2006.

Figure 63. 20-year-old *Isotrema tomentosa* vine cultivated in Calhoun, Co. Alabama, 27 Dec 2017. Seeds were collected by Hayes Jackson in 1997 from plants along the Tennessee River in Madison Co., Alabama, and sowed in the woods near his house. Photo: Hayes Jackson.

FAMILY 7. MAGNOLIACEAE (Magnolia Family)

1. Leaves about as broad as long, usually lobed; apices broadly truncate or emarginate (notched); flowers with greenish tepals that have an orange blotch at base; fruit a cigar-shaped aggregate of samaras, composed of dry, winged seeds (samaracetum) ....**1. *Liriodendron***
1. Leaves longer than broad, not lobed; apices obtuse, acute or acuminate; flowers with solid white, cream, yellow or pink tepals; fruit a cone-like aggregate of follicles (follicetum) ....**2. *Magnolia***

1. LIRIODENDRON Linnaeus 1753

[Lily tree; alluding to the flowers]

1. Liriodendron tulipifera L. {tulip-bearing} — TULIP-POPLAR; TULIP-TREE; YELLOW-POPLAR; FIDDLE-TREE; WHITEWOOD (Fig. 64).

Figure 64. *Liriodendron tulipifera*, Copiah Co. Mississippi, 14 Apr 2006. Photo: John Gwaltney.

Large deciduous tree (to 45 m). Low woods, mesic forests, swamps, bottomland forests, alluvial woods, and roadside ditches; flowers April–June; fruits September–October; common throughout Alabama (Fig. 65). Native to the eastern USA and adjacent Canada, from southern Vermont west through southern Ontario to Illinois, south to Louisiana and central Florida; it has escaped cultivation in east Texas and Iowa (Kartesz 2017).

The leaves of *Liriodendron tulipifera* are very distinctive, being truncate or notched at the apex and usually 4 to 6 lobed (Fig. 66a). Young stems have large stipules (Fig. 66b), which are shed later in the season. The large flowers (Fig. 67) are faintly fragrant and pollinated primarily by bees (Wood 1958). The fruit is a cigar-shaped "cone" that is borne erect on branches, and unlike *Magnolia*, separate into multiple winged samaras that contain the seeds (Fig. 68a–c).

Liriodendron is an important timber tree with many uses; it has lightweight wood and is one of the softest hardwoods in North America (Elias 1980). Some of the common names were given to this tree because the flowers are tulip-like, the wood is soft like a poplar, and in late summer or early fall the leaves turn yellow. It is a straight-growing tree (Fig. 69) that was historically referred to as "canoewood" because Indians and pioneers, like Daniel Boone, hollowed the trunks to make canoes (Rupp 1990). Tulip-Poplar is widely used in horticulture and often planted as a shade tree.

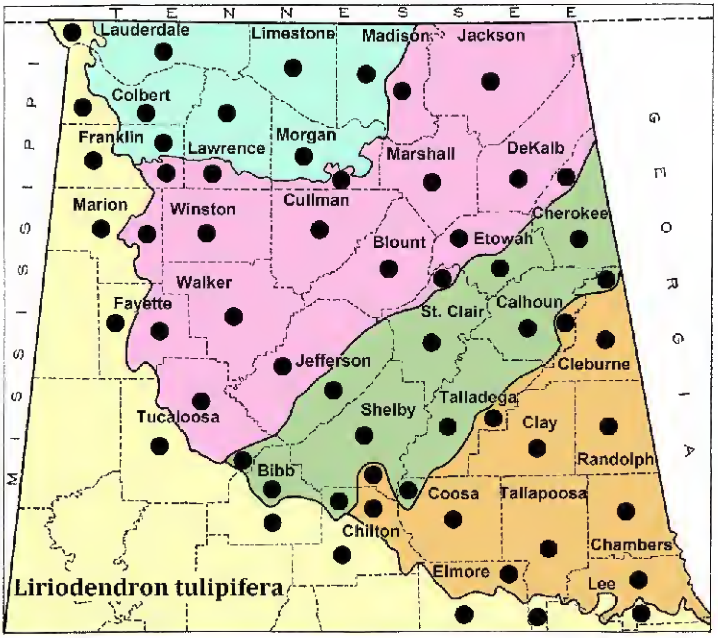


Figure 65. Distribution of *Liriodendron tulipifera* in northern Alabama.


(66a) Photo: John Gwaltney.

(66b) Photo: Melanie Taylor Spaulding.

Figure 66. *Liriodendron tulipifera*. A. Typical leaf, Copiah Co., Mississippi, 17 Nov 2005. B. Stipules below bud, Cleburne Co., Alabama, 17 Jun 2017.

Figure 67. *Liriodendron tulipifera* flower, Etowah Co., Alabama, 30 Apr 2013. Photo: T. Wayne Barger.

(68a) Ripening fruit. (68b) Dried fruit. (68c) Fruit shedding winged samaras.

Figure 68. *Liriodendron tulipifera* fruit from tree in Copiah Co. Mississippi. A. 9 May 2006. B. 2 Feb 2006. C. 2 Feb 2006. Photos: John Gwaltney.

Figure 69. *Liriodendron tulipifera* trunk, low woods along the nature trail at the Anniston Museum of Natural History, Calhoun Co., Alabama, 13 Jul 2017. Photo: Dan Spaulding.

Various species and varieties have been named based mostly on leaf shape, but many authors have reduced this genus to two closely related extant species, *Liriodendron tulipifera* in North America, and *L. chinense* (Hemsl.) Sarg. from central China (Meyer 1997). Wood (1958) recognized only two species and stated: "The leaves although always unmistakable are extremely variable." However, Weakley (2015) recognizes a new species from the Florida Peninsula and a new variety of *L. tulipifera* (Fig. 70) from the Atlantic and Gulf Coastal Plain. The leaves of these entities have 0–4 lobes (on sun leaves), but the new species has caudate lobed tips and smaller cones than the typical species. Plants in the northern Alabama study region all belong to the typical variety; however, more research is needed to determine the northern range extent of the Coastal Plain form.

Figure 70. Leaf shape of Coastal Plain entity, Baldwin Co., Alabama, 17 May 2012. Photo: T. Wayne Barger.

Liriodendron is an ancient genus that dates back in the fossil record to the Cretaceous period (Berry 1902). Some authors (e.g. Barkley 1975; Romanov & Dilcher 2013) place *Liriodendron* and related fossil genera *Archaeanthus* and *Liriodendroidea* in the family Liriodendraceae, separate from the Magnoliaceae sensu stricto, based on a combination of molecular sequence data (Azuma et al. 2001; Kim et al. 2001) and morphological studies (Romanov & Dilcher 2013). Such studies show their isolated position within the Magnoliaceae and their long separation as distinct evolutionary lineages that diverged over 100 million years ago.

2. **MAGNOLIA** Linnaeus 1753

[Pierre Magnol, 1638–1715; French professor of botany at Montpelier]

Recently, several authors have divided *Magnolia* sensu lato into as many as 16 different genera (Sima & Lu 2012). A multi-genera approach is currently promoted in the *Flora of China* (eFloras 2008), although the adoption of this concept by North American botanists has been somewhat measured. If followed, four additional genera would be recognized in the northern Alabama region: *Houpoea* (*M. tripetala*); *Metamagnolia* (*Magnolia macrophylla*); *Paramagnolia* (*M. fraseri* & *M. pyramidata*); and *Yulania* (*M. acuminata*). *Magnolia grandiflora* and *M. virginiana* would remain in the genus *Magnolia*.

1. Leaf base auriculate-cordate (with ear-like lobes).

  2. Leaf blade glaucous (whitish) beneath with appressed-pubescent; leaves broadly elliptic to obovate-oblong and very large (>50 cm long); buds, twigs and cone-like fruit pubescent .... **4. *Magnolia macrophylla***
  2. Leaf blade greenish and glabrous beneath; leaves medium-sized (< 50 cm long) and kite-shaped (rhombic-obovate to obovate-spatulate); buds, twigs, and cone-like fruit glabrous.

    3. Medium-sized to large tree when mature (with most flowers high up in tree and sometimes difficult to see); stamens more than 8 mm long; cone-like fruit 5.5–10 cm long; mature leaves often more than 25 cm long (sometimes smaller) .... **2. *Magnolia fraseri***
    3. Typically a smaller tree (flowers therefore easily observed); stamens less than 8 mm long; cone-like fruit 4–6 cm long; mature leaves usually less than 25 cm long (sometimes larger) .... **5. *Magnolia pyramidata***

1. Leaf base cuneate or rounded at base, not auriculate.

  4. Leaves evergreen and aromatic when crushed.

    5. Leaves thick-leathery (coriaceous), dark green above (distinctly glossy) and green or rusty tomentose beneath; cone-like fruit silky-villous .... **3. *Magnolia grandiflora***
    5. Leaves thin-leathery (subcoriaceous), medium green above (dull to slightly glossy) and glaucous (chalky white) beneath; cone-like fruit glabrous................... **8. *Magnolia virginiana***

  4. Leaves deciduous, not aromatic when crushed.

    6. Leaves averaging 35–50 cm and long in terminal umbrella-like clusters, crowded in false whorls toward branch tips; leaf base cuneate-attenuate (conspicuously tapering); buds glabrous; flowers with an unpleasant scent; tepals creamy white .... **7. *Magnolia tripetala***
    6. Leaves averaging 8–30 cm long and uniformly distributed along branchlets (scattered and alternate); leaf base rounded, subcordate to widely cuneate; buds unmistakably silvery to white pubescent; flowers odorless or with a pleasant aroma; tepals greenish-yellow, pink or rose-purple (rarely white).

      7. Single-trunked native tree; flowers appearing after leaves; tepals greenish-yellow to yellow, often glaucous; anthers dehiscing introrsely; cone-like follicles oblong-cylindrical (cucumber-like) .... **1. *Magnolia acuminata***
      7. Large spreading shrub or small low-branched or multi-trunked exotic tree (persisting from cultivation); flowers appearing before leaves (though may be present as leaves expand); tepals usually pinkish to rose-purple, not glaucous; anthers dehiscing laterally; cone-like follicles narrowly cylindric .... **6. *Magnolia ×soulangeana***

1. Magnolia acuminata (L.) L. {acuminate; referring to the leaf tips} — CUCUMBER-TREE; CUCUMBER MAGNOLIA; BLUE MAGNOLIA; COWCUMBER-TREE (Fig. 71). [*Magnolia acuminata* var. *alabamensis* Ashe; *M. acuminata* var. *aurea* (Ashe) Ashe; *M. acuminata* var. *cordata* (Michx.) Seringe; *M. acuminata* var. *ludoviciana* Sarg.; *M. acuminata* var. *ozarkensis* Ashe; *M. acuminata* var. *subcordata* (Spach) Dandy; *M. cordata* Michx.; *Tulipastrum acuminatum* (L.) Small var. *acuminatum*; *T. acuminatum* var. *aureum* Ashe; *T. cordatum* (Michx.) Small; *Yulania acuminata* (L.) D.L. Fu]

Figure 71. *Magnolia acuminata* flowering in rich woods along the Blue Ridge Parkway between Peaks of Otter and the city of Floyd, Virginia, May 2011. Photo: John Gwaltney.

Small to large, deciduous tree (9 to 30 m). Rich woods, forested slopes, coves, bluffs, and streambanks; flowers April–June; fruits July–September; uncommon in the Highland Rim, Ridge & Valley, and Piedmont; frequent in the Cumberland Plateau and Coastal Plain (Fig. 72). Native to the eastern USA from New York south to the Panhandle of Florida, west to Louisiana, western Oklahoma and Missouri (Kartesz 2017).

The flowers of *Magnolia acuminata* are slightly fragrant and the tepals are usually greenish-yellow and glaucous (Fig. 73). The fruit (Fig. 74a–b) was collected by early settlers to infuse whiskey with a pleasant bitter taste, giving the tree the name "Indian bitter" (Peattie 1948). A tea was also made and used as a substitute for quinine to treat malaria or typhoid fever (Martin 1992). The common name refers to the green, unripe "cones" that resemble cucumbers (Meyer 1997). Larger trees have been harvested for their timber, but the wood is somewhat weak and used mainly for crates and boxes (Elias 1980). *Magnolia acuminata* has been popular in cultivation since its discovery in 1736 by Virginia botanist, John Clayton (Peattie 1948).

Unlike Alabama's three other native, deciduous magnolias, the leaves of *Magnolia acuminata* are scattered along the branches and not in umbrella-like clusters at branch tips (Fig. 75). The bark of mature *M. acuminata* trees is furrowed, rather than smooth with scattered bumps and plates (Fig. 76).

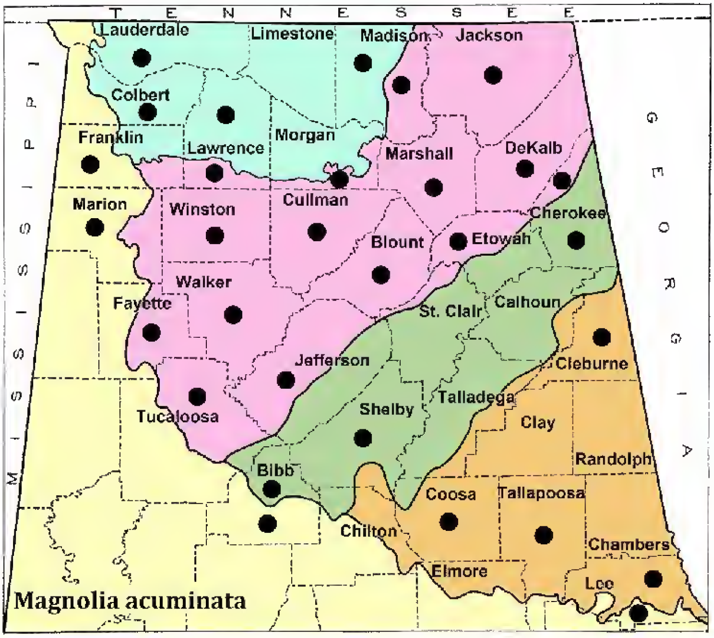


Figure 72. Distribution of *Magnolia acuminata* in northern Alabama.

Some authors, such as Ashe (1931), recognized many varieties of *Magnolia acuminata.* Weakley (2015) recognized only one variety, *M. acuminata* var. *subcordata*, and said: "It has been treated variously as a variety, a species, or merged with *M. acuminata.*" Ashe treated this taxon as *M. cordata*, but Harper (1928) stated: "This is a little-understood and somewhat mysterious species, or perhaps only a variety. It is supposed to differ from *M. acuminata* in being a smaller tree, with somewhat differently shaped leaves and smaller yellow flowers."

Coker (1943) treated *Magnolia cordata* as a variety and wrote that it differed "in usually smaller size of trees [to 9 m], pubescent twigs of first and usually second years, somewhat more consistently smaller and more broadly ovate leaves and geographical range (lower altitudes)." Coker (1943), as well as Weakley (2015), restrict this variety to the Lower Piedmont. However, there are trees on the Alabama Coastal Plain that have pubescent twigs and densely pubescent leaves, similar to the description of *M. acuminata* var. *subcordata.* Ashe (1931) noted that "these Alabama trees reached a height of 25 m thus greatly exceeding *M. cordata* [=*M. acuminata* var. *subcordata*]...where it seldom exceeds 10 m. It approaches *M. cordata* in the often soft pubescence of the lower surface of the leaves and in its pubescence twigs but the flowers in place of being canary yellow as are those of *M. cordata* are green or rarely yellowish green." Ashe (1931) named this new entity *M. acuminata* var. *alabamensis* and noted that the flowers were also larger (7.5 to 9 cm). Hardin (1954) recognized three varieties and stated that "*Magnolia acuminata* has been described under two generic, two specific and six varietal names involving some sixteen or more different combinations, all published prior to 1932." Later, Hardin (1972), decided that further study of populations in the field was needed before any varieties were recognized. The *M. acuminata* complex appears to be a very variable group, possibly connected by many forms, therefore no varieties are recognized by the authors of this paper at this time.

Figure 73. *Magnolia acuminata* flower close-up, Winston Co., Alabama, 12 Apr 2008. Photo: Brian Finzel.

(74a) Photo: Mike Parker. (74b) Photo: Scott Beuerlein.

Figure 74. Close-up of *Magnolia acuminata* fruits. A. Unripe fruit; Bucks Co., Pennsylvania, 1 Jun 2008. B. Ripe fruit, cultivated tree in Hamilton Co., Ohio, 22 Sep 2006.

Figure 75. *Magnolia acuminata* leaf arrangement (with young fruit at tip of branch), Chocolocco Wildlife Mangement area, Cleburne Co., Alabama, 8 May 1998. Photo: Bill Summerour.

Figure 76. *Magnolia acuminata* bark, cultivated in Hamilton Co., Ohio, 22 May 2006. Photo: Scott Beuerlein.

2. Magnolia fraseri Walter {in honor of John Fraser, (1750–1811), Scottish botanist} — FRASER'S MAGNOLIA; MOUNTAIN MAGNOLIA; EAR-LEAF UMBRELLA-TREE (Fig. 77). [*Paramagnolia fraseri* (Walter) Sima & S.G. Lu]

Figure 77. *Magnolia fraseri*, Blue Ridge Mountains in Tennessee, 7 May 2008. Photo: John Gwaltney.

Medium-sized, deciduous tree (to 25 m). Wooded ravines and mesic to dry forested slopes; flowers April–May, fruits July–September; rare in the upper mountainous area of the Piedmont, which Duncan (1967) includes as part of the Blue Ridge Province (Fig. 78). Native to the mountains from southern Pennsylvania south through West Virginia, Virginia, the Carolinas, Kentucky, Tennessee, Georgia, and northeast Alabama (Kartesz 2017).

British-born American botanist, Thomas Walter (1740–1789) named and described *Magnolia fraseri* in his *Flora Caroliniana* in 1788 (Weaver 1981). Harper (1928) noted that "Prof. Sargent in the latest edition of his Manual of Trees credits *M. fraseri* to northern Alabama, but without definite locality." A locality was finally discovered for Alabama in December 1996 by Jacksonville State University (JSU) professor, Bill Summerour, on Horseblock Mountain in the upper Piedmont of Cleburne County (pers. comm. Bill Summerour 2017). While exploring the area when he discovered the leaves of this magnolia on the forest floor. He collected them, along with a twig and old cone, and brought them to the JSU herbarium to be mounted, but it was incorrectly labeled by herbarium staff "January 1997." Dr. Summerour returned to the site several times in the spring of 1997 hoping to find flowers. On April 14, 1997, he was accompanied by the senior author and fellow JSU graduate, Eric Soehren, who (since he was the youngest) shimmied up the tree to get a flowering branch for Dr. Summerour to photograph (Fig. 79). The population is still extant today and contains trees much larger (Fig. 80) than its close relative, *M. pyramidata*, which occurs chiefly on the Coastal Plain, but has been documented from the adjacent Piedmont (Chilton County) and the Weisner Ridge section of the Ridge & Valley (Calhoun County).

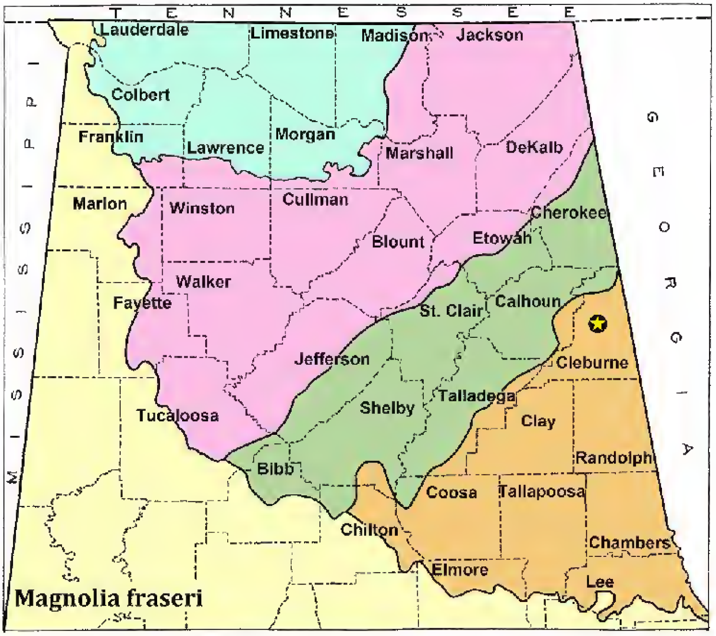


Figure 78. Distribution of *Magnolia fraseri* in northern Alabama.

Figure 79. Eric Soehren and Dan Spaulding with *Magnolia fraseri* along with the flower collected from the canopy; Horseblock Mountain, Cleburne Co., Alabama, 15 Apr 1997. Photo: Bill Summerour.

Figure 80. *Magnolia fraseri* trunks, Cleburne Co., Alabama, 16 Jul 2017. Photos: Dan Spaulding.

Weaver (1981) wrote that *Magnolia pyramidata* is a "shorter, shrubbier plant... with shorter stamens and fruit aggregates than typical *M. fraseri*." In separating these two similar species, Hardin (1972) included tepal and leaf size in his key, and Meyer (1997) included leaf shape in his treatment. The leaves of *M. fraseri* (Fig. 81) tend to gradually taper from the broader upper portion to the base, and the leaves of *M. pyramidata* typically abruptly taper from broadest part to the base; but all these characters are often too variable to be relied upon. The best character separating the two species is the size of the stamens, which are more than 8 mm in *M. fraseri*. (The stamen length of specimens collected in Cleburne Co., Alabama average around 11 mm long.) The flowers of *M. fraseri* are creamy white and fragrant (Fig. 82). The Alabama Natural Heritage Program (ALNHP 2017) lists Fraser's Magnolia as critically imperiled (S1) in Alabama, but the species is globally secure (G5).

Figure 81. *Magnolia fraseri* leaves, Cleburne Co., Alabama, 16 Jul 2017. Photos: Dan Spaulding.

Figure 82. *Magnolia fraseri* flower close-up, Horseblock Mountain in the Talladega National Forest, Cleburne Co., Alabama, 4 May 1997. Photo: Bill Summerour.

3. Magnolia grandiflora L. {large-flowered} — SOUTHERN MAGNOLIA; BULL-BAY; FLOWERING MAGNOLIA (Fig. 83). [*Magnolia foetida* (L.) Sarg.]

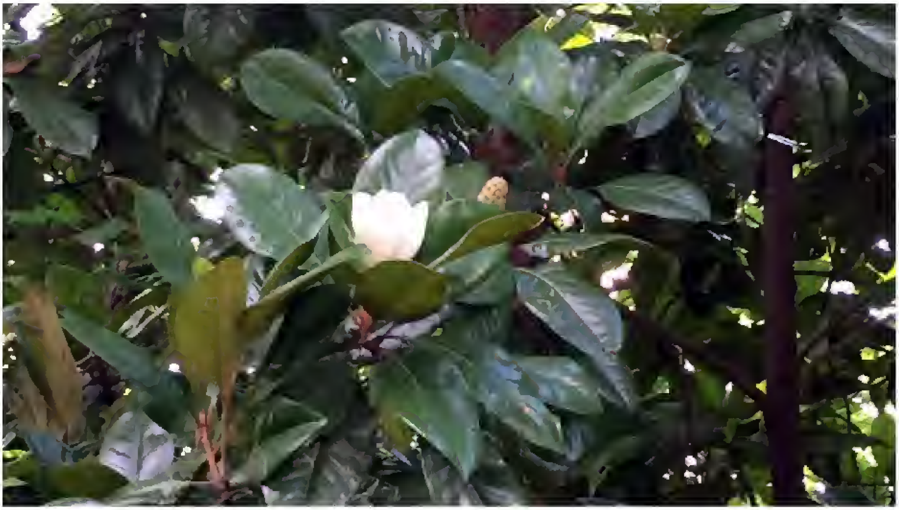


Figure 83. *Magnolia grandiflora*, naturalized population in disturbed woods, Cleburne Co., Alabama, 17 Jun 2017. Photo: Dan Spaulding.

Large, evergreen tree (to 35 m). Naturalized in low to dry woods, fence rows, and other disturbed areas; flowers May–June; fruits August–October; uncommon throughout northern Alabama and upper Coastal Plain; frequent in the lower Coastal plain (Fig. 84). *Magnolia grandiflora* is native to bottomland and maritime forests of the southeastern USA in the lower Coastal Plain from North Carolina to east Texas (Godfrey 1988); all records from northern Alabama (Clark 1971) and elsewhere are escapes from cultivation (Meyer 1997).

The showy flowers (Fig. 85a) of *Magnolia grandiflora* are fragrant and chiefly pollinated by beetles (like other magnolias), though honeybees are common visitors (Heiser 1962). Thien (1974) observed beetles entering freshly opened flowers or forcing their way into unopened buds to feed on the nectar, and while crawling around they transfer pollen to the stigmas; but he said that "bees are not efficient pollinators (if at all), for they gain access to the flowers only after the stigmas and stamens have completed their cycles."

Magnolia grandiflora is a well-known and popular ornamental tree with many cultivars on the market. Weakley (2015) proclaimed: "This is, of course, the classic "southern magnolia," along with live oak (*Quercus virginiana*) and bald-cypress (*Taxodium distichum*), a totem tree of the Deep South." According to Harper (1928), the leaves are the largest of any evergreen tree in the south, except for palms and yuccas. The thick leaves and the large, cone-like fruits (Fig. 85b) of *M. grandiflora* are sometimes used by florists in decorations.

Clark (1971) had only two records of *Magnolia grandiflora* from the study area in his flora; however, this species has now spread into natural and disturbed sites. All collections mapped are documented from naturalized populations; cultivated or suspicious collections have been excluded.

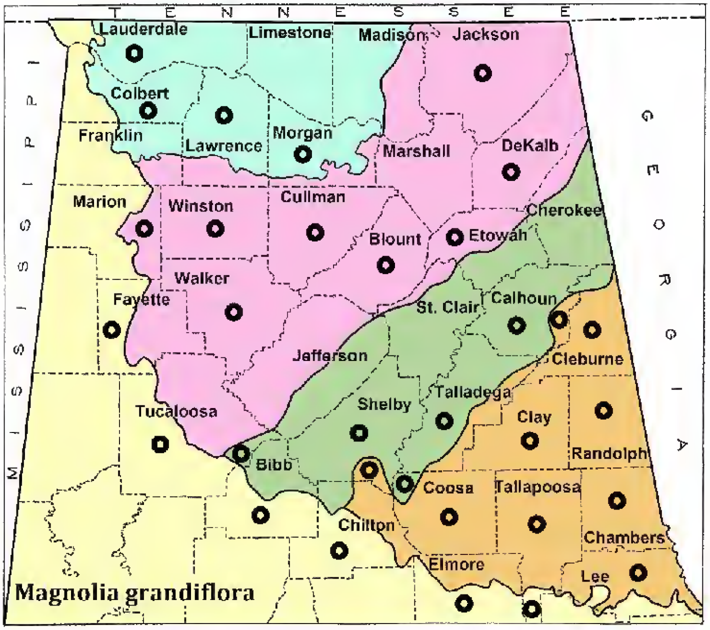


Figure 84. Distribution of *Magnolia grandiflora* in northern Alabama.

(85a) Fragrant flower with white tepals. (85b) Mature fruit with seeds.

Figure 85. Cultivated *Magnolia grandiflora* in Madison Co, Alabama. A. Flower; 14 May 2011. B. Fruit; 28 Sep 2013. Photos: Brian Finzel.

4. **Magnolia macrophylla** Michx. {large-leaved} — Bigleaf Magnolia; Oowah-Tree; Largeleaf Magnolia; Silver Magnolia; Bigleaf Cowcumber-Tree (Fig. 86).

Figure 86. *Magnolia macrophylla,* Powell Co., Kentucky, 1 Jun 2008. Photo: Brian Finzel.

Small to medium-sized, deciduous tree (15 to 20 m). Mesic woods, stream margins, forested slopes, coves, gorges, ravines, and bluffs; flowers April–June; fruits July–September; uncommon in the Highland Rim and Ridge & Valley; frequent in Piedmont, western Cumberland Plateau, and Coastal Plain (Fig. 87). Native to the southeastern USA ranging from Virginia to Arkansas, south to Georgia and Louisiana (but not Florida); it has become naturalized in some states north of it range (Kartesz 2017). Even though *M. macrophylla* has not been collected in the northeast corner of Alabama, it is abundant just a few miles north in Marion and Grundy counties, Tennessee (Clark 1966). *Magnolia macrophylla* is an acidophile, almost always growing in acid soil. It develops moderate to severe chlorosis in alkaline soil (pers. comm. Ross Clark 2017).

French naturalist and explorer, André Michaux (1770–1855), first discovered *Magnolia macrophylla* near Charlotte, North Carolina in 1789 (Coker & Totten 1945). Bigleaf Magnolia has the largest simple (non-divided), deciduous leaves (Fig. 88a–b) and largest flowers than any North American tree (pers. comm. Ross Clark 2017). The name "Silver Magnolia" comes from the fact that the leaves are covered with silver hairs underneath (Fig. 89). The flowers (Fig. 90) have a strong, sweet fragrance. Beetles are attracted by this odor and eat the nectarlike droplets that are secreted at the bases of the stigmas; the beetles subsequently get coated by the sticky substance and soon are covered with pollen (Thien 1974). Bumblebees have also been observed pollinating flowers (pers. comm. Ross Clark 2017). The round cones of *M. macrophylla* form in summer and turn pinkish-red later in the season (Fig. 91). The trunk of mature trees has light gray bark that is mostly smooth, but has scattered bumps and small plates on the surface (Fig. 92). The wood is hard and weak, so it is not used commercially (Elias 1980). Planted as an ornamental tree, but needs to be protected from strong winds because the giant leaves are easily torn. You can always tell if there has been a hailstorm during the summer from the condition of its leaves (pers. comm. Ross Clark 2017).

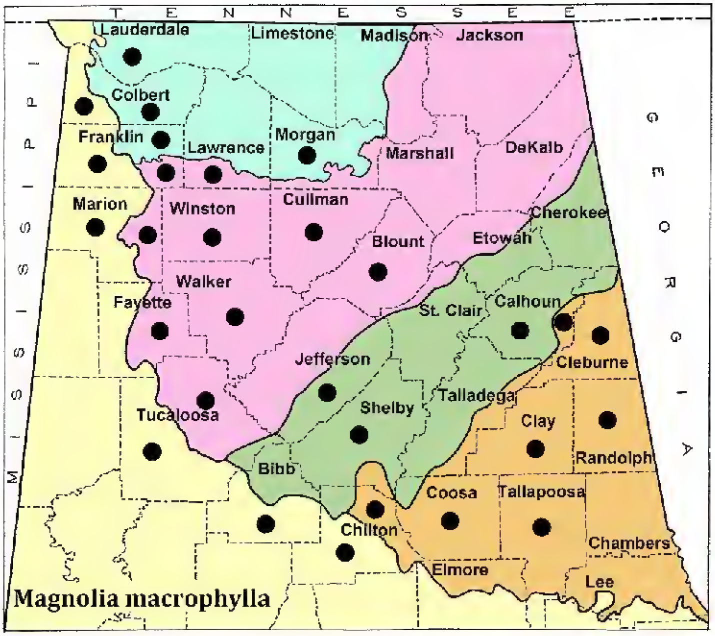


Figure 87. Distribution of *Magnolia macrophylla* in northern Alabama.


(88a) Whorl of leaves. (88b) John MacDonald with leaf.

Figure 88. *Magnolia macrophylla* leaves. A. Monroe Co., Alabama, 1 May 2012. Photo: T. Wayne Barger. B. Bankhead National Forest; Winston Co., Alabama, 6 Jul 2017. Photo: Dan Spaulding.


Figure 89. *Magnolia macrophylla* with white leaf undersurface, floating in creek in Hamilton Co., Tennessee, 28 Oct 2007. Photo: Alan Cressler.

Figure 90. *Magnolia macrophylla* flower, Bankhead National Forest. Lawrence Co., Alabama, 25 May 2004. Photo: Eric Soehren.

Figure 91. *Magnolia macrophylla* fruit, Tallapoosa Co., Alabama, 13 Sep 2007. Photo: T. Wayne Barger.

Figure 92. *Magnolia macrophylla* trunks, Marion Co., Alabama, 20 Aug 2017. Photos: Dan Spaulding.

Magnolia macrophylla is closely related to the smaller *M. ashei* Weatherby, a Florida Panhandle endemic. Miller (1975) stated that *M. ashei* is "probably a relict that through isolation has adapted to life as a shrub rather than a tree." Weatherby (1926), who named the species, said it has smaller flowers and the pubescence on the undersurface of the leaves is not as dense as that of *M. macrophylla*. Kral (1983) states that *M. ashei* is thought by some to be just a variant, but *M. macrophylla* is much taller, more widespread, and has broader and rounder fruit than *M. ashei* (Fig. 93). It is also noteworthy that he trunk of *M. ashei* is noticeable contorted, while *M. macrophylla* is straight (pers. comm. John Kartesz 2017).

Figure 93. *Magnolia ashei*, Okaloosa Co., Florida, 14 Apr 2001; fruit, 15 Aug 2002. Photos: Bill Summerour.

5. **Magnolia pyramidata** W. Bartram {pyramidal; referring growth habit} — PYRAMID MAGNOLIA; SOUTHERN CUCUMBER-TREE; BARTRAM'S MAGNOLIA (Fig. 94). [*Magnolia fraseri* Walter ssp. *pyramidata* (W. Bartram) A.E. Murray; *M. fraseri* var. *pyramidata* (W. Bartram) Torrey & A. Gray; *Paramagnolia fraseri* (Walter) Sima & S.G. Liu var. *pyramidata* (Bartram) Sima & S.G. Liu]

Figure 94. *Magnolia pyramidata*, Calhoun Co., Alabama, 20 Apr 1998. Photo: Bill Summerour.

Small, deciduous tree (to 12 m). Mixed wooded ravines, forested slopes, and bluffs; flowers April–May; fruits June–August; very rare in the Ridge & Valley and lower Piedmont; uncommon in the Coastal Plain (Fig. 95). Chiefly native in the Coastal Plain from South Carolina to east Texas (Kartesz 2017).

In Alabama, *Magnolia pyramidata* was documented from the Piedmont of Chilton County by Robert Kral on May 20, 1973. In the summer of 1997, it was discovered in the Wesner Ridge section of the Ridge & Valley province in Calhoun County by two Jacksonville State University (JSU) graduate students, Hayes Jackson and Steven Threlkeld. They were searching for Turkey Oak (*Quercus laevis*) on Reynolds Hill at Ft. McClellan, when came across Pyramid Magnolia under a stand of Longleaf Pine (*Pinus palustris*), about a hundred yards away from the oak on the same slope (pers. comm. Hayes Jackson 2017). Jackson noticed a lower branch of *M. pyramidata* under the pine straw that was starting to root, so he cut this branch and planted it in the woods surrounding his house in Anniston. The word spread about this northern population of Pyramid Magnolia, and in the spring of 1998, JSU professor Bill Summerour (pers. comm. 2017) visited this site with a group from Birmingham, and photographed the tree along with the flowers (Fig. 96a). Years later, the Eastern Bypass from Oxford to Anniston was completed, apparently destroying the habitat where *M. pyramidata* was found. Unfortunately, no herbarium specimen was made from the plant in the 1990s, but the senior author visited Hayes Jackson's house and made a voucher from the original tree that once grew in the wild (Fig. 96b). Recent searches have been made in the area for more trees, but none were found; more field work is planned.

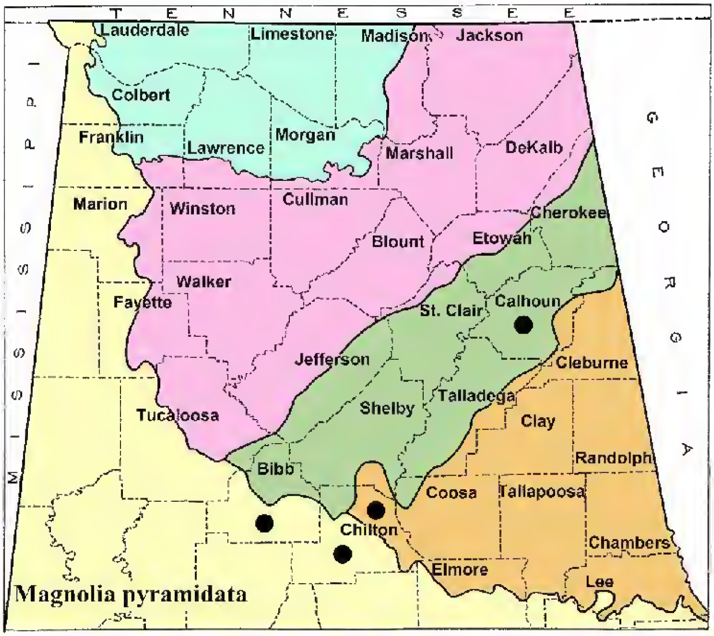


Figure 95. Distribution of *Magnolia pyramidata* in northern Alabama.

(96a) Photo: Bill Summerour. (96b) Photo: Dan Spaulding.

Figure 96. *Magnolia pyramidata* in Calhoun Co, Alabama. A. Birmingham group observing the shrubby tree with flower buds on Reynolds Hill in Ft. McClellan, 10 Apr 1999. B. Cutting from original tree planted at Hayes Jackson's house in Anniston, 9 Aug 2017.

The flowers of *Magnolia pyramidata* (Fig. 97) are similar in size to *M. fraseri*, but have smaller stamens (< 8mm long). Clark (1971) regarded *M. pyramidata* as synonymous with *M. fraseri* and stated: "There is no apparent reason to consider these as distinct entities, even though there is a range discontinuity." Weakley (2015) noted that *M. pyramidata* is "sometimes treated as a variety or subspecies of *M. fraseri*, to which it is clearly closely related, but the distributional and morphological differences are discrete and specific status seems warranted."

Figure 97. *Magnolia pyramidata* flower, Monroe Co., Alabama, 7 Apr 2011. Photo: T. Wayne Barger.

6. Magnolia ×soulangeana Soul.-Bod. {for Étienne Soulange-Bodin (1774–1846), a French horticulturalist} — SAUCER MAGNOLIA; TULIP MAGNOLIA (Fig. 98).

Figure 98. *Magnolia ×soulangeana* 'Alexandrina' in cultivation at Hayes Jackson's house in Anniston, Calhoun Co., Alabama, 20 Jan 2013. Photo: Hayes Jackson.

Large, multi-trunked, deciduous shrub or small tree with low branches (to 8 m). Commonly cultivated and rarely persistent at old homesteads; flowers late January–April; fruits August–September (sporadically); very rare waif in the Cumberland Plateau and Coastal Plain (Fig. 99). Collections of *Magnolia ×soulangeana* from Colbert, Dallas, and Lauderdale counties were planted and one collection from Barbour County was made along a roadside among pines and oaks (Keener et al. 2017). There is no evidence *M. ×soulangeana* escapes cultivation, and is therefore not truly part of our flora (pers. comm. Ross Clark 2017), but it is included in this paper because the plant can appear to be naturalized.

Magnolia ×soulangeana is often multi-trunked and has deciduous leaves that appear after flowering (Fig. 100). Saucer Magnolia is a hybrid between two Chinese species, *M. denudata* Desr. and *M. liliifolia* Desr., which are sometimes placed in the genus *Yulania* (Xia et al. 2008). Both of these species have been planted as ornamentals, but the hybrid, *M. ×soulangeana*, has far surpassed its parents in popularity. Numerous cultivars of *M. ×soulangeana* have been developed and are grown throughout the USA, Canada, Europe, and other countries.

Dirr (1983) stated: "The original hybrid was raised in the garden of Soulange-Bodin at Fromont, France from seed borne by *M. heptapeta* [=*M. denudata*] fertilized by pollen of *M. quinquepeta* [=*M. liliifolia*]. The plant first flowered in 1826 and the cultivars have become the most popular of all magnolias in American gardens." It is cherished for its beautiful flowers (Fig. 101) that appear well before the leaves.

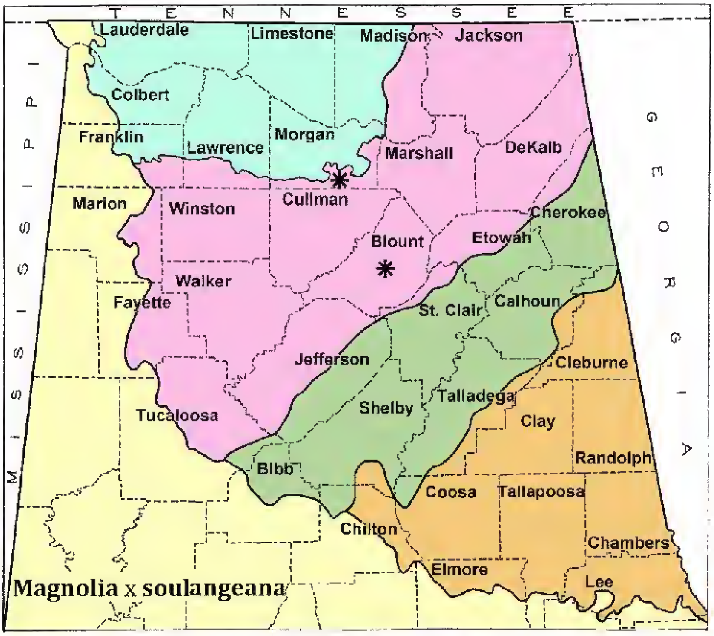


Figure 99. Distribution of *Magnolia ×soulangeana* in northern Alabama.

Figure 100. *Magnolia ×soulangeana* ‘Alexandrina’ in cultivation at Hayes Jackson’s house in Anniston, Calhoun Co., Alabama, 9 Aug 2017. Photos: Dan Spaulding.

Figure 101. *Magnolia ×soulangeana* in cultivation, Lee Co., Alabama, 28 Feb 2010. Photo: T. Wayne Barger.

7. Magnolia tripetala (L.) L. {with three petals} — UMBRELLA MAGNOLIA; UMBRELLA-TREE (Fig. 102). [*Houpoea tripetala* (L.) Sima & S.G. Lu]

Figure 102. *Magnolia tripetala*, St. Clair Co., Alabama, 24 Apr 2008. Photo: Brian Finzel.

Small, deciduous tree (to 15 m), usually with several trunks. Rich woods, stream bottoms, forested slopes, ravines, coves, and gorges; flowers April–May; fruits July–October; frequent in the Piedmont and Ridge & Valley; uncommon in the Cumberland Plateau; rare on the Coastal Plain (Fig. 103). Native to the eastern USA, but centered in the Southern Appalachians, ranging from southern Pennsylvania, southern Ohio, southern Indiana south to the Panhandle of Florida and Mississippi; it is disjunct in the Ouachita Mountains of central Arkansas and eastern Oklahoma (Weakley 2015). This species is occasionally cultivated and records from the northeastern USA are escapes from planted trees (Kartesz 2017).

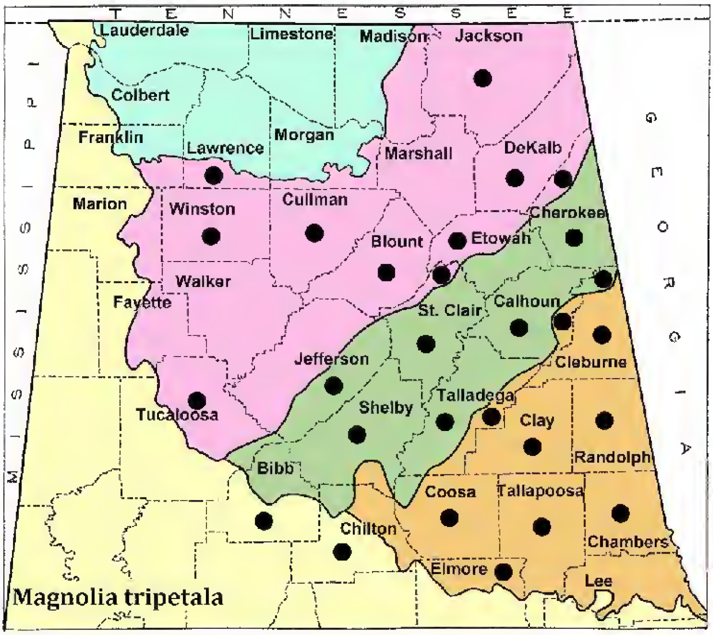


Figure 103. Distribution of *Magnolia tripetala* in northern Alabama.

Although Linnaeus named the species, it was first described by Mark Catesby in 1743 in his publication *Natural History of Carolina* and was introduced in eighteenth century gardens of England (Peattie 1948). Heiser (1962) described the white flowers (Fig. 104a) of *Magnolia tripetala* as having "a rather heavy odor which is frequently described as unpleasant," and after his observation in the field, he said it "seems reasonable to infer that *M. tripetala* is primarily, if not entirely, pollinated by beetles." The cone-like fruits (Fig. 104b) become red when mature and shed their crimson seeds by the end of summer.

Magnolia tripetala has leaves crowded at the ends of branches, giving them a whorled or umbrella-like appearance (Fig. 105), hence the common name. Three other species, *M. fraseri*, *M. macrophylla*, and *M. pyramidata*, are occasionally called "umbrella magnolias" for the same reason. These three species all have auriculate (eared) leaf bases, whereas the leaves of *M. tripetala* taper basally. *Magnolia tripetala* is a fast growing understory tree, but it doesn't get very large. The bark is gray and mostly smooth, but covered with scattered bumps and small plates (Fig. 106).

(104a) Flower. Photo: T. Wayne Barger. (104b) Fruit. Photo: Dan Spaulding.

Figure 104. *Magnolia tripetala*. A. Coosa Co., Alabama, 30 Apr 2013. B. Floodplain forest along Cane Creek, Randolph Co., Alabama, 27 Aug 2017.

Figure 105. *Magnolia tripetala* with umbrella-like leaves, wooded floodplain along Cane Creek, Randolph Co., Alabama, 27 Aug 2017. Photos: Dan Spaulding.

Figure 106. *Magnolia tripetala* trunks, floodplain along Cane Creek, Randolph Co., Alabama, 27 Aug 2017. Photo: Dan Spaulding.

8. Magnolia virginiana L. {of Virginia} var. **australis** Sarg. {southern} — SWEETBAY MAGNOLIA; SWEET-BAY; SILVER-BAY; SWAMP-BAY (Fig. 107). [*Magnolia australis* (Sarg.) Ashe; *M. glauca* L.]

Figure 107. *Magnolia virginiana*. Jackson Co., Alabama, 2 May 2012. Photo: T. Wayne Barger.

Medium to large, evergreen tree (to 28 m). Swamps, bogs, seeps, and streambanks; flowers April–July; fruits June–October; rare in the Highland Rim; uncommon in the Cumberland Plateau and Ridge & Valley; frequent in the Piedmont; common in the Coastal Plain (Fig. 108). The species is native from Massachusetts south to Florida, and then in the Southeast USA west to east Texas and north to Arkansas and Tennessee (Kartesz 2017). Only *Magnolia virginiana* var. *australis* has been documented from Alabama, even though Kral et al. (2011) reported *M. virginiana* var. *virginiana* from the state. Weakley (2015) maps the range of the type variety only in the eastern Atlantic states from southeast Massachusetts south to east Georgia.

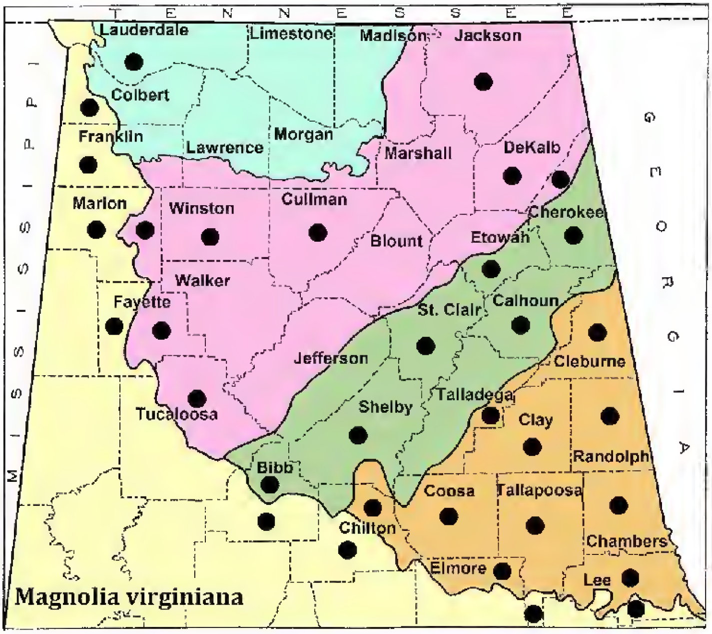


Figure 108. Distribution of *Magnolia virginiana* in northern Alabama.

Sweetbay Magnolia is a very common landscape plant in the eastern USA. It is hardy and even resists drought. Its flowers are extremely fragrant and beetle pollinated (Heiser 1962). The fruits are first green, turn red at maturity and the crimson, arillate seeds later dangle from each follicle (Fig. 109). Historically, the dried, aromatic bark was used as a tonic for its stimulant properties (Harper 1928). When young, this species is sometimes confused with *Persea palustris* (Swamp Bay) because they both have elliptic, aromatic leaves and often grow in the same habitat, however the crushed leaves of *P. palustris* have a spicy aroma and a rusty pubescence beneath. In contrast, *Magnolia virginiana* leaves have a sweet fragrance when crushed and are strongly glaucous and white pubescent beneath (Fig. 110).

Figure 109. *Magnolia virginiana*, swamp in Lee Co., Alabama, 27 Aug 2017. Photos: Dan Spaulding.

Figure 110. *Magnolia virginiana*, Cleburne Co., Alabama, 17 Jun 2017. Photo: Melanie Taylor Spaulding.

Sargent (1919) named the southern variety of this species, *Magnolia virginiana* var. *australis*, which he described as a taller, evergreen tree (Fig. 111) with silky white pubescence on the undersurface of the leaves and on young stems. Ashe (1931) elevated Sargent's variety to a species because he said there were no intermediates between the northern and southern trees. Most northern populations tend to be small, multi-trunked trees (to 10 m) with deciduous to semi-evergreen leaves that are glabrous or slightly pubescent underneath.

McDaniel (1966) was convinced that recognition of var. *australis* was justified, but Spongberg (1976) noted that even though "the characters outlined by McDaniel are indeed evidence of differences between northern and southern populations of *M. virginiana*, it would seem that differences are to be expected within a wide-ranging species." Del Tredici (1981) agreed with Spongberg that this magnolia was just a highly variable species and said "the situation is very complex and confused and that many different forms of *Magnolia virginiana* of uncertain origin can be found."

Recently, however, Azuma et al. (2011) demonstrated that "phylogenetic analysis of the data matrix clearly indicated that populations of *Magnolia virginiana* were divided into two major groups—one in the north and one across the south—which are essentially concordant with the morphological classification." Their analysis utilized cpDNA (chloroplast DNA) and revealed that five nucleotide substitutions in cpDNA separates the two varieties, which is equivalent to similar differences found in other *Magnolia* taxa that are recognized as separate species (Azuma et al. 2011).

Figure 111. *Magnolia virginiana* trunk, swamp in Lee Co., Alabama, 27 Aug 2017. Photo: Dan Spaulding.

FAMILY 8. ANNONACEAE (Custard-Apple Family)

1. ASIMINA Adanson 1763
[From Native American name, *Asiminin*]

The Custard-Apple family (Annonaceae) contains more than 1000 species (75–120 genera). While most are from the tropics, only the genus *Asimina* is found in the temperate to subtropical regions of North America (Wood 1958). A total of 10 species of *Asimina* are found in eastern North America, with most restricted to Florida and Georgia (Horn 2015).

1. Non-clonal shrub of well-drained slopes and upland woods, usually 1–3 meters tall, largest leaf blades <22 cm long (averaging 6–15 cm); peduncle length at anthesis 1–7 mm (sometimes appearing nearly sessile); outer petal length 3–8 (-10) mm long; flowers 1–1.7 cm broad; mature fruit averaging 3 cm long (rarely to 6 cm) .... **1. *Asimina parviflora***
1. Clonal shrub or tree of floodplains and adjacent slopes, 1–14 m tall; largest leaf blades usually >18 cm long (averaging between 20–25 cm); peduncle length at anthesis (6-) 8–20 mm; outer petal length 10–25 mm; flowers >2 cm broad; mature fruit 2–15 cm long.

    2. Tree (or shrub when young) 3–14 m tall; largest leaves mostly >24 cm long; peduncle length on mature flowers (9–) 11–19 mm; outer petal width (12–) 15–27 mm and curved outward near apex; fruit averaging 7–15 cm long with numerous seeds .... **3. *Asimina triloba***
    2. Small shrub < 3 m tall; largest leaves mostly <27 cm long; peduncle length on mature flowers (6–) 8–12 mm; outer petal width 7–14 (-16) mm and curved outward near base; fruit rarely forming, but if present, about 2 cm long and with very few seeds ...... **2. *Asimina* ×*piedmontana***

1. Asimina parviflora (Michx.) Dunal {small-flowered} — SMALL-FLOWER PAWPAW; SMALL-FRUIT PAWPAW (Fig. 112).

Figure 112. *Asimina parviflora* with fruits, woods in Blount Co., Alabama, 13 Sep 2013. Photo: Brian Finzel.

Non-clonal, deciduous shrub. Upland woods, forested slopes, bluffs, and ravines; flowers March–May; fruits late May–September; rare in the Highland Rim (in acidic areas); common in all the other provinces of Alabama (Fig. 113). Native to the southeastern USA, from southeast Virginia west to southern Arkansas, south to east Texas and Florida; apparently absent from Tennessee (Kartesz 2017). Ross Clark (pers. comm. 2017) observed it in Marion Co., Tennessee, but didn't collect a voucher.

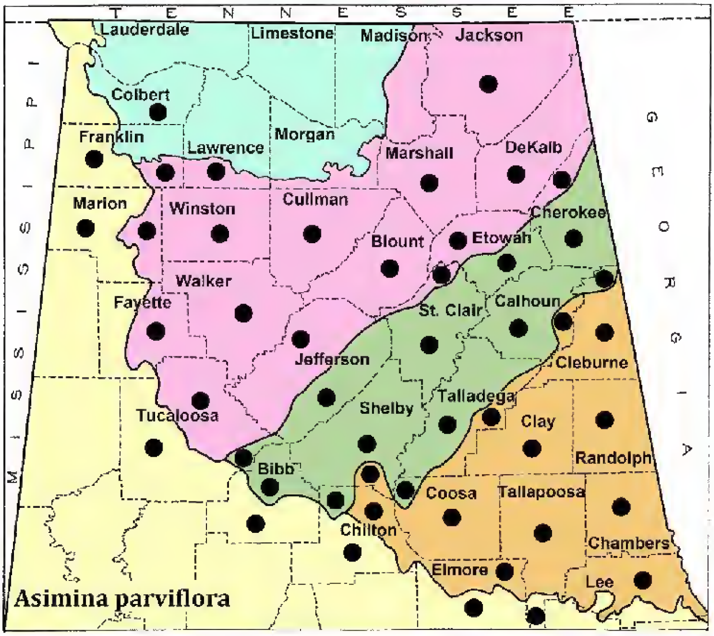


Figure 113. Distribution of *Asimina parviflora* in northern Alabama.

Harper (1928) stated that *Asimina parviflora* is "similar to *A. triloba* except in size, being seldom more than three or four feet tall, and having leaves and flowers only half as large." A hybrid between the two species was not known at the time. It is much easier to identify *Asimina* species in the field than on herbarium sheets, because *A. parviflora* is not clonal (rarely in clusters of more than five stems) and occurs in well-drained habitats (Horn 2015). *Asimina parviflora* is also rarely above one's head (averaging >2 m tall), hence the name "Dwarf Pawpaw." *Asimina triloba* and *A.* ×*piedmontana* are both clonal and located either in floodplains or on adjacent slopes. However, *A. triloba* is a tree (when mature) and *A.* ×*piedmontana* is a shrub less than 3 m tall. *Asimina parviflora* flowers (Fig. 114) are smaller and its peduncles (Fig. 115) are shorter than *A. triloba* and *A.* ×*piedmontana*. The fruit of Dwarf Pawpaw is much smaller than Common Pawpaw, but both are edible. Fruits usually do not form in the hybrid *A.* ×*piedmontana* (pers. comm. Charles Horn 2017).

The peculiar odor of crushed leaves of *Asimina* is reminiscent of a mixture of green peppers and tomatoes, thus helpful in identification in the field. The caterpillars of the beautiful black and white striped Zebra Swallowtail (*Euripides marcellus*) feed exclusively on pawpaw leaves. The female butterflies are skilled at locating *Asimina* plants and deposit their globe-shaped eggs on twigs, flowers and new leaves (Ogard & Bright 2010).

The brownish flowers of *Asimina* are slightly ill-scented and are believed to be pollinated by beetles (Wood 1958). However, recent research by Kate Goodrich on the pollination of *Asimina*, suggests that flies are possible pollinators (pers. comm. Charles Horn 2017).

Figure 114. *Asimina parviflora* flowering branch, Shelby Co., Alabama, 8 Apr 2015. Photo: Brian Finzel.

Figure 115. *Asimina parviflora* short peduncled flower, Shelby Co., Alabama, 8 Apr 2015. Photo: Brian Finzel.

2. **Asimina ×piedmontana** C.N. Horn {of the Piedmont; where hybrid was collected and described} — PIEDMONT PAWPAW (Fig. 116).

Figure 116. *Asimina ×piedmontana,* lower wooded slope adjacent to floodplain along Johnson Creek, Union Co., South Carolina, 26 Apr 2008. Photo: Charles Horn.

Clonal, deciduous shrub. Low woods and lower slopes adjacent to floodplains; flowers March–May; seldom fruits; rare in the Cumberland Plateau, Ridge & Valley, and Piedmont (Fig. 117); possible in the Coastal Plain. *Asimina ×piedmontana* range overlaps the distribution of its parents (Horn 2015) and the hybrid may be more common than records indicate.

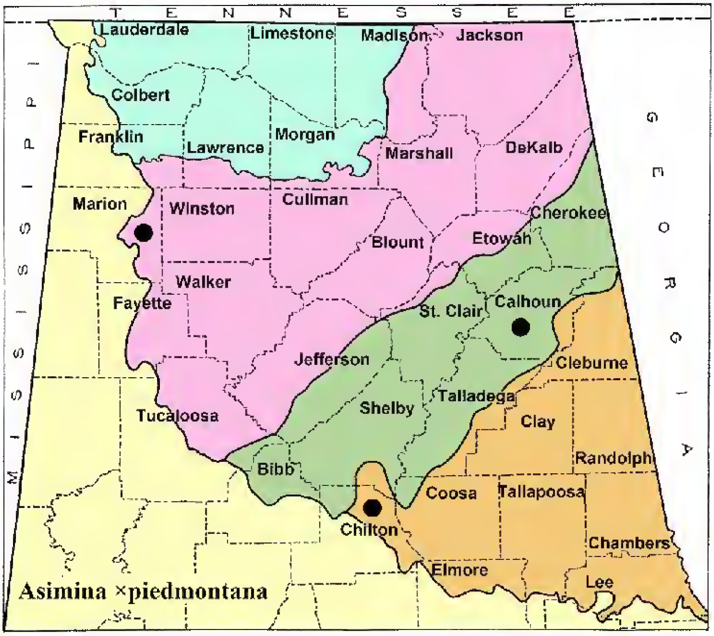


Figure 117. Distribution of *Asimina ×piedmontana* in northern Alabama.

Kral (1960) said that "hybrid swarms [in Florida] were common in *Asimina* with sprinklings of both parents" and also stated that "suspected hybrids between *A. triloba* and *A. parviflora* have been found." Kral (1997) mentioned in his treatment of the Annonaceae in the Flora of North America: "Putative hybrids between the two have been observed in northern Alabama."

Horn (2015) investigated variation in leaf size, flower morphology, and habitat of *Asimina* in South Carolina, and demonstrated that a hybrid between *A. parviflora* and *A. triloba* (*A. ×piedmontana*) exists, with flowers intermediate in size (Fig. 118a–f). Horn (2015) wrote: "The floral features of peduncle length, petal length, and petal width, are clearly the best flower parameters to help separate the three taxa." He also said: "Most striking was that the outer petals were rolled outwards laterally along their length on the hybrid." The leaves are also intermediate between its parents, largest ones 22–27 cm long (Fig. 119).

Asimina ×piedmontana is clonal (Fig. 120) and forms colonies like *A. triloba*, but the hybrid is usually less than 3 meters tall (Fig. 121), with branches commonly arching. Horn (2015) discovered that young plants of *A. triloba* (>3 m tall) are easily confused with mature populations of *A. ×piedmontana*. The problem was resolved when he realized that vegetative and floral buds are morphologically different between the two taxa. The vegetative buds of *A. triloba* are more elongate (2–3 times longer than wide), and in plants less than 3 m tall, flower buds are absent because of their immaturity. Conversely, in *A.* ×*piedmontana* vegetative buds are smaller and not as elongate, and plants the same size as immature *A. triloba* possess rounded floral buds (Fig. 122a–b).

Figure 118. Flower comparison of three *Asimina*. A–B. *Asimina parviflora*. C–D. *Asimina* ×*piedmontana*. E–F. *Asimina triloba*. Photos: Charles Horn. Figure originally published in Castanea 80: 262–272 (Horn 2015).

Figure 119. *Asimina* ×*piedmontana* leaves, woods along floodplain of Johnson Creek, Union Co., South Carolina, 7 Jul 2009. Photo: Charles Horn.

Figure 120. Clonal patch of *Asimina* ×*piedmontana*, woods along Sulphur Spring Branch, Newberry Co., South Carolina, 4 Jul 2007. Photo: Charles Horn.

Figure 121. Charles Horn and *A. ×piedmontana*, Union Co., South Carolina, 25 Aug 2007. Photo: Hart Scott.

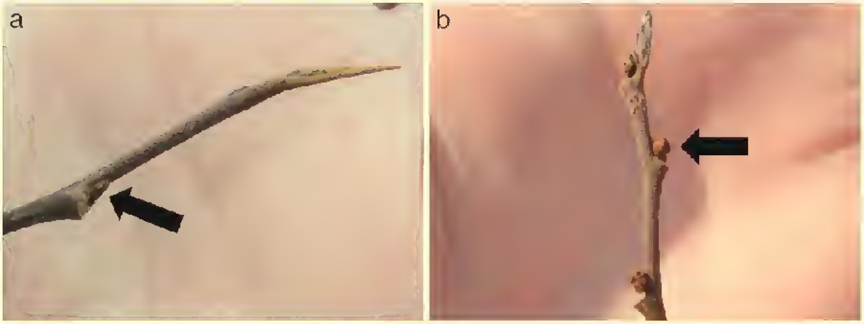


Figure 122. Buds of *Asimina triloba* and *Asimina ×piedmontana*. A. Immature *Asimina triloba* twig with terminal and lateral (arrow) vegetative buds (note that flower buds are lacking), Lynch's Woods, Newberry Co., South Carolina, Dec 2014. B. Mature *Asimina ×piedmontana* twig with terminal vegetative bud and flowering lateral buds (arrow) (note shorter terminal bud), Lynch's Woods, Newberry Co., South Carolina, Mar 2008. Photos: Charles Horn. Figure originally published in Castanea 80: 262–272 (Horn 2015).

3. Asimina triloba (L.) Dunal {three-lobed} — COMMON PAWPAW; INDIAN-BANANA; CUSTARD-APPLE (Fig. 123).

Figure 123. *Asimina triloba*, alluvial woods in the Bankhead National Forest, Lawrence Co., Alabama, 11 May 2005. Photo: Eric Soehren.

Clonal, deciduous small tree or large shrub (to 14m). Alluvial woods, bottomland forests; creek banks, low woods, mesic hardwood forests, swamp margins, and moist slopes along streams; flowers March–May; fruits late June–October; frequent throughout Alabama, though less common in the lower Coastal Plain (Fig. 124). *Asimina triloba* is native to the eastern USA and Canada from southern Ontario south to northern Florida, west to eastern Texas and Nebraska. It occurs further north and is the most widespread species of *Asimina* in North America (Wilbur 1970).

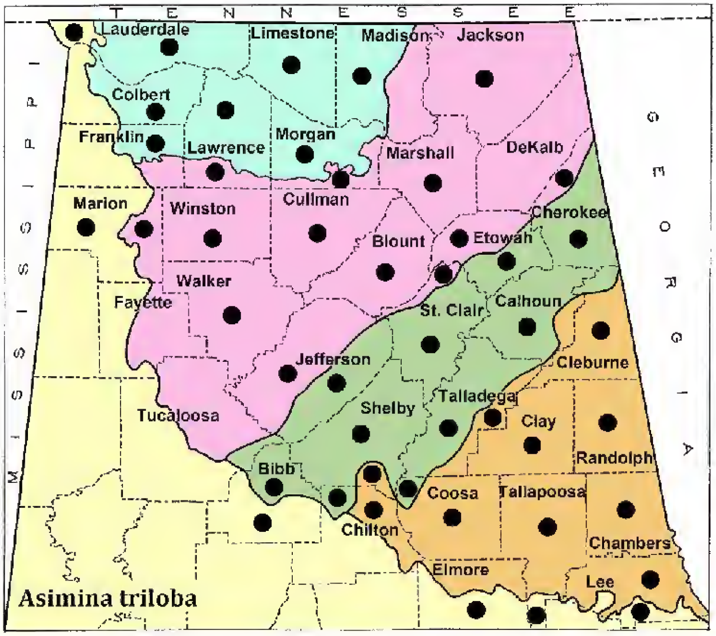


Figure 124. Distribution of *Asimina triloba* in northern Alabama.

Asimina triloba is often confused with *A. parviflora* based on herbarium specimens alone, but the two species are easy to distinguish in the field. Common Pawpaw becomes a single-trunked tree that forms colonies in floodplains (Fig. 125), though immature plants are usually present and often the same size as Dwarf Pawpaw (which occurs in dry habitats). The leaves of *A. triloba* are typically longer than *A. parviflora*, and its flowers (Fig. 126) and fruits (Fig. 127) are larger, with longer peduncles.

Figure 125. *Asimina triloba*, alluvial woods, Randolph Co., Alabama, 27 Aug 2017. Photos: Dan Spaulding.

Figure 126. *Asimina triloba* flowers, Madison Co., Alabama, 19 Apr 2014. Photos: Brian Finzel.

Figure 127. *Asimina triloba* fruit, along creek in Macon Co., Alabama, 31 Jul 2010. Photo: Eric Soehren.

The common name "pawpaw" is believed to be a corruption of Papaya, the name of the tropical fruit (Little 1980). *Asimina triloba* has the largest edible fruit native to North America (Hormaza 2014) and they are sometimes called wild or false bananas, but are technically large berries. They are eaten by wildlife such as opossums, squirrels, raccoons, bears, and turkeys (Elias 1980). The fruit is only palatable when they are fully mature. When unripe, the berries are greenish and hard, but by late fall, they become soft and turn nearly black with wrinkled skin. The flesh of ripe fruit is yellow or orange and has a custard-like consistency (Peattie 1948). Kral (1960) said they "have the taste and texture somewhat reminiscent of a sweetish avocado" and have "been eaten (even relished) by the Indians and settlers of eastern North America."

In 1806, some members of the Lewis and Clark expedition subsisted for days on the fruit of this species and early settlers utilized it when their crops failed (Hormaza 2014). Fruits of some selected cultivars of *A. triloba* can weigh more than three pounds and are occasionally sold at farmers' markets in the fall. (pers. comm. Ross Clark 2017).

Caution should be taken when eating the fruit of Pawpaw, because according to Kingsbury (1964), "a small fraction of the population is sensitive to this plant, reacting with contact dermatitis" and "certain individuals may exhibit severe gastrointestinal symptoms after ingestion of the fruit." The seeds of *Asimina* contain alkaloids and are therefore poisonous. In the past they were ground into powder and used to kill head lice (Martin 1992). Historically, pioneers in eastern North America made a yellow dye from the ripe pulp of the fruit (Elias1980). The tough bark of *A. triloba* was cut into strips by pioneers to string fish (Peattie 1948) and also used in Mississippi to make ropes and mats (Harper 1928).

FAMILY 9. CALYCANTHACEAE (Strawberry-Shrub Family)

1. CALYCANTHUS Linnaeus 1759

[Cup flower; alluding to the cup-like receptacle at the base of the flowers]

1. **Calycanthus floridus** L. {flowering} — EASTERN SWEETSHRUB; CAROLINA-ALLSPICE; SWEET BUBBY-BUSH; STRAWBERRY-SHRUB; SWEET-BUBBIES (Fig. 128). [*Butneria fertilis* (Walter) Kearney; *B. florida* (L.) Kearney; *Calycanthus brockianus* Ferry & Ferry; *C. fertilis* Walter; *C. floridus* var. *glaucus* (Willd.) Torrey & A. Gray; *C. floridus* var. *laevigatus* (Willd.) Torrey & A. Gray; *C. mohrii* Small; *C. nanus* Loisel.]

Figure 128. *Calycanthus floridus*, Cleburne Co., Alabama, 7 Apr 2011. Photo: T. Wayne Barger.

Clonal, deciduous shrub (1–3 meters tall). Rich woods, forested slopes, ravines, low woods, and streambanks; flowers late March–June; fruits June–September; uncommon in the Highland Rim and western Cumberland Plateau; frequent in the eastern Cumberland Plateau, Ridge & Valley, Piedmont, and Coastal Plain (Fig. 129). Native to the southeastern USA from Virginia west to southern Illinois, south to east Texas and northern Florida; there are no records from Arkansas, but the species has escaped from cultivation in other mid-eastern and northeastern states (Kartesz 2017).

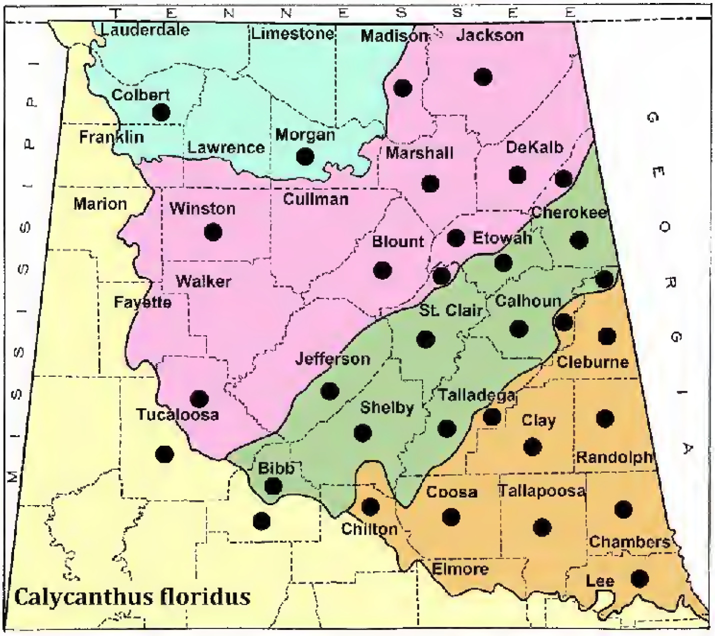


Figure 129. Distribution of *Calycanthus floridus* in northern Alabama.

Pollination of *Calycanthus floridus* is known to occur by at least two species of beetles (Nicely 1965). The flowers have numerous burgundy, strap-shaped tepals (petals and sepals that look alike) and often a fruity fragrance reminiscent of strawberries or pineapples; but sometimes they have a spicy odor or rarely none at all. Sweetshrub flowers have been wrapped in handkerchiefs to make fragrant sachets (Harper 1928). The name "Sweet-Bubbies" possibly comes from the fact that some ladies put flowers in their cleavage to "freshen up" (pers. comm. Ross Clark 2017).

The fruit of Sweetshrub is about the size of a fig, greenish-yellow when immature (Fig. 130a), turning brown to gray at maturity (Fig. 130b); superficially resembling the cocoon of a silk moth (Fig. 130c). The fibrous, bag-like fruit contains brown seeds that resemble baked beans or coffee beans (Sterns 1888). The seeds (achenes) are about 1 cm long and sparsely covered with silky hairs. They contain strychnine and poisoning of livestock has been reported from eating the fruit (Wood 1958). *Calycanthus floridus* is easily identified without flowers or fruits, because of its conspicuously enlarged nodes and widely spaced, opposite leaves with blades that extend beyond the twig tips. (Fig. 131). This clonal shrub often forms large patches from suckering. The bark of *C. floridus* has a strong lemony-pine or camphor smell when scratched and crushed leaves are slightly aromatic.

Sweetshrub is commonly used in gardens and landscaping, especially in the southeastern USA. Typically, the flowers are deep burgundy, however there are now a number of cultivars, including one with white flowers, which originated from a wild population in Tennessee (pers. comm. Ross Clark 2017). The English naturalist, Mark Catesby, discovered *Calycanthus floridus* during his explorations of South Carolina early in 18th Century (Reveal 2012a).

Figure 130. *Calycanthus floridus* fruits in Calhoun Co., Alabama. A. Ripe fruit, 10 Aug 2017. B. Dried fruit, 25 Sep 2017. Photos: Dan Spaulding. C. Silk moth cocoon (*Hyalophora cecropia*). Photo: Garrett Hargiss.

Figure 131. *Calycanthus floridus* leaves, Calhoun Co., Alabama, 25 Sep 2017. Photo: Dan Spaulding.

Some authors recognize two varieties of *Calycanthus floridus* that supposedly differ on amount of pubescence (Clark 1971; Johnson 1997). Plants with glabrous or slightly pubescent twigs and leaves have been called *C. floridus* var. *glaucus* (or var. *laevigatus*). Fernald (1950) treated the smooth variety as a distinct species, *C. fertilis*, and noted that its flowers were less fragrant than *C. floridus*, which he said "when crushed yielding a strong fragrance suggesting strawberries." Weakley (2017), however, concluded that there are no varieties of *C. floridus*. He stated: "Based on field experience and herbarium specimens from across the eastern North American distribution of *Calycanthus*, these two alleged entities have broadly overlapping distributions and no other morphological, ecological, or phenological characters that correlate with the variable pubescence character. There is no apparent basis to regard the variable pubescence character as anything other than trivial and taxonomically uninformative variation."

In North America, a single well-marked and less closely related species, *Calycanthus occidentalis* Hook. & Arn., occurs in the mountains of the Pacific Coast states (Wood 1958) and a third species, Chinese Sweetshrub, *C. chinensis* (W.C. Cheng & S.Y. Chang) W.C. Cheng & S.Y. Chang ex P.T. Li, is endemic to China (Li & Bartholomew 2008).

FAMILY 10. LAURACEAE (Laurel Family)

1. Leaves evergreen; lower surface of leaf blades and petioles with rusty-brown shaggy pubescence; flowers bisexual, blooming late April through June when leaves are present .... **2. *Persea***

1. Leaves deciduous; lower surface of blades and petioles glabrous or with whitish silky pubescence; flowers unisexual (plants dioecious), blooming March–April before the leaves appear.

    2. Small to medium tree usually with some lobed leaves; leaf blade typically with 3 major nerves (2 lateral ones arising above base of midrib); crushed leaves with a fruity-citrus fragrance; ripe fruit dark blue .... **3. *Sassafras***
    2. Medium to large shrub with simple, unlobed leaves; leaf blade with one dominant nerve (the midrib); crushed leaves with a strong spicy fragrance; ripe fruit bright red .... **1. *Lindera***

1. LINDERA Thunberg 1783
[Johann Linder, 1676–1723; Swedish botanist]

1. Lindera benzoin (L.) Blume {old generic name in Lauraceae} — NORTHERN SPICEBUSH; BENJAMIN-BUSH (Fig. 132). [*Benzoin aestivale* (L.) Nees var. *aestivale*; *B. aestivale* var. *pubescens* Palmer & Steyerm.; *B. benzoin* (L.) J.M. Coult.; *Lindera benzoin* var. *pubescens* (Palmer & Steyerm.) Rehder]

Medium to large deciduous shrub (to 5 m tall); rich (often calcareous) woods, alluvial forests, streambanks, low woods, bottomlands, and swamp margins; flowers March–April; fruits late May–October; frequent throughout Alabama (Fig. 133). Native to eastern North America ranging from southern Maine through Ontario to Michigan, southwest to southeastern Kansas, south to Texas and northern Florida (Kartesz 2017).

Lindera benzoin is easily identified by its aromatic leaves and twigs, which have a strong spicy odor. The small, light yellow flowers are among the earliest to appear in the spring, well before the leaves (Fig. 134). They occur in tight umbel-like clusters on the bare twigs and have a sweet, pungent fragrance (somewhat lemon-scented). The fragrant flowers attracts bees, flies, and beetles as pollinators (Stokes 1981). The oblong fruits (drupes) are bright green in mid-summer, but soon ripen to a rich, shiny red (except for a very rare orange-yellow fruited form in the northeastern USA).

Figure 132. *Lindera benzoin*, Jackson Co., Alabama, 1 Sep 2010. Photo: T. Wayne Barger.

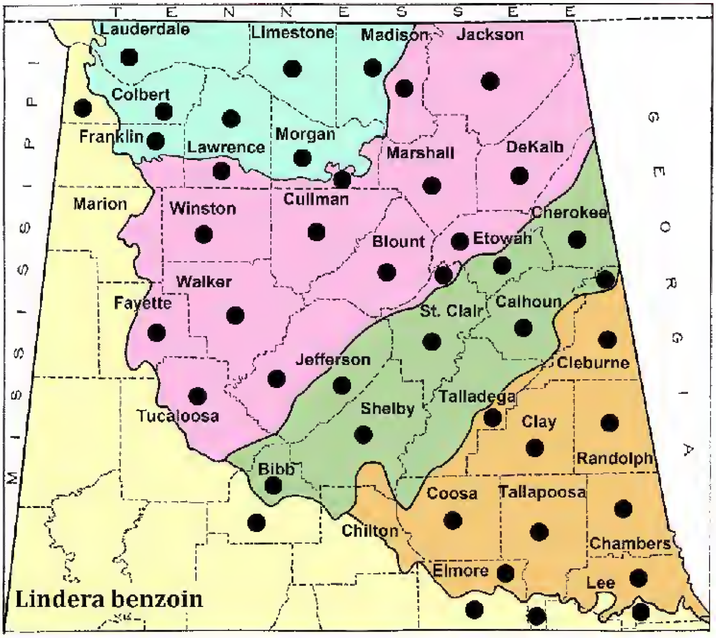


Figure 133. Distribution of *Lindera benzoin* in northern Alabama.

Figure 134. *Lindera benzoin* flowers, Madison Co., Alabama, 6 Mar 2007. Photo: Brian Finzel.

Early pioneers used dried and powdered fruits as a spice and American Indians harvested the berries to make a medicinal tea (Martin 1992). Roland Harper (1928) said he was told that an extraction from the twigs was used for a beverage by local folk in Alabama. *Lindera* and *Sassafras* are hosts for Spicebush Swallowtail (*Papilio troilus*); the caterpillars eat the leaves and often fold over portions of the blades for protection when not feeding (Ogard & Bright 2010).

Some authors (Fernald 1950; Gleason & Cronquist 1963) recognized *Lindera benzoin* var. *pubescens*, which differed by its hairy leaves and twigs, but Weakley (2015) stated that "the varieties so recognized overlap broadly in distribution; it seems best to regard this as mere variation within the species." Two other species of *Lindera* occur on the Coastal Plain of Alabama and are quite rare. Bog Spicebush, *L. subcoriacea* B.E. Wofford, has thick leaves that lack drip tips and have a lemony odor when crushed. Pondberry or Southern Spicebush, *Lindera melissifolia* (Walter) Blume, has thin leaves, like *L. benzoin*, but they are broadly lanceolate, mostly rounded at the base, and have a fruity smell when crushed.

2. PERSEA P. Miller 1754

[Ancient name used by Theophrastus and later adopted by Linnaeus]

1. Persea palustris (Raf.) Sarg. {of marshes} — SWAMP BAY; SWAMP RED BAY (Fig. 135). [*Laurus carolinensis* Catesby ex Michx. var. *pubescens* Pursh; *Persea borbonia* (L.) Spreng. forma *pubescens* (Pursh) Fernald; *P. borbonia* (L.) Spreng. var. *pubescens* (Pursh) Little; *P. carolinensis* (Catesby ex Michx.) Nees forma *pubescens* Mez; *P. pubescens* (Pursh) Sarg.; *Tamala palustris* Raf.; *T. pubescens* (Pursh) Small]

Large evergreen shrub or small tree (to 15m tall). Swamps, marshes, seeps, creek margins, wet woods, bottomland forests, and drier wetland margins; flowers April–June; fruits late July–October; rare in the southern Ridge & Valley and Piedmont; common in the Coastal Plain (Fig. 136). Chiefly occurring in the Coastal Plain from Delaware to east Texas (Kartesz 2017).

Figure 135. *Persea palustris*, blackwater swamp in Baldwin Co., Alabama, 3 Oct 2009. Photo: Fred Nation.

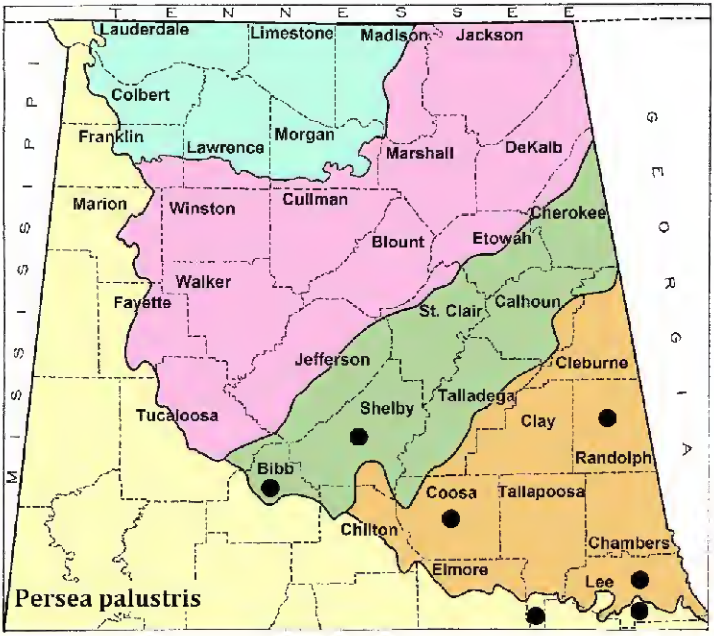


Figure 136. Distribution of *Persea palustris* in northern Alabama.

Ogard and Bright (2010) wrote that the leaves of Swamp Bay "are almost always deformed and disfigured by Redbay Psyllid [*Trioza magnoliae*] larvae, tiny nymphs whose saliva causes leaf margins to swell and curl into popcorn-like galls (Fig. 137)." The authors conclude that this provides additional camouflage for the bumpy caterpillars of the Palamedes Swallowtail (*Papilio palmedes*), also known as swamp butterflies, which feed on the leaves (Fig. 138). The aromatic leaves of this species have been dried and used to flavor soups (Harper 1928). *Persea palustris* is sometimes mistaken for a young *Magnolia virginiana* tree in the field, but *Persea* leaves have a spicy rather than sweet smell when crushed.

Some floristic treatments (Radford et al. 1968; Clark 1971) did not recognize *Persea palustris* as distinct from *P. borbonia.* Fernald (1945) stated: "I have abandoned the futile attempt to see two species or two varieties in the glabrous-leaved material and that with leaves densely pubescent beneath, and I cannot look upon them as anything but glabrous and pubescent forms of one species." Wood (1958) agreed with Fernald and treated it as a form. Little (1979) wrote: "Swampbay was first described as a variety in 1814 [*Laurus carolinensis* var. *pubescens*], as a species in 1838 [*Tamala palustris*] and as a form in 1889 [*Persea carolinensis* forma *pubescens*]."

Kopp (1966), in his taxonomic revision of *Persea*, recognized *P. palustris* (Fig. 139a–b) as separate from *P. borbonia* (Fig. 140a–b) and noted that the erect and crisped pubescence on vegetative parts of *P. palustris*, along with the longer length of the peduncles (4–7 cm long) are the main differences that separate the two species. Weakley (2015) stated: "Though variable in amount of hairs on the leaves, the hairs of *P. palustris* [rusty and spreading] are always of a distinctly different character than those of *P. borbonia* [tan or golden and appressed]." Weakley also noted that the leaf blades of *P. palustris* tend to be longer and more acute than *P. borbonia* (Red Bay), which is usually a larger tree found on the lower Coastal Plain of Alabama (and the Southeast) in drier maritime habitats, such as sandy hammocks and coastal scrub-dunes. *Persea palustris* is a smaller tree or shrub found in wetter sites (Fig. 141).

Figure 137. *Persea palustris* galls, Moore Co., North Carolina, 10 Jun 2006. Photo: Jeffery Pippen.

Figure 138. Palamedes Swallowtail caterpillar on *Persea palustris,* margin of swampy woods, Fall Line Hills district of the Coastal Plain, Lee Co., Alabama, 27 Aug 2017. Photo: Dan Spaulding.

(139a) *Persea palustris* inflorescence on long peduncles. Photo: Jeffery Pippen.

(139b) *Persea palustris* drupes on long peduncle. Photo: Will Cook.

Figure 139. *Persea palustris*. A. Flowers, Moore Co., North Carolina, 10 Jun 2006. B. Fruits, Columbus Co., North Carolina, 21 Mar 2007.

(140a) *Persea borbonia* inflorescence on short peduncles. Photo: Alan Cressler.

(140b) *Persea borbonia* drupes on short peduncles. Photo: Alan Cressler.

Figure 140. *Persea borbonia* on Jekyll Island in the Atlantic Coastal Plain, Glynn Co., Georgia. A. Flowers, 25 Apr 2012. B. Fruit, 25 Oct 2009.

Figure 141. Trunk of *Persea palustris*, margin of swamp margin in the Fall Line Hills district of the Coastal Plain, Lee Co., Alabama, 27 Aug 2017. Photo: Dan Spaulding.

3. **SASSAFRAS** J. Presl 1825
[Native American name]

1. Sassafras albidum (Nutt.) Nees {whitish} — SASSAFRAS; AGUE-TREE; CINNAMONWOOD (Fig. 142). [*Sassafras albidum* (Nutt.) Nees var. *molle* (Raf.) Fernald; *S. officinale* T. Nees & C.H. Eberm. var. *albidum* (Nutt.) S.F. Blake; *S. officinale* var. *officinale*; *S. sassafras* (L.) H. Karst.; *S. variifolium* Kuntze]

Figure 142. *Sassafras albidum*, Cleburne Co., Alabama, 17 Jun 2017. Photo: Melanie Taylor Spaulding.

Small to medium-sized deciduous tree (to 25 m). Mixed upland woodlands and borders, fence rows, old fields, and roadsides; flowers March–April; fruits June–August; common throughout Alabama (Fig. 143). Native to the Eastern Deciduous Forest ecosystem of North America, from Maine through southern Ontario west to Iowa, and south to central Florida and eastern Texas (Kartesz 2017).

Sassafras is a common understory tree of forests in Alabama, but is also found in open disturbed sites. It often occurs in clumps because the parent tree frequently spreads by underground runners (Elias 1980). Because of its stoloniferous habit, it is quite resistant to fire (pers. comm., Ross Clark 2017). *Sassafras* is dioecious, which means that staminate (male) and pistillate (female) flowers are borne on different trees. The small unisexual, yellowish flowers (Fig. 144a–b) appear before the unfolding of the leaves in early spring and are showier on "male" trees. The fruit ripens in late summer and is a dark blue-black drupe borne on a red fleshy, club-shaped pedicel (Fig. 145).

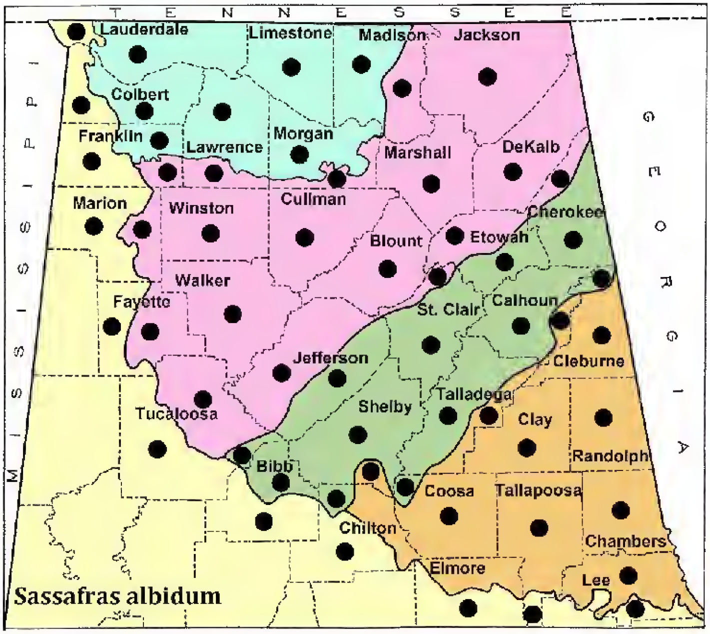


Figure 143. Distribution of *Sassafras albidum* in northern Alabama.


(144a) Male flowers. Photo: T. Wayne Barger. (144b) Female flowers. Photo: Brian Finzel.

Figure 144. *Sassafras albidum*. A. Staminate (male) flowers, Colbert Co., Alabama, 23 Mar 2016. B. Pistillate (female) flowers, Madison Co. Alabama, 7 Apr 2015.

Figure 145. Fruit of *Sassafras albidum*, Madison Co. Alabama, 31 Jul 2014. Photos: Brian Finzel.

The leaves of *Sassafras* have a citrus-like scent and usually come in three shapes: three-lobed ("turkey-foot"), one-lobed ("mitten"), and a simple, unlobed leaf (Fig. 146). Trees with only simple leaves are very rare. In autumn the leaves turn various shades of orange, yellow, red, and even pink. The wood is soft and weak, but occasionally was used for fence posts and rails (Sargent 1922). Sassafras is sometimes planted as an ornamental tree.

Figure 146. *Sassafras* leaf shapes, Cleburne Co., Alabama, 17 Jun 2017. Photo: Melanie Taylor Spaulding.

The name "sassafras" is an American Indian name that was adopted by Spanish and French settlers in the mid-16th century (Little 1980). It was first brought to England by Sir Francis Drake in the 1580s and soon was claimed to be a panacea because of its reputed medicinal properties (Rupp 1990). It was once thought to be a cure for malaria, hence the name Ague-Tree (Peattie 1948). The word "ague" refers to an illness involving fever and shivering, like malaria.

The leaves of *Sassafras albidum* are the crucial ingredient of gumbo filé powder, which is used in Creole cooking to flavor and thicken gumbo (Wood 1958). This powder was first prepared by the Choctaw Indians of Louisiana (Sargent 1922). The root-beer scented oil from the roots was extracted as a flavoring for tea and is the original source for root-beer (Radford et al. 1968). The aromatic oil was also used to perfume soap (Little 1980).

Harper (1928) said that saplings in Alabama "are often cut for pea-vine supports, brooms, hoops, etc., and the roots are dug for sassafras tea, a popular semi-medicinal beverage or spring tonic in rural districts." Native Americans utilized the twigs as chewing sticks and dentists in the past combined the oil in dental poultices to relieve pain (van der Werff 1997). The use of *Sassafras* has now been banned by the U.S. Food and Drug Administration because the chemical compound safrole is considered to be a carcinogen (Dwyer et al. 1986). Studies in the 1960s have shown that oil of sassafras causes liver cancer in rats (Martin 1992).

Fernald (1950) recognized two varieties of American sassafras: *Sassafras albidum* var. *albidum* (White Sassafras), with leaves glabrous and glaucous underneath, and *S. albidum* var. *molle* (Red Sassafras), with leaves densely pubescent beneath. However, recent floristic treatments do not recognize any varieties (Weakley 2015). The genus *Sassafras* existed as far back as the Lower Cretaceous when the dinosaurs roamed the earth (Berry 1911). Today this genus consists of only three extant species: *S. albidum*, endemic to eastern North America; *S. randaiense* (Hayata) Rehder, endemic to Taiwan; and *S. tzumu* (Hemsl.) Hemsl., endemic to mainland China (Li et al. 2008).

ACKNOWLEDGEMENTS

We are indebted to the following people for their excellent photographs that greatly improved this paper: Scott Beuerlein, Charles Bryson, Will Cook, Alan Cressler, Brian Finzel, Floyd Griffith, John Gwaltney <www.southeasternflora.com>, Garrett Hargiss, Charles Horn, Hayes Jackson, Fred Nation, Mike Parker, Jeffery Pippen <www.jeffpippen.com>, Hart Scott, Shannon Sharp, Eric Soehren, Melanie Taylor Spaulding, Savannah Spaulding, Bill Summerour, and Chris Taylor. Brian Finzel deserves special recognition for providing the most photos in this paper; we are truly thankful for his superb photographs. We extend our gratitude to Ross Clark, Larry Davenport, Dwayne Estes, Charles Horn, and John Kartesz for adding their insightful additions to this work. The notes from Ross Clark's Ph.D. dissertation, *The Woody Plants of Alabama*, which he gave to the senior author, was very helpful in adding distributions of various taxa in northern Alabama. We appreciate the field work for this project by Kevin England, Melanie Taylor Spaulding, Savannah Spaulding, and Chris Taylor. We thank Curtis Hansen (AUA) for his assistance in finding or eliminating records reported in the study area and Cynthia S. Moyer for her tireless work at the Anniston Museum of Natural History herbarium (AMAL). We are grateful to all the curators and collection managers who allowed us to examine their specimens: Curtis Hansen (AUA), Francine Hutchinson (JSU), Tiana Rehman (BRIT), and Jimmy Triplett (JSU). We appreciate the reviews of this treatment of the primitive Angiosperms of northern Alabama by Charles Bryson, Ross Clark, Larry Davenport, Dwayne Estes, Brian Finzel, Curtis Hansen, John Kartesz, Charles Horn, Guy Nesom, Eric Soehren, Bruce Sorrie, Bill Summerour, and Jimmy Triplett. This treatment is dedicated to all the students, professors, and many other botanists, past and present, whose floristic studies in Alabama made this work possible.

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Phytoneuron 2018-12: 1–12. Published 26 February 2018. ISSN 2153 733X

ANDRÉ MICHAUX'S AMERICAN PLANT COLLECTIONS, 1785-1796

AMY HACKNEY BLACKWELL
Coordinator, South Carolina Plant Conservation Alliance
South Carolina Botanical Garden
Clemson, South Caroline 29634
amyblackwell@mac.com

PATRICK D. MCMILLAN
Director, South Carolina Botanical Garden
Clemson University, South Carolina 29634
pmcmill@clemson.edu

CHRISTOPHER W. BLACKWELL
Department of Classics
Furman University
Greenville, South Carolina 29613
cwblackwell@gmail.com

ABSTRACT

This article points readers to an online collection of digital images of the Michaux herbarium in Paris and corresponding information, posted to the Botanica Caroliniana website. Included is a table of contents of Michaux's herbarium by volume and family.

André Michaux's collection in the herbarium of the Jardin des Plantes, part of the Muséum National d'Histoire Naturelle in Paris, is a wide-reaching, annotated body of evidence for the botany of eastern North America, and especially the Southeast, for the years between 1785 and 1800. In 2014, we took digital photographs of Michaux's specimens, and through the cooperation of the Jardin des Plantes, we are able to publish these images and accompanying data under an open content license. The data include two kinds: digital images of specimens and data recording specimens.

An online view of the data is at Blackwell et al. (2017; Images of André Michaux's Specimens, Jardin des Plantes), with a canonical version of the data in TSV format available under version control.

Here we provide a table of the contents of Michaux's herbarium by volume and family. Mixhaux's herbarium is organized by the Linnaean taxonomy used in Michaux's Flora Boreali-Americana. This is a cursory overview of the nearly 4000-specimen collection, but it should help guide the reader through the online collection. We point readers to the online images and full catalog. All of the identifications and other metadata are accessible there, with the caveat that this online catalog is mostly unedited and is a work in progress.

This table includes references to Linnaean taxonomy and page references to the Flora Boreali-Americana. The Flora is in two volumes; volume 2 begins with Didynamia Gymnospermia (Lamiaceae sensu lato).

Volume	Family	Linnaean Class	Linnaean Order	Flora Boreali-Americana
1	Plantaginaceae	Monandria	Monogynia	1
	Amaranthaceae	Monandria	Monogynia	1
	Cannaceae	Monandria	Digynia	2
	Callitrichaceae	Monandria	Digynia	2
	Oleaceae	Diandria	Monogynia	3
	Plantaginaceae	Diandria	Monogynia	4
	Acanthaceae	Diandria	Monogynia	7
	Plantaginaceae	Diandria	Monogynia	10
	Lentibulariaceae	Diandria	Monogynia	11
	Lamiaceae	Diandria	Monogynia	13
	Onagraceae	Diandria	Monogynia	17
1B	Valerianaceae	Triandria	Monogynia	18
	Burmanniaceae	Triandria	Monogynia	19
	Hydrocharitaceae	Triandria	Monogynia	20
	Haemodoraceae	Triandria	Monogynia	20
	Iridaceae	Triandria	Monogynia	22
	Xyridaceae	Triandria	Monogynia	23
	Iridaceae	Triandria	Monogynia	23
	Commelinaceae	Triandria	Monogynia	23
	Mayacaceae	Triandria	Monogynia	26
	Caryophyllaceae	Triandria	Monogynia	26
	Cyperaceae	Triandria	Monogynia	27
2	Poaceae	Triandria	Digynia	43
2B	Cyperaceae	Triandria	Monogynia	34
	Poaceae	Triandria	Digynia	38
3	Poaceae	Triandria	Digynia	67
3B	Haloragaceae	Triandria	Trigynia	76
	Cistaceae	Triandria	Trigynia	76
	Molluginaceae	Triandria	Trigynia	77
	Rubiaceae	Tetrandria	Monogynia	78
	Tetrachondraceae	Tetrandria	Monogynia	82
	Rubiaceae	Tetrandria	Monogynia	83
	Linnaeaceae	Tetrandria	Monogynia	87

	Onagraceae	Tetrandria	Monogynia	87
4	Cornaceae	Tetrandria	Monogynia	91
	Callicarpaceae	Tetrandria	Monogynia	
	Plantaginaceae	Tetrandria	Monogynia	94
	Solanaceae	Tetrandria	Monogynia	95
	Gentianaceae	Tetrandria	Monogynia	96
	Lythraceae	Tetrandria	Monogynia	99
	Rutaceae	Tetrandria	Monogynia	99
	Nyctaginaceae	Tetrandria	Monogynia	100
	Rosaceae	Tetrandria	Digynia	100
	Hamamelidaceae	Tetrandria	Digynia	100
	Potamogetonaceae	Tetrandria	Tetragynia	101
	Ruppiaceae	Tetrandria	Tetragynia	102
4B	Rubiaceae	Pentandria	Monogynia	103
	Caprifoliaceae	Pentandria	Monogynia	105
	Diervillaceae	Pentandria	Monogynia	106
	Caprifoliaceae	Pentandria	Monogynia	106
	Campanulaceae	Pentandria	Monogynia	108
	Primulaceae	Pentandria	Monogynia	109
	Grossulariaceae	Pentandria	Monogynia	109
	Caryophyllaceae	Pentandria	Monogynia	112
	Apocynaceae	Pentandria	Monogynia	114
5	Sapotaceae	Pentandria	Monogynia	122
	Primulaceae	Pentandria	Monogynia	123
	Menyanthaceae	Pentandria	Monogynia	124
	Primulaceae	Pentandria	Monogynia	126
	Boraginaceae	Pentandria	Monogynia	128
	Hydrophyllaceae	Pentandria	Monogynia	133
	Convolvulaceae	Pentandria	Monogynia	135
5B	Polemoniaceae	Pentandria	Monogynia	142
	Gentianaceae	Pentandria	Monogynia	146
	Loganiaceae	Pentandria	Monogynia	146
	Plumbaginaceae	Pentandria	Monogynia	
	Scrophulariaceae	Pentandria	Monogynia	148
	Solanaceae	Pentandria	Monogynia	149

	Ericaceae	Pentandria	Monogynia	150
	Diapensiaceae	Pentandria	Monogynia	152
	Rhamnaceae	Pentandria	Monogynia	153
6	Rhamnaceae	Pentandria	Monogynia	154
	Celastraceae	Pentandria	Monogynia	155
	Cyrillaceae	Pentandria	Monogynia	157
	Iteaceae	Pentandria	Monogynia	156
	Vitaceae	Pentandria	Monogynia	159
	Montiaceae	Pentandria	Monogynia	160
	Araliaceae	Pentandria	Digynia	161
	Apiaceae	Pentandria	Digynia	162
	Saxifragaceae	Pentandria	Digynia	171
	Ulmaceae	Pentandria	Digynia	172
	Amaranthaceae	Pentandria	Digynia	173
	Convolvulaceae	Pentandria	Digynia	175
	Gentianaceae	Pentandria	Digynia	175
	Hydroleaceae	Pentandria	Digynia	177
6B	Adoxaceae	Pentandria	Trigynia	178
	Anacardiaceae	Pentandria	Trigynia	182
	Staphyleaceae	Pentandria	Trigynia	184
	Parnassiaceae	Pentandria	Tetragynia	184
	Araliaceae	Pentandria	Pentagynia	185
	Droseraceae	Pentandria	Pentagynia	186
7	Agavaceae	Hexandria	Monogynia	187
	Amaryllidaceae	Hexandria	Monogynia	188
	Hypoxidaceae	Hexandria	Monogynia	
	Nartheciaceae	Hexandria	Monogynia	189
	Juncaceae	Hexandria	Monogynia	190
	Commelinaceae	Hexandria	Monogynia	193
	Pontederiaceae	Hexandria	Monogynia	
	Acoraceae	Hexandria	Monogynia	194
	Araceae	Hexandria	Monogynia	
	Alliaceae	Hexandria	Monogynia	
	Bromeliaceae	Hexandria	Monogynia	195
	Agavaceae	Hexandria	Monogynia	196

	Liliaceae	Hexandria	Monogynia	197
	Colchicaceeae	Hexandria	Monogynia	198
	Liliaceae	Hexandria	Monogynia	200
	Ruscaceae	Hexandria	Monogynia	201
	Liliaceae	Hexandria	Monogynia	
	Ruscaceae	Hexandria	Monogynia	
	Berberidaceae	Hexandria	Monogynia	203
	Cabombaceae	Hexandria	Digynia	206
7B	Arecaceae	Hexandria	Trigynia	206
	Juncaginaceae	Hexandria	Trigynia	208
	Tofieldiaceae	Hexandria	Trigynia	
	Melanthiaceae	Hexandria	Trigynia	211
	Liliaceae	Hexandria	Trigynia	214
	Trilliaceae	Hexandria	Trigynia	215
	Polygonaceae	Hexandria	Trigynia	216
	Saururaceae	Hexandria	Tetragynia	218
	Alismataceae	Hexandria	Polygynia	218
	Sapindaceae	Heptandria	Monogynia	219
	Primulaceae	Heptandria	Monogynia	220
	Melastomataceae	Octandria	Monogynia	221
	Onagraceae	Octandria	Monogynia	223
8	Onagraceae	Octandria	Monogynia	224
	Thymeleaceae	Octandria	Monogynia	236
	Berberidaceae	Octandria	Monogynia	236
	Polygonaceae	Octandria	Trigynia	237
	Lauraceae	Enneandria	Monogynia	243
8B	Polygonaceae	Enneandria	Monogynia	246
	Tofieldiaceae	Enneandria	Trigynia	247
	Ericaceae	Decandria	Monogynia	249
9	Diapensiaceae	Decandria	Monogynia	250
	Ericaceae	Decandria	Monogynia	252
9B	Ericaceae	Decandria	Monogynia	258
	Clethraceae	Decandria	Monogynia	260
	Fabaceae	Decandria	Monogynia	261
	Ericaceae	Decandria	Monogynia	266

	Onagraceae	Decandria	Monogynia	267
	Hydrangeaceae	Decandria	Digynia	268
	Saxifragaceae	Decandria	Digynia	268
10		Decandria	Digynia	
	Polygonaceae	Decandria	Trigynia	271
	Caryophyllaceae	Decandria	Trigynia	271
	Caryophyllaceae	Decandria	Tetragynia	275
	Caryophyllaceae	Decandria	Pentagynia	276
	Crassulaceae	Decandria	Pentagynia	
	Penthoraceae	Decandria	Pentagynia	278
	Phytolaccaceae	Decandria	Decagynia	278
	Aristolochiaceae	Dodecandria	Monogynia	279
		Dodecandria	Monogynia	
	Lythraceae	Dodecandria	Monogynia	280
	Cactaceae	Icosandria	Monogynia	282
	Hydrangeaceae	Icosandria	Monogynia	282
	Rosaceae	Icosandria	Monogynia	284
	Rosaceae	Icosandria	Digynia	287
10B	Rosaceae	Icosandria	Trigynia	290
	Rosaceae	Icosandria	Pentagynia	291
	Rosaceae	Icosandria	Polygynia	295
11	Rosaceae	Icosandria	Polygynia	302
	Calycanthaceae	Icosandria	Polygynia	305
	Malvaceae	Polyandria	Monogynia	306
	Cistaceae	Polyandria	Monogynia	307
	Ranunculaceae	Polyandria	Monogynia	308
	Papaveraceae	Polyandria	Monogynia	309
	Berberidaceae	Polyandria	Monogynia	309
	Sarraceniaceae	Polyandria	Monogynia	310
	Nymphaeaceae	Polyandria	Monogynia	311
	Nelumbonaceae	Polyandria	Monogynia	
	Hamamelidaceae	Polyandria	Digynia	312
	Ranunculaceae	Polyandria	Trigynia	314
11B	Nelumbonaceae	Polyandria	Polygynia	317
	Ranunculaceae	Polyandria	Polygynia	317

	Schisandraceae	Polyandria	Polygynia	326
	Magnoliaceae	Polyandria	Polygynia	326
	Annonaceae	Polyandria	Polygynia	329
	Lamiaceae	Didynamia	Gymnospermia	1
12	Lamiaceae	Didynamia	Gymnospermia	7
	Phrymaceae	Didynamia	Angiospermia	13
	Plantaginaceae	Didynamia	Angiospermia	13
	Euphorbiaceeae	Didynamia	Angiospermia	
	Orobanchaceae	Didynamia	Angiospermia	16
	Plantaginaceae?	Didynamia	Angiospermia	17
	Orobanchaceae	Didynamia	Angiospermia	17
12B	Plantaginaceae	Didynamia	Angiospermia	
	Scrophulariaceae	Didynamia	Angiospermia	21
	Plantaginaceae	Didynamia	Angiospermia	22
	Acanthaceae	Didynamia	Angiospermia	23
	Plantaginaceae	Didynamia	Angiospermia	24
	Bignoniaceae	Didynamia	Angiospermia	25
	Orobanchaceae	Didynamia	Angiospermia	26
	Brassicaceae	Tetradynamia	Siliculosa	27
	Iridaceae	Monadelphia	Triandria	
	Diapensiaceae	Monadelphia	Pentandria	34
	Linaceae	Monadelphia	Pentandria	36
	Passifloraceae	Monadelphia	Pentandria	37
13	Malvaceae	Monadelphia	Polyandria	44
	Fabaceae	Diadelphia	Pentandria	48
	Fumariaceae	Diadelphia	Hexandria	51
	Polygalaceae	Diadelphia	Octandria	52
	Theaceae	Diadelphia	Octandria	
	Geraniaceae	Monadelphia	Decandria	38
	Oxalidaceae	Monadelphia	Decandria	38
	Styracaceae	Monadelphia	Polyandria	40
	Symplocarpaceae	Monadelphia	Polyandria	43
	Theaceae	Monadelphia	Polyandria	43
13B	Fabaceae	Diadelphia	Decandria	55
	Asteraceae			

14	Asteraceae	Syngenesia	Polygamia Aequalis	83
14B	Fabaceae	Diadelphia	Decandria	70
	Hypericaceae	Polyadelphia	Polyandria	77
15	Asteraceae	Syngenesia	Polygamia Aequalis	101
	Asteraceae	Syngenesia	Polygamia Superflua	108
15B	Asteraceae	Syngenesia	Polygamia Superflua	125
16	Asteraceae	Syngenesia	Polygamia Frustranea	138
16B	Balsaminaceae	Syngenesia	Monogamia	149
	Violaceae	Syngenesia	Monogamia	149
	Campanulaceae	Syngenesia	Monogamia	151
	Orchidaceae	Gynandria	Monandria	155
	Aristolochiaceae	Gynandria	Hexandria	161
	Araceae	Gynandria	Monadelphia	162
	Platanaceae	Monoecia	Monandria	163
	Araceae	Monoecia	Diandria	163
	Podostemaceae	Monoecia	Diandria	164
	Eriocaulaceae	Monoecia	Triandria	165
	Cyperaceae	Monoecia	Triandria	167
17	Fagaceae	Monoecia	Polyandria	192
17B	Cyperaceae	Monoecia	Triandria	169
	Euphorbiaceae	Monoecia	Triandria	175
	Buxaceae	Monoecia	Tetrandria	177
	Urticaceae	Monoecia	Tetrandria	178
	Moraceae	Monoecia	Tetrandria	179
	Betulaceae	Monoecia	Tetrandria	180
	Asteraceae	Monoecia	Pentandria	182
	Euphorbiaceae	Monoecia	Pentandria	185
	Araceae	Monoecia	Polyandria	186
	Typhaceae	Monoecia	Polyandria	189
	Alismataceae	Monoecia	Polyandria	189
	Haloragaceae	Monoecia	Polyandria	190
	Juglandaceae	Monoecia	Polyandria	191

18	Betulaceae	Monoecia	Polyandria	201
	Altinginiaceae	Monoecia	Polyandria	202
	Pinaceae	Monoecia	Monadelphia	203
	Cupressaceae	Monoecia	Monadelphia	208
	Euphorbiaceae	Monoecia	Monadelphia	209
18B	Cucurbitaceae	Monoecia	Syngenesia	217
	Schisandraceae	Monoecia	Syngenesia	218
	Amaranthaceae	Monoecia	Syngenesia	
	Hydrocharitaceae	Dioecia	Monandria	220
	Ericaceae	Dioecia	Diandria	221
	Oleaceae	Dioecia	Diandria	222
	Salicaceae	Dioecia	Diandria	225
	Elaeagnaceae	Dioecia	Tetrandria	227
	Myricaceae	Dioecia	Tetrandria	227
	Aquifoliaceae	Dioecia	Tetrandria	228
	Cannabaceae	Dioecia	Pentandria	230
	Vitaceae	Dioecia	Pentandria	230
19	Santalaceae	Dioecia	Pentandria	231
	Rutaceae	Dioecia	Pentandria	235
	Aquifoliaceae	Dioecia	Pentandria	236
	Smilacaceae	Dioecia	Hexandria	237
	Dioscoreaceae	Dioecia	Hexandria	239
	Polygonaceae	Dioecia	Octandria	240
	Fabaceae	Dioecia	Decandria	241
	Menispermaceae	Dioecia	Polyandria	241
	Zamiaceaee	Dioecia	Polyandria	242
	Salicaceae	Dioecia	Polyandria	243
	Amaranthaceae	Dioecia	Monadelphia	244
	Taxaceae	Dioecia	Monadelphia	245
	Cupressaceae	Dioecia	Monadelphia	245
	Ulmaceae	Polygamia	Monoecia	247
	Melanthiaceae	Polygamia	Monoecia	249
	Urticaceae	Polygamia	Monoecia	
	Sapindaceae	Polygamia	Monoecia	252
	Fabaceae	Polygamia	Monoecia	254

19B	Ericaceae	Polygamia	Dioecia	255
	Oleaceae	Polygamia	Dioecia	255
	Araliaceae	Polygamia	Dioecia	256
	Fabaceae	Polygamia	Dioecia	257
	Ebenaceae	Polygamia	Dioecia	258
	Nyssaceae	Polygamia	Dioecia	258
	Pteridaceae	Cryptogamia	Filices	261
	Blechnaceae	Cryptogamia	Filices	264
	Osmundaceae?	Cryptogamia	Filices	
	Aspleniaceae	Cryptogamia	Filices	264
	Polypodiaceae	Cryptogamia	Filices	
20	Osmundaceae	Cryptogamia	Filices	272
	Lygodiaceae	Cryptogamia	Filices	275
	Equisetaceae	Cryptogamia	Equisetaceae	281
	Psilotaceae	Cryptogamia	Lycopodiaceae	282
	Lycopodiaceae	Cryptogamia	Lycopodiaceae	
	Selaginellaceae?	Cryptogamia	Lycopodiaceae	
		Cryptogamia	Hepaticae	276
20B		Cryptogamia	Musci	285
	Lichen			
21	Poaceae	Triandria	Digynia	52

Methodology

The 20 volumes of Michaux's herbarium are organized according to the classification scheme Michaux used for his Flora Boreali-Americana. The top level of the organization is Linnaean class. Within each class are subdivisions by orders, which are marked by bits of paper stuck in between folders. The genera are contained in individual manila folders, which can contain numerous specimens. Each volume of the collection is divided into two parts. In our cataloging, we designated volumes as 1 followed by 1B, 2 followed 2B, etc.

The Michaux collection was not included in the herbarium's online catalog. Because the collection is organized by Linnaean taxonomy, it was difficult or impossible to search for specific specimens, especially since we did not have internet access and so could not easily cross check the historical names of modern taxa. The best catalog was the Flora Boreali Americana, because the entire collection is organized according to that scheme. In any case, we were not looking for specific specimens.

We established a workflow using our available equipment: a Fujifilm XE-2 camera with a Fuji XF 14mm f/2.8 lens (shooting handheld), two Apple Macbook Pro laptops, and a countertop next to a window that served as our light source. We photographed the entire collection in three full days: 2845 specimens, plus assorted detail shots and shots of folder covers.

The specimens are organized according to the Linnaean taxonomy described in Michaux's *Flora Boreali Americana*. We recorded Michaux's names for all of them, as well as transcribing various notes and noting which specimens had been identified as type material by other scholars examining the collection. Many specimens contained locality notes, which are transcribed in their own field; mostly this information refers to where the plants grow, not where individual specimens were collected.

McMillan and Hackney Blackwell examined all the specimens in Volume 1, and McMillan has identified all of them. Any other identifications listed with the specimens come from McMillan's examination of the actual specimens in Paris, done during the photography.

Raw Image Data

We photographed the specimens with a Fujifilm XE-2 camera with a Fuji XF 14mm f/2.8 lens, handheld, under natural light from the windows at the Herbarium. The resulting camera-RAW images were processd in Apple Aperture for color balance, sharpening. The reference versions are online as Pyramidal TIFF images in a world-readable directory on a server at the University of Houston. We are grateful to the Center for High Performance Computing at the Univesity of Houston, Keith Crabb, Director, for providing this space on their servers. All images in the *Botanica Caroliniana* library are licensed under a Creative Commons, 3.0 BY-NC license. The TIFF images can be found at, and downloaded from

http://amphoreus.hpcc.uh.edu/botcar/reference_images_2017a/

Integrated Images and Data

The master dataset is under version-control on GitHub at

https://github.com/botcar/botcar-data/blob/master/Michaux2017/michaux_specimens_master.tsv

These data are in plain text in tab-separated-values format. The first record in each row is a unique identifier for a specimen; this is expressed as a Universal Resource Name (URN), an internet standard, following the Cite2 URN format specified by the Cite Architecture (http://cite-architecture.github.io).

The second record is another Cite2 URN identifying an image of the specimen.

For more convenient viewing and browsing, there is an online presentation of that data at

http://folio.furman.edu/projects/botanicacaroliniana/michaux/index.html

On this page, users can sort the table by columns, or filter it by typing in the text-fields at the top of each column. The image URNs are liked to an online viewer that provides a zooming interface to the full-resolution image, and offers a “download image” link.

ACKNOWLEDGEMENTS

This work has been funded by a grant from the Andrew Mellon Foundation for teaching historical botany as an exploration of the liberal arts, a union of history, botany, and computer science. Funding paid for a summer undergraduate research experience focused on the botanical collections of Joseph Lord (Dorchester, SC, 1707-1710; see Blackwell 2014) and it allowed us to travel to Europe for collaborative meetings. McMillan gave a talk on our Catesby work at the Natural History Museum in London, Blackwell gave talk at the British Library, and we met with colleagues at RBG Kew and the Hamburg Botanischer Garten. We also spent several days in Paris examining and photographing the Michaux materials. Questions about these data should be directed to: christopher.blackwell@furman.edu

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LECTOTYPIFICATION OF *RAILLARDELLA PRINGLEI* GREENE (ASTERACEAE)

BRUCE G. BALDWIN
Jepson Herbarium and Department of Integrative Biology
University of California
Berkeley, California 94720-2465
bbaldwin@berkeley.edu

ABSTRACT

Raillardella pringlei Greene (Asteraceae) is lectotypified.

Protologue for *Raillardella pringlei* Greene (Bull. Torrey Bot. Club 9: 17. 1882) included "High mountains west of Mt. Shasta; collected by C.G. Pringle, in August, 1881" and did not cite any specimens. Fide Mauz (2011, p. 113), in a letter to Pringle (28 November 1881, Pringle Correspondence, UVM), Greene wrote that "A still finer thing, i.e. *Raillardella pringlei* Greene, there were three specimens of. I took one, and that is gone to the best place, Cambridge. I want one of the two remaining ones."

Evidently, the specimen that Greene indicated had "gone" to Cambridge is the specimen GH 0011590, which I here designate as lectotype of *Raillardella pringlei* Greene. One of the other two specimens is in NDG (62389) and the second is in CAS (1037). Fragments from NDG 62389 are in UC (444423).

ACKNOWLEDGEMENTS

I thank Dr. K. Gandhi for calling to my attention the need for this lectotypification and Dr. J.L. Strother for assistance.

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Zamudio, S., H.D. Juárez Gutiérrez, y J. Hernández Rendón. 2018. Cuatro especies nuevas de *Pinguicula* (Lentibulariaceae) de México. Phytoneuron 2018-14: 1–20. Published 28 March 2018. ISSN 2153 733X

CUATRO ESPECIES NUEVAS DE *PINGUICULA* (LENTIBULARIACEAE) DE MÉXICO

SERGIO ZAMUDIO
Apartado postal 392
61600 Pátzcuaro, Michoacán, México.
szamudioruiz@gmail.com

HÉCTOR DAVID JUÁREZ GUTIÉRREZ
Centro Universitario de Ciencias Biológicas y Agropecuarias (CUCBA)
Universidad de Guadalajara
km 15.5 carretera Guadalajara-Nogales
Las Agujas, Nextipac
Zapopan, 45110, Jalisco, México
david.juarez@mareterraconsultores.com

JULIÁN HERNÁNDEZ RENDÓN
Centro Universitario de Ciencias Biológicas y Agropecuarias (CUCBA)
Universidad de Guadalajara
km 15.5 carretera Guadalajara-Nogales
Las Agujas, Nextipac
Zapopan, 45110, Jalisco, México
Juli19barca7s9k@hotmail.com

RESUMEN

Se describen e ilustran cuatro especies nuevas del género *Pinguicula,* las cuatro representan endemismos para la flora mexicana. Dos de ellas habitan una pequeña porción en la parte sur de la Sierra Madre Oriental, **Pinguicula robertiana** (subg. *Isoloba,* sección *Heterophyllum*) del estado de San Luis Potosí, destaca por la corola blanca, hojas invernales membranáceas espatuladas, con el ápice redondeado, y hojas de verano lineares; y **P. rzedowskiana** (subg. *Pinguicula,* sección *Longitubus*) del estado de Querétaro, que se distingue por la corola rojo-purpúrea, hojas invernales membranáceas espatuladas y hojas de verano lineares. Las otras dos especies provienen del occidente del país **P. casperi** (subg. *Isoloba,* sección *Heterophyllum*) de los estados de Jalisco y Durango, presenta corola blanca a ligeramente lila, hojas invernales crasas, con el ápice acuminado, y hojas de verano pecioladas, con la lámina ovado-elíptica; y **P. michoacana** (subg. *Pinguicula,* sección *Orcheosanthus*) del estado de Michoacán, caracterizada por tener corola rosa a morada, hojas invernales crasas, con el ápice acuminado, y hojas de verano pecioladas, con la lámina obovadas-elíptica a suborbicular.

ABSTRACT

Four new, narrowly endemic species of *Pinguicula* are described and illustrated. Two are from a small area of the Sierra Madre Oriental: **Pinguicula robertiana** Zamudio & Hernández Rendón **sp. nov.** (subg. *Isoloba,* sect. *Heterophyllum*), from San Luis Potosí, is characterized by a white corolla, membranous spathulate winter leaves with rounded apex, and linear summer leaves; **P. rzedowskiana** Zamudio & D. Juárez **sp. nov.** (subg. *Pinguicula,* sect. *Longitubus*), from Querétaro, is distinctive in its red-purple corolla, spathulate membranous winter leaves, and linear summer leaves. The other two are from the western region of the country: **P. casperi** D. Juárez & Zamudio **sp. nov.** (subg. *Isoloba,* sect. *Heterophyllum*), from Jalisco and Durango, has white to slightly lilac flowers, succulent (thick) winter leaves with acuminate apex, and petiolate, ovate-elliptic summer leaves; **P. michoacana** Zamudio & D. Juárez, **sp. nov.** (subg. *Pinguicula,* sect. *Orcheosanthus*), from Michoacán, has pink to purple corollas, thick winter leaves with broadly acuminate apex, and petiolate, obovate-elliptic to suborbicular summer leaves.

El estudio del género *Pinguicula* (Lentibulariaceae) en el siglo XXI ha tenido como resultado el descubrimiento de 21 especies nuevas en todo el mundo; de éstas, ocho son de México (Zamudio 2001, Zamudio y Studnicka 2001, Zamudio y van Marm 2003, Luhrs et al. 2004, Zamudio 2005, Luhrs & Lampard 2006, Rivadavia, et al. 2017), siete de Cuba, cuatro de Italia, una de Bolivia y una de Turquía. No debe sorprendernos el hecho de que la mayoría de los taxa nuevos provengan de México, pues diversos autores ya han comentado que este país posee la mayor diversidad de especies del género en el mundo y también ha sido señalado como el principal centro moderno de diversificación del género. Exploraciones botánicas realizadas en años recientes en distintas localidades de los estados de Durango, Jalisco, Michoacán, Querétaro y San Luis Potosí, han conducido al descubrimiento de cuatro nuevas especies del género *Pinguicula* L., las que se describen a continuación.

PINGUICULA ROBERTIANA Zamudio & J. Hernández Rendón, **sp. nov.** TIPO: **MÉXICO. San Luis Potosí.** Municipio de Xilitla, 11/03/2014, *S. Zamudio, U. Guzmán, y R. Pedraza 16696* (holotipo UAMIZ; isotipos ENCB, MEXU). Figura 1.

Herba perennis. Folia biformia radicalia, hiemalia numerosa, spathulata, longe spathulata vel elliptico-lanceolata, 15–50 mm longa, 3–6 mm lata, apice obtusata vel rotundata. Folia aestivalia 6(12)–20, lamina lineata 70–230 mm longa, 2–5 mm lata, apice obtusata, base attenuata, margine revoluta. Pedunculi 1–3 erecti virides 40–70(100) mm alti. Flores 15–25 mm longis (calcari incluso). Calyx bilabiatus, lobis triangularibus, 1–3 mm longis, 0.5–2 mm latis. Corolla bilabiata, alba vel lilacino maculata in labii ínferi lobi basis, labium superum bilobum lobis oblongis rotundatis 3–6 mm longis, 3–5 mm latis, labium inferum paulo majus trilobum lobis oblongis vel obovato–oblongis rotundatis 4–8 mm longis, 3–6 mm latis, extus glandulis stipitatis obsita. Tubus subcylindricus leviter infundibuliformis sine palato albo-viridis 5–10 mm longus, 5–8 mm latus intus pilis in lineis triabus ordinatis. Calcar cylindricum obtusum, viride, 3–6(8) mm longum, 0.5–1 mm latum. Capsula subglobosa, 2–3 mm diámetro. Semina numerosa, fusiformia, ±1mm longa, ±0.5 mm lata, alveolata.

Planta herbácea perenne; hojas basales dimórficas agrupadas en dos rosetas subsecuentes; roseta invernal laxa, epigea, con 10–20 hojas membranáceas espatuladas, largamente espatuladas a elíptico-lanceoladas, de 15–50 mm de largo, 3–6 mm de ancho, ápice obtuso a redondeado, margen entero, esparcidamente pubescentes en el haz, con tricomas simples de 1–2 mm de largo, glabras en el envés; roseta de verano con 6–12(20) hojas membranáceas, lineares, de 70–230 mm de largo, 2–5 mm de ancho, ápice obtuso, base atenuada, margen revoluto, glandular-pubescentes en el haz, con tricomas simples multicelulares de 1–2 mm, y con glándulas sésiles dispersas; pedúnculos 1–3 por planta, de 40–70(100) mm de largo, densa a esparcidamente glandular-pubescentes, con tricomas de menos de 1 mm, los pedúnculos se vuelven reclinados al madurar el fruto; flores de 15–25 mm de largo (incluyendo el espolón); cáliz bilabiado, esparcidamente glandular-pubescente por fuera, glabrescente con la edad, labio superior trilobado hasta ½ de su longitud, lóbulos triangulares, de 1–3 mm de largo, 1–2 mm de ancho, ápice obtuso, labio inferior bilobado hasta ½ de su longitud, lóbulos triangulares, de 1–3 mm de largo, 0.5–2 mm de ancho, ápice obtuso; corola bilabiada blanca, a veces con máculas lilas en la base de los lóbulos del labio inferior, garganta blanco-verdosa, labio superior bilobado, lóbulos oblongos, de 3–6 mm de largo, 3–5 mm de ancho, ápice redondeado, labio inferior trilobado, lóbulos oblongos a obovado-oblongos, de 4–8 mm de largo, 3–6 mm de ancho, ápice redondeado; tubo cilíndrico a infundibuliforme, de 5–10 mm de largo, 5–8 mm de ancho, blanco-verdoso, densamente piloso en el interior con tres bandas de pelos glandulares retrorsos que se extienden hasta la base; espolón cilíndrico, verde, de 3–6(8) mm de largo, ápice redondeado, con pelos glandulares estipitados muy cortos en el interior; ovario subgloboso, glabro a esparcidamente glandular pubescente, con glándulas sésiles y estipitadas, estigma blanco bilabiado, el labio superior reducido, el labio inferior oblato, con el margen ligeramente fimbriado, de ±1.5 mm de largo, y ±2 mm de ancho; cápsula subglobosa, de 2–3 mm de diámetro; semillas numerosas fusiformes, alveoladas, de ±1 mm de largo, ±0.5 mm de ancho.

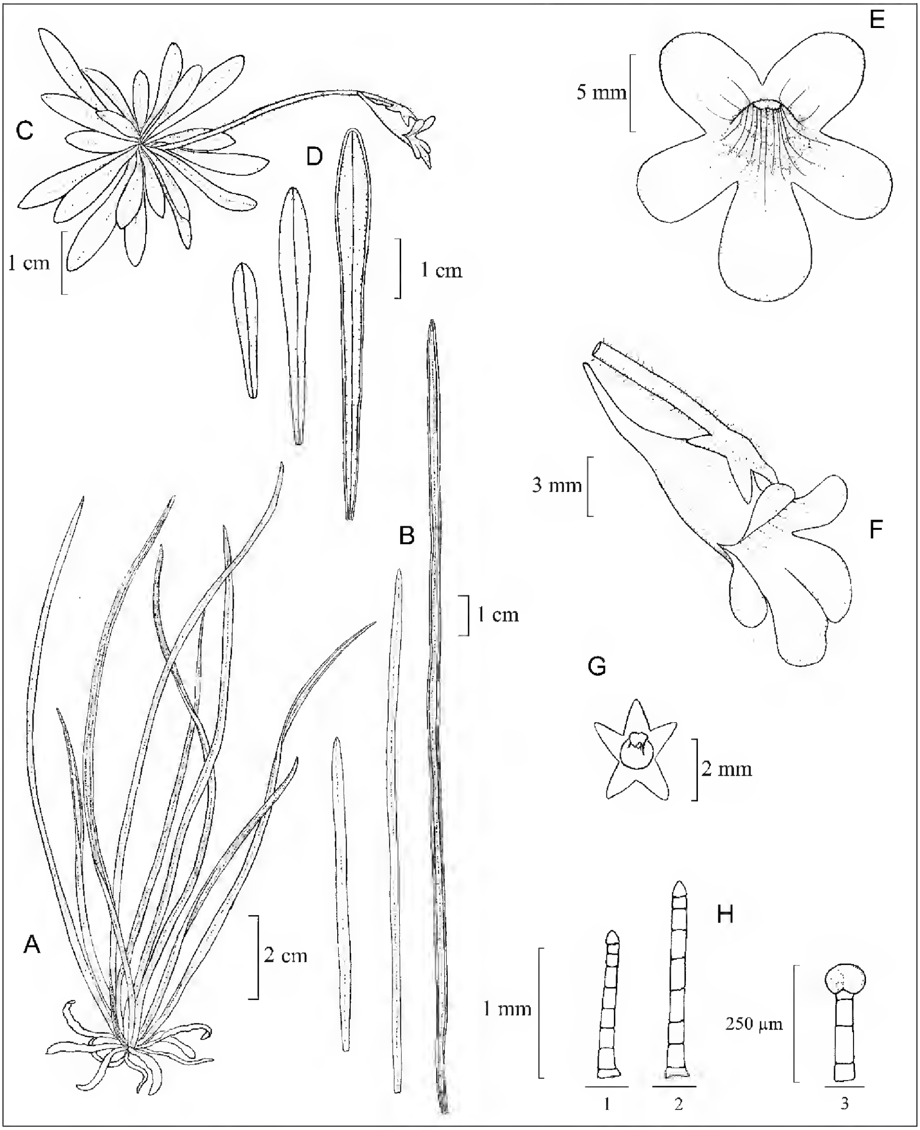

Figura 1. *Pinguicula robertiana*. A. Hábito de la planta con hojas de verano y restos de hojas de invierno. B. Serie de hojas de verano. C. Roseta de invierno con flor. D. Serie de hojas de invierno. E. Flor vista de frente. F. Vista lateral de la flor. G. Cáliz. H. Pelos del interior del tubo de la corola; 1 y 2, pelos multicelulares simples subulados; 3, pelo glandular estipitado del tubo y espolón. Ilustrado por Manuel Ramírez Amezcua.

Se trata de un estrecho endemismo conocido del municipio de Xilitla, San Luis Potosí. Se desarrolla en lugares húmedos sobre paredes verticales de rocas calizas, o en las paredes de cuevas en medio del bosque mesófilo de montaña. Altitud de 1600 a 2000 m. Se ha colectado con flores, rosetas invernales y hojas de verano al inicio de su desarrollo en los meses de noviembre a marzo; y con frutos, rosetas de verano bien desarrolladas y restos de hojas de invierno en junio.

El nombre de la especie se dedica en honor a Roberto Pedraza Ruiz, fotógrafo y amante de la naturaleza, quien encontró por primera vez una de las poblaciones del nuevo taxón y nos alertó sobre su existencia.

Material adicional revisado. MÉXICO. San Luis Potosí. Municipio de Xilitla, 7/06/2013, *Zamudio y Sánchez 16330* (ENCB, MEXU, UAMIZ, ejemplares con rosetas de invierno, hojas de verano jóvenes, frutos y algunas flores); ibid., 10/11/2016, *Zamudio et al. 17170* (ENCB, IBUG, MEXU, UAMIZ, ejemplares con flores y rosetas de invierno); ibid., 4/07/2017, *Zamudio et al. 17254* (CIIDIR, ENCB, IBUG, MEXU, UAMIZ, ejemplares estériles con hojas de verano); ibid., 3/09/2017, *Hernández Rendón et al. 158* (IBUG, SLPM, MEXU, ejemplares estériles con hojas de verano).

De acuerdo con la clasificación propuesta por Casper (1966), *Pinguicula robertiana* se ubica dentro del subgénero *Isoloba,* Barnhart em. Casper, sección *Heterophyllum* Casper por presentar hojas de diferente forma y tamaño en las rosetas de verano e invierno (heterófilas), corola bilabiada, con los lóbulos enteros, tubo cilíndrico-infundibuliforme, sin paladar, con tres bandas de pelos glandulares retrorsos y espolón cilíndrico, más corto que el tubo. Dentro de esta sección se encuentra intermedia entre las subsecciones *Isolobopsis* Casper y *Orcheosanthopsis* Casper; con la subsección *Isolobopsis* coincide en el espolón más corto que el tubo, en cambio con la subsección *Orcheosanthopsis* coincide por la corola subbilabiada y el tubo cilíndrico-infundibuliforme. Los caracteres usados por Casper para separar estas subsecciones no son consistentes, pues tanto en *P. heterophylla* como en *P. parvifolia* las corolas no son completamente isolobas, pues en ocasiones se observan subisolobas, con el labio superior un poco más corto que el inferior y el tamaño del espolón no parece ser constante, por lo que con estas variaciones y las características de la nueva especie, no se justifica la existencia de las subsecciones.

Tomando en cuenta lo anterior, dentro de la sección *Heterophyllum*, *Pinguicula robertiana* tiene mayor parecido con *P. heterophylla* Benth., por la forma de las hojas de verano lineares, pero la semejanza es solo aparente ya que difieren en muchos caracteres (Cuadro 1). Las principales diferencias entre estas especies son: en *P. robertiana* la roseta de invierno es epigea, está formadas por 10 a 20 hojas membranáceas espatuladas, arregladas laxamente, mientras que en *P. heterophylla* ésta es hipogea, formada por numerosas hojas carnosas, ampliamente lanceoladas, agrupadas densamente formando una roseta compacta parecida a un bulbo; la roseta de verano en *P. robertiana* está formada por 10 a 20 hojas lineares, mientras que en *P. heterophylla* está formada por tres tipos de hojas con diferente forma y tamaño y solo las hojas internas son linear-lanceoladas; la corola en *P. robertiana* es claramente bilabiada, blanca, a veces con algunas manchas moradas en la base de los lóbulos del labio inferior, los lóbulos son oblongos u obovados, el tubo cilíndrico a infundibuliforme, en cambio en *P. heterophylla* la corola es subisoloba, violácea, purpúrea o blanca, los lóbulos son obovado-oblongos, el tubo es subcilíndrico.

Caracteres	***Pinguicula heterophylla***	***Pinguicula robertiana***
Roseta de Invierno	Hipogea, compacta en forma de bulbo, con numerosas hojas (ca. 100).	Epigea, laxa, con 10 a 20 hojas.
Hojas de invierno	Crasas, ampliamente lanceoladas, de 10–25 mm de largo, 1–3 mm de ancho, ápice agudo, ciliadas.	Membranáceas, espatuladas, largamente espatuladas a elíptoco-lanceoladas, de 15–50 mm de largo, 3–6 mm de ancho, ápice obtuso a redondeado.
Hojas de verano	Exteriores obovado-oblongas, obtusas a agudas, de 15 a 25 mm de largo, 4–6 mm de ancho. Intermedias oblongo-lanceoladas, agudas, de 30 a 60 mm de largo, 7–10 mm de ancho. Interiores largamente linear-lanceoladas, en la base 4–5 mm de ancho, 60–90(150) mm de largo, gradualmente alargadas en un acumen tenue circinado, margen fuertemente revoluto.	Lineares, de 70–230 mm de largo, 2–5 mm de ancho, ápice obtuso, base atenuada, margen revoluto.
Pedúnculos	1–4 por planta, erectos, de (60)100–150(230) mm, cubiertos densamente con glándulas estipitadas.	1–3 por planta, erectos, de 40–70(100) mm de largo, densa a esparcidamente glandular-pubescentes, reclinados al madurar el fruto.
Flores	20–240 mm de largo (incluyendo el espolón).	15–25 mm de largo (incluyendo el espolón).
Cáliz	Cubierto con glándulas estipitadas por fuera; labio superior trilobado, lóbulos triangular-lanceolados, el labio inferior profundamente bilobado, lóbulos triangular-lanceolados, agudos.	Esparcidamente glandular-pubescente por fuera; labio superior trilobado hasta ½ de su longitud, lóbulos triangulares, de 1–3 mm de largo, 1–2 mm de ancho, ápice obtuso; labio inferior bilobado hasta ½ de su longitud, lóbulos triangulares, de 1–3 mm de longitud, 0.5–2 mm de ancho, ápice obtuso.
Corola	Subisoloba, violácea, purpúrea o blanca, cubierta por fuera con glándulas estipitadas dispersas; lóbulos obovado-oblongos, redondeados a trucados, 5–10 mm de largo, 3–4 mm de ancho, irregularmente cubiertos con pelos glandulares capitados dispersos.	Bilabiada blanca, a veces con máculas lilas en la base de los lóbulos del labio inferior; lóbulos oblongos a obovado-oblongos, de 3–8 mm de largo, 3–6 mm de ancho, ápice redondeado.

Tubo	Subcilíndrico, ensanchado - infundibularmente en la garganta, sin paladar, 6–11 mm de largo, 3–5 mm de ancho, densamente piloso por dentro con pelos largos irregularmente capitados, más cortos y retrorsos en la base, ordenados en tres líneas.	Cilíndrico-infundibuliforme, de 5–10 mm de largo, 5–8 mm de ancho, blanco-verdoso, sin paladar, densamente piloso en el interior con tres líneas de pelos glandulares retrorsos.
Espolón	Subcilíndrico, corto, 4–5 mm de largo, 0.7–1 mm de ancho, redondeado o agudo. Formando un ángulo con la corola o bien subrecto.	Cilíndrico, recto, verde, de 3–6(8) mm de largo, ápice redondeado, más corto que el tubo de la corola, con pelos glandulares estipitados muy cortos en el interior.
Hábitat	Bosque de encino y pino.	Bosque mesófilo de montaña.
Altitud	1600 a 2500 m.	1600 a 2000 m.
Sustrato	Rocas ígneas y granitos.	Rocas calizas.

Cuadro 1. Comparación entre *Pinguicula heterophylla* y *P. robertiana.*

PINGUICULA RZEDOWSKIANA Zamudio & D. Juárez, **sp. nov.** TIPO. **MÉXICO. Querétaro.** Municipio de Jalpan, 13/10/2011, *S. Zamudio, G. Aguilar, y B. Servín 15305* (holotipo UAMIZ; isotipos ENCB, IBUG, MEXU, SLPM). Figura 2.

Herba perennis. Folia biformia radicalia, hiemalia numerosa membranacea vel leviter incrassata, spathulata vel oblanceolata 25–60 mm longa, 3–6 mm lata, apice acutata vel obtusata. Folia aestivalia lineata, 50–100(300) mm longa, 2–8 mm lata, apice acutata vel obtusata, base attenuata, margine valde revoluta. Pedunculi 1–2 erecti virides 70–140 mm longi. Flores 20–25 mm longis (calcari incluso). Calyx bilabiatus, labium superum trilobum lobis ellipticis vel oblongo-ellipticis 2–4 mm longis, 1–2 mm latis, labium inferum bilobum lobis ellipticis, oblongo-ellipticis vel triangularibs 2–4 mm longis, 1–2 mm latis. Corolla bilabiata rubro-purpurea extus glandulis stipitatis obsita, labium superum bilobum lobis oblongis vel obovatis 4–8 mm longis, 3–6 mm latis, labium inferum trilobum lobis oblongis vel obovatis 6–10 mm longis, 4–9 mm latis, apice rotundatis, basim versus pilis capitatis obsitis. Tubus longe-infundibuliformis, albus vel albo-viridulus, 7–14(16) mm longus, 4–6 mm latus. Calcar cylindrico-infundibuliforme subulatum, purpureum 4–8 mm longum. Capsula cylindrica vel botuliformis 6–7 mm longa, 4–55 mm lata. Semina numerosa, fusiformia, ± 1 mm longa, ± 0.5 mm lata, alveolata, spiculata.

Planta herbácea perenne; hojas basales dimórficas agrupadas en dos rosetas subsecuentes; roseta invernal laxa, epigea, con 10–20(25) hojas membranáceas o algo carnosas, sésiles, espatuladas a oblanceoladas, de 25–60 mm de largo, 3–6 mm de ancho, ápice agudo a obtuso, atenuadas en la base, margen entero, a veces teñido de color púrpura, cubiertas en el haz con tricomas simples multicelulares traslúcidos, de 1 a 2 mm de largo; roseta de verano laxa, con 5–15 hojas membranáceas péndulas, lineares, de (50)100–300 mm de largo, 2–8 mm de ancho, ápice agudo a obtuso, base atenuada, margen fuertemente revoluto, densamente glandular-pubescentes en el haz, con tricomas simples multicelulares menores de 1 mm y glándulas sésiles dispersas; pedúnculos 1–2, de 70–140 mm de largo, densamente glandular-pubescentes, con tricomas de 1–2 mm, reclinados cuando madura el fruto; flores de 20–27 mm de largo (incluyendo el espolón); cáliz bilabiado, esparcidamente glandular-pubescente por fuera, con pelos de más de 1 mm, labio superior trilobado, lóbulos unidos ¼ parte de su longitud en la base, elípticos a oblongo-elípticos, de 2–4 mm de largo, 1–2 mm de ancho, ápice obtuso, labio inferior bilobado, lóbulos elípticos, oblongo-elípticos a

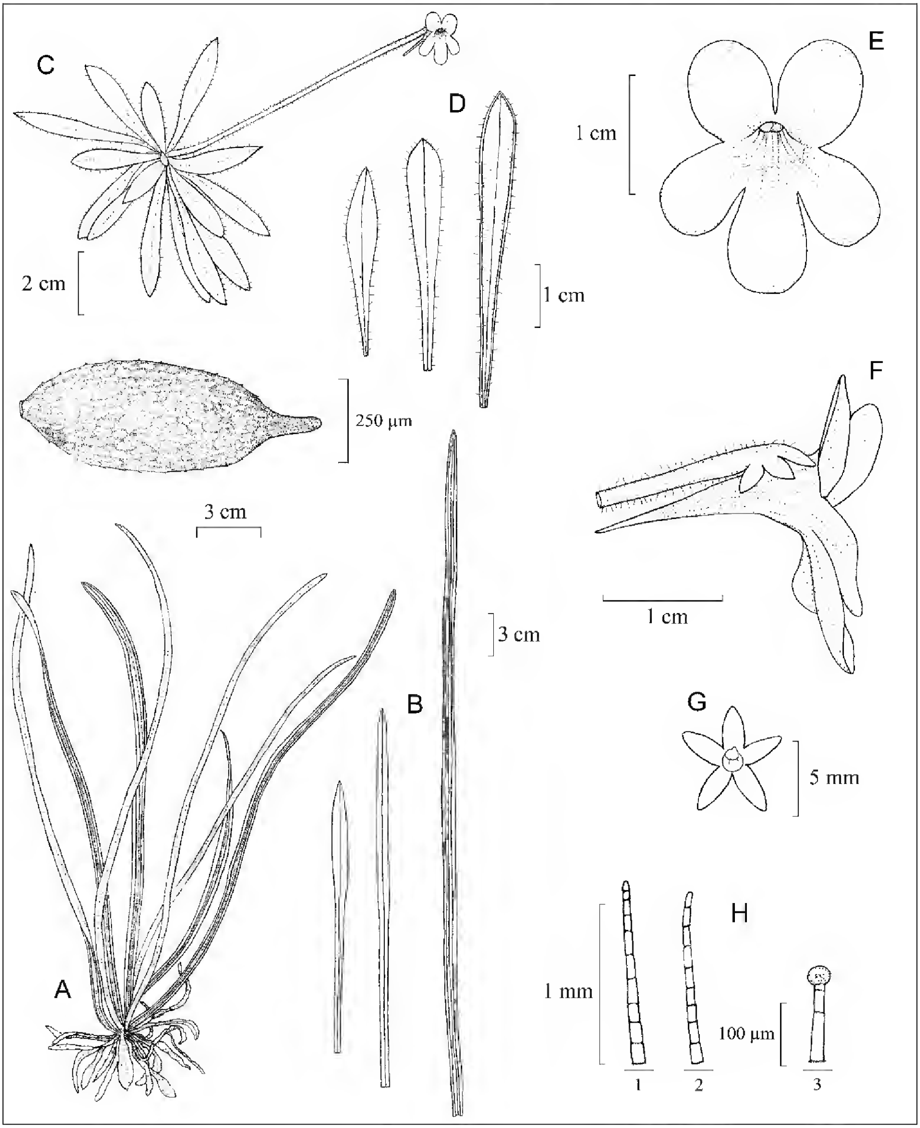

Figura 2. *Pinguicula rzedowskiana*. A. Hábito de la planta con hojas de varano y resto de hojas de invierno. B. Serie de hojas de verano. C. Roseta de invierno con flor. D. Serie de hojas de invierno. E. Corola vista de frente. F. Vista lateral de la corola. G. Cáliz. H. Pelos del interior del tubo de la corola, 1 y 2 pelos multicelulares simples subulados; 3, pelo glandular estipitado del tubo y espolón. Ilustrado por Manuel Ramírez Amezcua.

triangulares, unidos 1/2–3/4 partes en la base, de 2–4 mm de largo, 1–2 mm de ancho, ápice obtuso; corola bilabiada, rojo-purpúrea, casi glabra en la parte externa, con escasas glándulas estipitadas cortas, garganta blanca o más clara que los lóbulos, con tricomas simples multicelulares cilíndricos, de ca. 1mm, en la parte ventral, labio superior bilobado, lóbulos oblongos a obovados, de 4–8 mm de largo, 3–6 mm de ancho, ápice redondeado, labio inferior trilobado, lóbulos oblongos a obovados, de 6–10 mm de largo, 4–9 mm de ancho, ápice redondeado; tubo largamente infundibuliforme, de 7–14(16) mm de largo, 4–6 mm de ancho, blanco, blanco-verdoso o teñido de púrpura parcialmente, piloso en el interior, en la parte ventral con pelos multicelulares simples gruesos, subulados; espolón púrpura o más oscuro que el tubo, cilíndrico-infundibuliforme, subulado, de 4–8 mm de largo, con pelos glandulares estipitados dispersos en su interior; ovario subgloboso, de ±2 mm de diámetro, cubierto de glándulas estipitadas, estigma blanco, bilabiado, el labio inferior flabelado, de ±2mm de largo, por ±3 mm de ancho, con el margen fimbriado, cápsula cilíndica a botuliforme, de 6–7 mm de largo, 4–5 mm de ancho; semillas numerosas, obovoides, de ±1 mm de largo, ±0.5 mm de ancho, negras, superficie alveolada, espiculada.

Esta especie es conocida de una sola localidad en el noreste del estado de Querétaro, crece sobre riscos de rocas calizas con escurrimientos de agua entre el bosque de *Pinus greggii* Engelm. ex Parl., con elementos de bosque mesófilo de montaña. Altitud de 1950 a 2100 m. Se ha encontrado con hojas de verano en los meses de abril a mayo y en octubre con rosetas de invierno bien desarrolladas y flores. Los frutos se observan tanto en el mes de octubre como en abril.

El nombre de la especie se dedica con admiración al célebre botánico mexicano Jerzy Rzedowski Rotter en reconocimiento al tiempo y esfuerzo que ha dedicado al estudio de la flora mexicana.

Material adicional revisado. MÉXICO. Querétaro. Municipio de Jalpan, 29/03/2012, *Aguilar, Zamudio y Servín 857* (MEXU, QMEX, SLPM, UAMIZ, ejemplares estériles con hojas de invierno y verano); ibid., 26/05/2012, *Zamudio, Servín, Carranza y Juárez 15570* (ENCB, IBUG, MEXU, QMEX, SLPM, UAMIZ, ejemplares estériles con hojas de invierno y verano).

Pinguicula rzedowskiana se ubica en el subg. *Pinguicula* Casper, la sección *Longitubus* Zamudio & Rzedowski, por la corola bilabiada, rojo-purpúrea y el tubo largamente infundibuliforme, más largo que el espolón. Presenta una combinación única de caracteres que la distinguen claramente de cualquier otra especie de la sección; los más notorios son: la roseta de invierno epigea, laxa, con hojas membranáceas o ligeramente crasas, espatuladas a oblanceoladas y las largas hojas de verano lineares, con el margen fuertemente revoluto. Dentro de esta sección podría confundirse con *P. calderoniae* Zamudio, por las hojas de verano lineares, pero se diferencia fácilmente porque esta última forma una roseta invernal compacta, con hojas crasas, obtruladas a elípticas. Por otro lado *P. rzedowskiana* florece mientras mantiene la roseta invernal, en contraste *P. calderoniae* florece durante el desarrollo de la roseta de verano (Cuadro 2).

Caracteres	***Pinguicula calderoniae***	***Pinguicula rzedowskiana***
Roseta de invierno	Hipogea, compacta en forma de bulbo.	Epigea, laxa.
Hojas de invierno	Crasas, obtruladas a elípticas en contorno, acuminadas, de 3–10 mm de largo, 1.5–4 mm ancho.	Membranáceas o algo carnosas, espatuladas a oblanceoladas, ápice agudo a obtuso, de 25–60 mm de largo, 3–6 mm de ancho.
Roseta de verano	Laxa, con 3–8 hojas erectas.	Laxa, con 5–15 hojas péndulas.

Hojas de verano	Lanceolado-lineares, de 60–260 mm de largo, 3–8.5 mm de ancho, margen revoluto.	Lineares, de (50)100–300 mm de largo, 2–8 mm de ancho, ápice agudo a obtuso, margen fuertemente revoluto.
Pedúnculos	1–3 erectos, de 60–150 mm de largo, esparcidamente glandular-pubescentes.	1–2 erectos, de 70–140 mm de largo, densamente glandular-pubescentes, reflexos cuando madura el fruto.
Flores	20–35 mm de largo (incluyendo el espolón).	20–25 mm de largo (incluyendo el espolón).
Cáliz	Cubierto con glándulas estipitadas por fuera; lóbulos del labio superior lanceolados a triangulares; lóbulos del labio inferior lanceolados a triangulares.	Esparcidamente glandular-pubescente por fuera; lóbulos del labio superior elípticos a oblongo-elípticos; lóbulos del labio inferior elípticos, oblongo-elípticos a triangulares.
Corola	Bilabiada, rojo-purpúrea; lóbulos del labio superior oblongos a angostamente oblongos, obtusos a redondeados, 5–8 mm de largo, 3–6 mm de ancho; lóbulos del labio inferior oblongos a angostamente oblongos, ápice truncado a redondeado, de 5–9 mm de largo, 2.5–6 mm de ancho.	Bilabiada, morado-purpúrea, garganta blanca; lóbulos del labio superior oblongos a obovados, ápice redondeado, 4–8 mm de largo, 3–6 mm de ancho; lóbulos del labio inferior oblongos a obovados, ápice redondeado a truncado, 6–10 mm de largo, 4–9 mm de ancho.
Tubo	Largamente infundibuliforme, de 7–10 mm de largo, blanco o ligeramente teñido de púrpura, sin paladar, piloso por dentro con pelos multicelulares, cilíndrico-subulados, más cortos hacia la base.	Largamente infundibuliforme, de 7–14(16) mm de largo, blanco, blanco-verdoso o teñido de púrpura parcialmente, piloso en el interior con pelos cilídrico- subulados y pelos galdular-capitados.
Espolón	Igual o más largo que el tubo, de 7–16 mm.	Más corto que el tubo, de 4–8 mm.
Hábitat	Bosque mesófilo de montaña.	Bosque mesófilo de montaña.
Altitud	2200 a 2300 m.	1950 a 2100 m.
Sustrato	Rocas calizas.	Rocas calizas.

Cuadro 2. Comparación entre *Pinguicula calderoniae* y *P. rzedowskiana*.

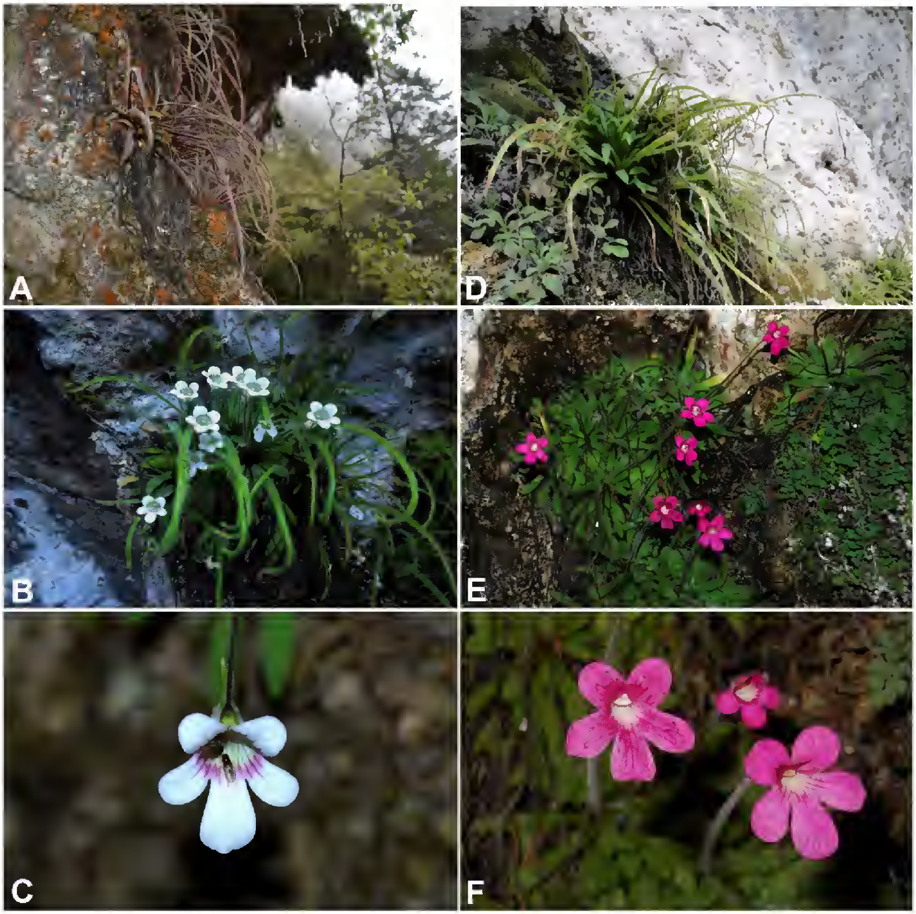

Figura 3. *Pinguicula robertiana* A-C. A. Hábito mostrando rosetas de verano. B. Rosetas entransición con flores. C. Flor. *Pinguicula rzedowskiana* D-F. D. Hábito mostrando rosetas de verano. E. Rosetas de invierno con flores. F. Flores

Es interesante comentar que a pesar de que las poblaciones de *P. calderoniae* se encuentran relativamente cerca y en ambientes muy parecidos a *P. rzedowskiana*, hasta ahora no se ha observado que crezcan juntas.

La descripción de *Pinguicula rzedowskiana* representa un nuevo registro para la Flora del Bajío y de regiones adyacentes, pues debido a su reciente descubrimiento, no fue incluida en el fascículo de la Familia Lentibulariaceae (Zamudio, 2005b), y añade un estrecho endemismo para la porción sur de la Sierra Madre Oriental y para México.

PINGUICULA CASPERI D. Juárez & Zamudio, **sp. nov.** TIPO. **MÉXICO. Durango.** Municipio de Mezquital, 24/06/2013, *S. Zamudio, D. Juárez, S. González, & J. Noriega 16390* (holotipo IBUG; isotipos CIIDIR, ENCB, EBUM, IBUG, MEXU, UAMIZ). Figura 4.

Herba perennis. Folia biformia radicalia rosulata, hiemalia numerosa crassa, ovato-lanceolata vel lanceolata, (4)14–27(30) mm longa, (1)5–16(20) mm lata, apice acuminata, margine longe ciliata. Folia aestivalia petiolata; petioli 11–45 mm longi, margine ciliati, lamina ovato-elliptica, 15–60 mm longa, 11–40 mm lata, apice rotundata, base cuneata vel attenuata, margine involuta. Pedunculi 2–6 erecti virides vel purpurei 40–135(150) mm longi uniflori. Flores 16–25(30) mm longis (calcari incluso). Calyx bilabiatus, lobis triangularibus, 3.5–8 mm longis, 0.5–3.5 mm latis, calyx fructifer accrescens. Corolla subisoloba alba vel lilacina lobis obovatis vel oblongis (6)8.5–13.5(15) mm longis, 3–8 mm latis, apice rotundatis, basem versus pilis capitatis obsitis; tubus subcylindricus leviter ventricosus albus vel purpureus 5–8 mm longus, (2.8)4–5 mm latus; calcar subcylindricum obtusum viride 2–4 mm longum, 0.5–1(1.5) mm latum. Capsula subglobosa 4–5 mm longa, 3–5.5 mm lata. Semina numerosa, fusiformia, ca. 0.5 mm longa, ca. 0.1 mm lata.

Planta herbácea perenne; hojas basales dimórficas divididas en dos rosetas subsecuentes; roseta invernal compacta, hipogea, en forma de bulbo, de 10–25(30) mm de largo, (4.5)10–20 mm de diámetro, formada por 20 a 50 hojas crasas, las exteriores ovado-lanceoladas, de (4)14–27(30) mm de largo, (1)5–16(20) mm de ancho, ápice acuminado, margen ciliado, cilios de 8–10 mm de largo, las interiores lanceoladas, de (4)7–14 mm de largo, (1)2–5(6) mm de ancho, ápice acuminado, glabras; roseta de verano laxa, con (2)4–6 hojas membranáceas, verde claro, pecioladas; peciolo cóncavo y piloso hacia el extremo superior, de 11–45 mm de largo, margen ciliado, cilios de ± 8 mm de largo; lámina ovado-elíptica, de 15–60 mm de largo, 11–40 mm de ancho, ápice redondeado, base cuneada a atenuada, margen involuto, cubierta en el haz por glándulas sésiles y glándulas estipitadas; pedúnculos 2–6, erectos, verdes o teñidos de morado, glabros o cubiertos por glándulas estipitadas más densas hacia la parte superior, unifloros, de 40–135(150) mm de largo; flores de 16–25(30) mm de largo, (incluyendo el espolón); cáliz bilabiado, cubierto por glándulas estipitadas en la cara externa y escasas hacia la cara interna, acrescente en la fructificación, labio superior dividido hasta 2/3 partes o más en tres lóbulos triangulares, los laterales dispuestos en un ángulo mayor a 90° con respecto al medio, de 3.5–8 mm de largo, 0.5–3.5 mm de ancho, labio inferior bilobado, dividido 1/2 a 1/3 de su longitud, lóbulos triangulares, de 4–6(6.5) mm de largo, 0.5–2.5(3) mm de ancho; corola subisoloba, blanca a lila, labio superior bilobado, labio inferior trilobado, un poco más grande que el superior, lóbulos obovados a oblongos, de (6) 8.5–13.5(15) mm de largo, 3–8 mm de ancho, ápice redondeado, cubiertos con pelos glandulares capitados, desde la garganta hasta la mitad inferior de la cara interna, escasos y de menor tamaño en la cara externa, garganta estrecha, pilosa; tubo subcilíndrico, blanco o teñido de morado, ligeramente ventricoso, de 5–8 mm de largo, (2.8)4–5 mm de ancho, cubierto por glándulas estipitadas dispersas en la parte exterior y en el interior por largos pelos glandulares capitados aglomerados en la parte inferior justo antes del espolón; espolón subcilíndrico, verde, de 2–4 mm de largo, 0.5–1(1.5) mm de ancho, formando un ángulo obtuso con el tubo; ovario subgloboso, de 1.5 mm de diámetro, glandular-pubescente, con glándulas pedunculadas cortas, estigma bilobado, blanco, subsésil, el lóbulo inferior un poco más grande que el superior ovado a ampliamente ovado, labio superior con el ápice acuminado-mucronado; cápsula subglobosa, cubierta por glándulas pedunculadas cortas, esparcidas, de 4–5 mm de largo, 3–5.5 mm de ancho; semillas numerosas, elipsoidales, ± 0.5 mm de largo, ± 0.1 mm de ancho.

Esta especie se conoce de pocas localidades de los estados de Durango y Jalisco. Crece en suelos pedregosos del tipo regosol, con escasa materia orgánica acumulada sobre terrenos planos o laderas con pendiente ligera y afloramientos de rocas ígneas extrusivas, en bosques de encino o pino-encino abiertos, a veces con elementos de bosque tropical caducifolio. Altitud 1300 a 2722 m. La floración inicia entre junio y julio (al principio de la temporada de lluvias) junto con el inicio del desarrollo de la roseta de verano, y termina a mediados de agosto cuando la roseta de verano alcanza

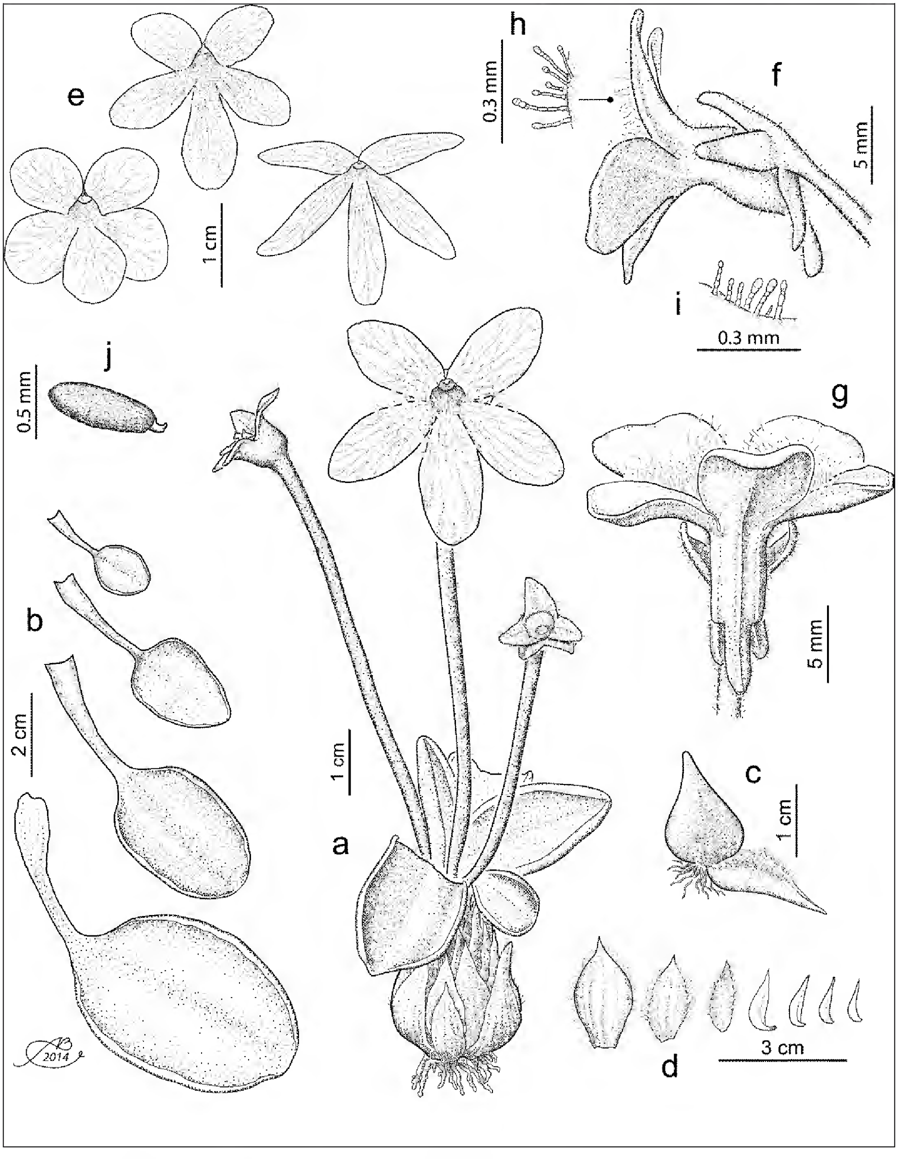

Figura 4. *Pinguicula casperi*. A. Hábito de la planta con hojas de invierno, hojas de verano jóvenes y flores. B. Serie de hojas de verano. C. Roseta invernal, vista lateral. D. Serie de hojas invernales. E. Vista frontal de las flores mostrando variación de los lóbulos de la corola. F. Vista lateral de la flor. G Vista anterior de la flor. H. Pelos del exterior de la corola. I. Pelos del interior de la corola. J. Semilla. Ilustrado por Alfonso Barbosa.

el máximo tamaño. La roseta de verano comienza a desarrollarse en julio, incrementando la longitud de las hojas hasta el mes de agosto y manteniéndose así hasta septiembre, cuando el tamaño de las hojas desciende y comienza el desarrollo de la roseta invernal, la cual en octubre está ya bien formada y se mantiene enterrada hasta el inicio de la temporada de lluvias del siguiente año.

El nombre de la especie se designó en honor de Siegfried Jost Casper, taxónomo alemán, en reconocimiento al extraordinario esfuerzo que ha hecho durante muchos años para estudiar el género *Pinguicula* en todo el mundo, generando conocimiento valioso hasta la actualidad.

Material adicional revisado. MÉXICO. Durango. Municipio de Mezquital, 13/07/1984, *González 1383* (CIIDIR, IEB); ibid. 18/06/1985, *González 1750* (CIIDIR, IEB, MEXU); ibid. 15/06/1985, *Torres S. 18* (CIIDIR, MEXU); ibid. 24/06/2013, *Zamudio, Juárez, González & Noriega 16394* (IBUG, UAMIZ); ibid. 25/06/2013, *Zamudio, Juárez, González & Noriega 16400* (IBUG, MEXU, UAMIZ). **Jalisco.** Municipio de Ahualulco de Mercado, 2/07/2011, *Rodríguez, García & Sánchez 6193* (IBUG); ibid. 5/07/2012, *Juárez & García 37* (IBUG 2 ejemplares); ibid, 22/09/2012, *Juárez & Salazar 46* (IBUG); ibid. 22/06/2013, *Zamudio & Juárez 16384* (CIIDIR, IBUG); municipio de Tapalpa, 18/06/1984, *H. Iltis 29168* (IEB, IBUG); ibid. 21/06/2013, *Zamudio & Juárez 16359* (CIIDIR, IBUG).

De acuerdo con la clasificación de Casper (1966), la corola subisoloba, tubo subcilíndrico y espolón más corto que el tubo, permite ubicar a *Pinguicula casperi* dentro del subg. *Isoloba,* sección *Heterophyllum,* subsección *Isolobopsis.* Dentro de esta subsección *P. casperi* se asemeja en general a *P. parvifolia* Robinson; sin embargo, la especie nueva se diferencia de esta última por formar plantas más robustas, por las hojas de verano ovado-elípticas, con láminas de 15 a 60 mm de largo, por 11 a 40 mm de ancho, mientras que en *P. parvifolia* las hojas son ovado-oblongas a elípticas, de 15 a 50 mm de largo y 7 a 15 mm de ancho. Los pedúnculos de *P. casperi* por lo general son más pequeños, de 40 a 135 mm de largo, en tanto que en *P. parvifolia* son de 30 a 180 mm de largo. Los lóbulos del cáliz en *P. casperi* son triangulares a ovado-triangulares y acrescentes durante la fructificación, los del labio superior se sobreponen a los del labio inferior, mientras que en *P. parvifolia* son más delgados, oblongo-lanceolados, no son acrescentes ni se sobreponen. La cápsula de *P. casperi* mide de 4 a 5 mm de largo, por 3 a 5.5 mm de ancho y se encuentra cubierta por el cáliz que es acrescente, en tanto que en *P. parvifolia* la cápsula mide de 3 a 3.5 mm de largo, por 2 a 2.5 mm de ancho y no está cubierta por el cáliz (Cuadro 3).

Caracteres	***Pinguicula parvifolia***	***Pinguicula casperi***
Hojas de invierno	60–80 hojas con el ápice acuminado.	20–50 hojas con el ápice agudo-acuminado.
Hojas de verano	2–4(5) hojas ovado-oblongas a elípticas, de 15–50 mm de largo y 7–15 mm de ancho.	(2)4–6 hojas ovado-elípticas, de 15–60 mm de largo y 11–40 mm de ancho.
Pedúnculos	1–3, de 30–180 mm de largo.	2–6, de 40–135(150) mm de largo.
Flores	(12)14–20(28) mm de largo (incluyendo el espolón).	16–25(30) mm de largo (incluyendo el espolón).
Cáliz	Lóbulos oblongo-lanceolados, no son acrescentes ni se sobreponen.	Lóbulos triangulares a ovado-triangulares, acrescentes en la fructificación, los del labio superior

		se sobreponen a los del labio inferior.
Corola	Subisoloba, azul-púrpura o blanca; lóbulos oblongos a obovado-oblongos o subespatulados, 5–10(15) mm de largo, (2)3–6.5 mm de ancho, ápice redondeado o rara vez subtruncado, con tricomas capitados hacia la base.	Subisoloba, blanca a lila; lóbulos obovados a oblongos, de (6)8.5–13.5(15) mm de largo, 3–8 mm de ancho, ápice redondeado, cubiertos con pelos glandulares capitados desde la garganta hasta la mitad inferior de la cara interna, escasos y de menor tamaño en la cara externa.
Tubo	Subcilíndrico, amarillo, de 5–8 mm de largo y 3–4 mm de ancho.	Subcilíndrico, blanco o teñido de morado, de 5–8 mm de largo y (2.8)4–5 mm de ancho.
Espolón	Subcilíndrico, amarillo, de 2–5(7) mm de largo.	Subcilíndrico, verde, de 2–4 mm de largo.
Hábitat	Bosques de encino, de pino, de pino-encino, de encino-pino, de oyamel y bosque mesófilo de montaña.	Bosques abiertos de encino o pino-encino, con elementos de bosque tropical caducifolio en algunas localidades.
Altitud	1035 a 2750 m.	1300 a 2722 m.
Sustrato	Rocas ígneas.	Rocas ígneas.

Cuadro 3. Comparación entre *Pinguicula parvifolia* y *P. casperi.*

Es importante destacar que en la mayoría de las localidades en donde se conoce a *Pinguicula casperi*, también se encuentran de manera simpátrica *P. parvifolia* y *P. oblongiloba* DC.; sin embargo, cada especie ocupa distintos microhábitats; *P. casperi* crece en terrenos planos o con pendiente suave, sobre suelos pedregosos, en bosques abiertos de encino o pino-encino, en lugares expuestos a la radiación solar durante el día (Fig. 8A), en tanto que *P. parvifolia* y *P. oblongiloba* prefieren lugares sombreados y húmedos, sobre bordos de arroyos, taludes y paredones con exposición norte o noreste de los mismos bosques, en donde no están sometidas directamente a la radiación solar.

La especie nueva muestra características intermedias entre *Pinguicula parvifolia* y *P. oblongiloba,* hecho que nos permite postular la hipótesis del origen híbrido de *P. casperi*, teniendo como parentales putativos a *P. parvifolia* y *P. oblongiloba* (Figuras 5 y 6); aunque las plantas de la especie nueva en general son más parecidas a *P. parvifolia*, algunas características morfológicas como las hojas de verano más grandes y anchas, con peciolos ciliados, la corola subisoloba, casi bilabiada, con el labio inferior más grande que el superior, el tubo de la corola morado y la acrecencia de los lóbulos del cáliz al madurar, muestran la influencia genética de *P. oblongiloba.*

Las plantas del supuesto híbrido presentan mayor vigor y son más robustas que los parentales y han ocupado con éxito un hábitat diferente al preferido por los parentales formando poblaciones muy densas, mucho mayores que las de los parentales, las que marginalmente tienen contacto con uno o ambos parentales, formando entonces un enjambre híbrido. De esta manera, se piensa que el híbrido ocupó de manera progresiva un hábitat distinto al de los parentales aislándose de éstos y evitando de esta manera la competencia con ellos.

Figura 5. Parentales putativos de la especie de origen hibrido. A. *Pinguicula parvifolia*. B. *P. oblongiloba*. C. *P. casperi*.

Figura 6. Complejo de hibridación en *Pinguicula casperi*. A. *P. parvifolia*. B. *P. parvifolia* x *P. casperi*. C. *P. casperi*. D. *P. oblongiloba*.

Con la información disponible no es posible decir si el evento de hibridación entre *Pinguicula parvifolia* y *P. oblongiloba* ocurrió una sola vez o ha ocurrido en varias ocasiones en diferentes lugares y tiempos, pero la extensa área ocupada por *P. casperi* desde el sur de Durango hasta el centro de Jalisco y la distribución disyunta de las poblaciones genera la incógnita de si su origen ocurrió en uno o varios eventos históricos de hibridación, las diferencias en la densidad y extensión de las poblaciones conocidas en cada lugar sugieren un origen múltiple, sin embargo prevalece la duda, por lo que es necesario realizar estudios genéticos o moleculares para esclarecerla.

Si se confirma la hipótesis del origen híbrido de *Pinguicula casperi*, este es un claro ejemplo de la ocurrencia de evolución reticulada entre algunas de las especies mexicanas de *Pinguicula*, como ya lo ha sugerido con anticipación Zamudio (2001a).

PINGUICULA MICHOACANA Zamudio & D. Juárez, **sp. nov.** TIPO. **MÉXICO. Michoacán.** Municipio de Jiquilpan, 18/09/2014, *S. Zamudio e I. García-Ruiz 16860* (holotipo UAMIZ; isotipos CIIDIR, ENCB, EBUM, IBUG, MEXU, UAMIZ). Figura 7.

Herba perennis. Folia radicalia rosulata biformia, hiemalia crassa, ovato-lanceolata vel lanceolata longe acuminata 4–25(30) mm longa, 1–5(7) mm lata; folia aestivalia pauca 2–8 petiolata, petiolo (15)20–25(40) mm longo ciliato, lamina obovato-elliptica vel suborbiculata (15)20–60 mm longa, 10-50 mm lata apice rotundata, margine involuta. Pedunculi 1–4(6), erecti virides vel purpurei (40)50–120(150) mm alti uniflori. Flores 35–45(50) mm longi (calcari incluso). Calyx bilabiatus, labium superum trilobum lobis lanceolatis, labium inferum bilobum lobis lanceolatis. Corolla profunde bilabiata rosea vel purpurea, labium superum bilobum lobis oblongis rotundatis vel truncatis, labium inferum paulo majus trilobum lobis oblongis vel obovato-oblongis rotundatis 8–20(25) mm longis, 5–10 mm latis; tubus infundibuliformis brevissimus sine palato albo-pilosus pilis brevibus cylindricis; calcar cylindrico-subulatum purpureum vel roseum, (15)20–30 mm longum, 0.5–1 mm latum. Capsula subglobosa 4–6 mm diametro. Semina numerosa, fusiformia, ca. 0.5 mm longa, ca. 0.1 mm lata.

Planta herbácea perenne; hojas basales dimórficas divididas en dos rosetas subsecuentes; roseta invernal compacta, hipogea, de 4–25(30) mm de largo, por (5)10–15 mm de ancho, formada por 20–40 hojas crasas, las exteriores ovado-lanceoladas, de (5)15–25(30) mm de largo, por 3–5(7) mm de ancho, ápice largamente acuminado, margen entero, las interiores lanceoladas, de 4–7 mm de largo, por 1–3 mm de ancho, ápice largamente acuminado, glabras; roseta de verano laxa, con 2–8 hojas membranáceas, pecioladas; peciolo cóncavo, de (15)20–25(40) mm de largo, margen ciliado, cilios de 3–6 mm de largo; lámina obovado-elíptica a suborbicular, de (15)20–60 mm de largo, por 10–50 mm de ancho, ápice redondeado, base cuneada a atenuada, margen ligeramente involuto, cubierta por glándulas sésiles y glándulas estipitadas en el haz; pedúnculos 1–4(6), erectos, verdes o teñidos de morado, cubiertos por glándulas estipitadas más densas hacia la parte superior, de (40)50–120(150) mm de largo; flores de 35–45(50) mm de largo (incluyendo el espolón); cáliz bilabiado, cubierto por glándulas estipitadas en la cara externa y escasas hacia la cara interna, labio superior trilobado, lóbulos lanceolados, de 3–5 mm de largo, 1–2 mm de ancho, labio inferior bilobado, lóbulos lanceolados, de 3–5 mm de largo, 0.5–2 mm de ancho; corola bilabiada, de color rosa a púrpura, con una mácula blanca en el centro del labio inferior, labio superior bilobado, lóbulos oblongos, de 8–15 mm de largo, por 5–10 mm de ancho, ápice redondeado a truncado, labio inferior trilobado, lóbulos oblongos a obovado-oblongos, de 8–20(25) mm de largo, por 5–10 mm de ancho, ápice redondeado a truncado; tubo infundibuliforme, de 2–5 mm de largo, por 1.5–3 mm de ancho, cubierto por pelos glandulares capitados en el interior; espolón cilíndrico-subulado, rosa a purpura, de (15)20–30 mm de largo, por 0.5–1 mm de ancho; ovario subgloboso, glandular-pubescente, con glándulas pedunculadas cortas, de ± 1.5 mm de diámetro, estigma bilobado, rosa a púrpura, subsésil, el lóbulo inferior un poco más grande que el superior, oblato; cápsula subglobosa, de 4–6 mm de diámetro, cubierta por glándulas pedunculadas cortas esparcidas; semillas numerosas, elipsoidales, ± 0.5 mm de largo, por ± 0.1 mm de ancho.

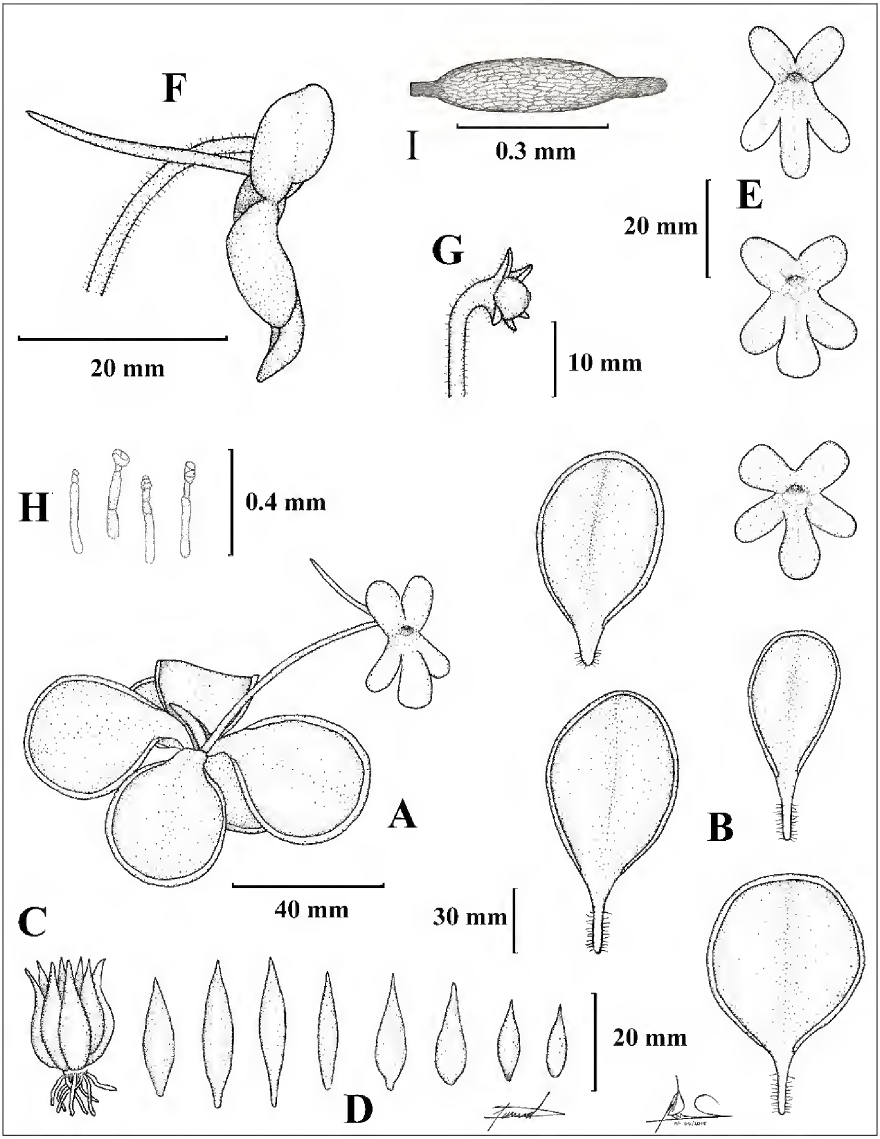

Figura 7. *Pinguicula michoacana*. A. Hábito de la planta con hojas de verano y flor. B. Serie de hojas de verano. C. Roseta de invierno. D. Serie de hojas de invierno. E. Vista frontal de las flores mostrando variación en los lóbulos de la corola. F. Vista lateral de la flor. G. Fruto. H. Pelos de la corola. I. Semilla. Ilustrado por Manuel Ramírez Amezcua y David Juárez.

Figura 8. *Pinguicula casperi* A-C. A. Hábitat. B. Hábito mostrando flores. C. Plantas con hojas de verano, flores y frutos; *Pinguicula michoacana* D-F. D. Roseta de invierno. E. Roseta de verano. F. Flor

Pinguicula michoacana se conoce de una sola localidad en el municipio de Jiquilpan, Michoacán. Crece sobre concreciones de carbonato de calcio, en paredes de rocas ígneas basálticas con orientación noroeste y escurrimiento de agua, junto con densas poblaciones de algas, musgos y líquenes, entre el bosque tropical caducifolio. Altitud 1800 m. Florece desde finales de marzo hasta septiembre, presenta mayor floración cuando la temperatura y humedad aumentan durante la temporada de lluvias. Los frutos se encuentran un mes después de iniciada la floración, por lo que las etapas de floración y fructificación se traslapan en parte, produce por temporada hasta 6 frutos por planta. La roseta de verano comienza a crecer entre marzo y abril, alcanzando su máximo desarrollo en agosto, posteriormente se reduce para iniciar la formación de la roseta invernal, ésta comienza a formarse a finales de septiembre, y entre octubre y noviembre ya está bien conformada, manteniéndose enterrada durante la temporada seca invernal hasta marzo o abril del siguiente año.

Debido a la reducida distribución de esta especie, se le considera un microendemismo dentro del estado de Michoacán, del cual toma su nombre.

Material adicional revisado. MÉXICO. Michoacán. Municipio de Jiquilpan, 6/03/2014, *Zamudio y García-Ruiz 16686* (MEXU, UAMIZ).

De acuerdo con la clasificación subgenérica de Casper (1966) *Pinguicula michoacana* se ubica en el subg. *Pinguicula*, sección *Orcheosanthus* DC., por la corola profundamente bilabiada, con lóbulos más grandes que el tubo, éste cortamente infundibuliforme y espolón más largo que la corola. La flor de *P. michoacana* es muy parecida a la de *P. oblongiloba* y podría confundirse con ella durante la floración, pero la nueva especie difiere principalmente por las características morfológicas de la roseta de invierno, así como en el hábitat en que se desarrolla. La roseta invernal de *P. michoacana* está formada por 20 a 40 hojas crasas, ovado-lanceoladas a lanceoladas, con el ápice largamente acuminado, glabras, sin cilios, más bien parecidas a las de *P. acuminata* Benth., mientras que en *P. oblongiloba* está formada por 60 a 86 hojas crasas, con el ápice agudo a cortamente acuminado, y el margen ciliado, en ésta las rosetas de invierno están cubiertas por una capa formada por los restos de las hojas de verano del año anterior que son escariosas y ciliadas. La acrecencia del cáliz durante la fructificación observada en *P. oblongiloba* no se presenta en *P. michoacana*. Por otro lado, los ambientes en que se desarrollan son distintos, *P. michoacana* crece sobre concreciones de carbonato de calcio en paredes verticales de rocas ígneas, con escurrimientos de agua, entre el bosque tropical caducifolio, a 1800 m de altitud, mientras que *P. oblongiloba* se desarrolla sobre suelo arcilloso, en taludes o bordos de arroyos o en las paredes de cañadas sombreadas y húmedas en bosque de pino, de encino, de pino-encino, de enebro y bosque mesófilo de montaña, entre (1100)1500–2500(2800) m (Cuadro 4).

Caracteres	*Pinguicula oblongiloba*	*Pinguicula michoacana*
Roseta de invierno	Hipogea, compacta en forma de bulbo, cubierta por hojas escariosas.	Hipogea, compacta en forma de bulbo, no cubierta por hojas escariosas.
Hojas de invierno	(25)60–86, con el ápice agudo-acuminado, margen ciliado.	20–40, con el ápice largamente acuminado, margen glabro.
Hojas de verano	(2)3–4(8). lámina suborbicular a oblongo-elíptica, de (16)20–50(75) mm de largo y (6)10–55 mm de ancho.	2-8, lámina obovada-elíptica a suborbicular, de (15)20–60 mm de largo y 10–50 mm de ancho.
Pedúnculos	De (50)100–150(230) mm de largo.	De (40)50–120(150) mm de largo.
Flores	De (28)30–40(55) mm de largo (incluyendo el espolón).	De 35–45(50) mm de largo (incluyendo el espolón).
Cáliz	Bilabiado, lóbulos lanceolados, de (1.5)4–6 mm de largo y 1–3 mm de ancho, acrescentes durante la fructificación.	Bilabiado, lóbulos lanceolados, de 3–5 mm de largo y (0.5)1–2 mm de ancho, no acrescentes durante la fructificación.
Tubo	Tubo corto, ampliamente infundibuliforme, de 3–5 mm de largo.	Tubo corto, infundibuliforme, de 2–5 mm de largo.

Hábitat	Bosque de pino, de encino, de pino-encino, de enebro y mesófilo de montaña.	Bosque tropical caducifolio.
Altitud	(1100)1500–2500(2800) m.	1800 m.
Sustrato	Suelo arcilloso derivado de rocas ígneas.	Concreciones de carbonato de calcio sobre rocas ígneas.

Cuadro 4. Comparación entre *Pinguicula oblongiloba* y *P. michoacana.*

La descripción de estos cuatro taxa nuevos incrementa la diversidad del género *Pinguicula* conocida para México a un aproximado de 50 especies; una de las características de la mayoría de las especies recientemente descritas es que son endemismos muy estrechos y refuerza la idea de que los elementos de este género descubiertos en los últimos años son endemismos de distribución muy restringida, que se encuentran aislados en hábitats particulares en las montañas mexicanas, por lo que no se descarta la posibilidad de que en un futuro cercano se descubran más especies nuevas en este país.

AGRADECIMIENTOS

Se agradece al Dr. Jerzy Rzedowski por la revisión del artículo, a Gabriela Aguilar, Ignacio García, Socorro González, Ulises Guzmán, Jorge Noriega, Arturo de Nova, Roberto Pedraza, Ricardo Quirino, María Magdalena Salinas, Erandi Sánchez, Benito Servín, Hugo Von Thaden, Juan José Von Thaden, e Ignacio Torres, por su compañía y ayuda en las exploraciones de campo; a José Manuel Ramírez Amezcua por la preparación de los dibujos. El apoyo financiero para la realización de este trabajo proviene de la Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO) y del Consejo Nacional de Ciencia y Tecnología (CONACyT).

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Rzedowski, J. 2018. Tres novedades de Campanulaceae-Lobelioideae del estado de Oaxaca (México). Phytoneuron 2018-15: 1–9. Published 28 March 2018. ISSN 2153 733X

TRES NOVEDADES DE CAMPANULACEAE-LOBELIOIDEAE DEL ESTADO DE OAXACA (MÉXICO)

JERZY RZEDOWSKI
Instituto de Ecología, A.C.
Centro Regional del Bajío
Apartado postal 386
61600 Pátzcuaro, Michoacán, México
jerzedowski@gmail.com

RESUMEN

Se describen e ilustran tres especies nuevas de Campanulaceae-Lobelioideae del estado mexicano de Oaxaca, una de ellas perteneciente a un género nuevo, todas probablemente de limitada distribución geográfica. **Lobelia quiexobrae** Rzed., **sp. nov.**, se ha colectado en dos localidades cercanas de la Sierra Madre del Sur, en el distrito de Miahuatlán, y se relaciona con la simpátrica *L. hintoniorum* B.L. Turner. El único ejemplar de **Lobelia rosalindae** Rzed., **sp. nov.**, procede de un sitio cercano al límite con Chiapas, en las estribaciones montañosas del lado oriente del Istmo de Tehuantepec. Aunque sus características florales son similares a las de muchos representantes mexicanos de la secc. *Stenotium*, el tinte anaranjado-rojizo de sus corolas no la ubica claramente allí. **Wimmeranthus inopinatus** Rzed., **gen. & sp. nov.**, se describe asimismo de un solo espécimen, proveniente de la región mixteca. El género nuevo está estrechamente vinculado con *Diastatea* Scheidw. y con *Porterella* Torr.

ABSTRACT

Three new species of Campanulaceae-Lobelioideae from the Mexican state of Oaxaca, one of them belonging to a new genus, are described and illustrated. All are probably of limited geographical distribution. **Lobelia quiexobrae** Rzed., **sp. nov.**, was collected in two localities of the Sierra Madre del Sur in the district of Miahuatlán and is related to the sympatric *L. hintoniorum* B.L. Turner. The only specimen of **Lobelia rosalindae** Rzed., **sp. nov.**, comes from a place near the Chiapas border in the mountains on the eastern side of the Isthmus of Tehuantepec. Its flower characters are similar to those of many Mexican species of sect. *Stenotium*, but the orange-reddish corollas do not help to place it clearly there. **Wimmeranthus inopinatus** Rzed., **gen. & sp. nov.**, is described from a single specimen collected in the Mixteca region. *Diastatea* Scheidw. and *Porterella* Torr. are the close relatives of the new genus.

En el transcurso del examen de materiales no identificados de los géneros *Diastatea* y *Lobelia* en el herbario del Instituto de Biología de la Universidad Nacional Autónoma de México (MEXU) se encontraron tres ejemplares de Oaxaca pertenecientes a especies aparentemente aun desconocidas, que se describen e ilustran a continuación.

LOBELIA QUIEXOBRAE Rzed., **sp. nov.** TIPO: **MÉXICO. Oaxaca.** Distr. Miahuatlán, Mpio. San Juan Mixtepec, 2+ km S, lat. 16°18'03"N, long. 96°18'03"W, elev. 2400 m, 14 Nov 1996, *E. Hunn OAX-429* (holotipo: MEXU). Figura 1.

Planta herbacea ut videtur perennis glabra 30-50 cm alta; caulis erectus aliquantum ramosus striatus; folia elliptico-rhombea ad rhombea vel lineari-elliptica, 2-5 cm longa, 3-9 mm lata, apice acuta vel acuminata, basi longe attenuata; racemi longe pedunculati secundiflori 3-8 floribus, pedicellis ad 3 cm longis; hypanthium 0.5-1.5 mm longum et latum, calycis segmenti lineares vel lanceolati 2-3 mm longi; corolla azureo-atropurpurea, tubo 10-11 mm longo interdum albido-azureo, labii superi segmentis linearibus vel subulatis 2-3 mm longis, labii inferi segmentis oblanceolatis 5-6 mm longis; antheratum tubus ca. 3 mm longus glaber sed antherarum inferum apices barbati; fructus ca. 12 mm longus inferus in minus quam 1/4 partem longitudinis; semina ellipsoidea ca. 1 mm longa, brunneo-rubella nitida.

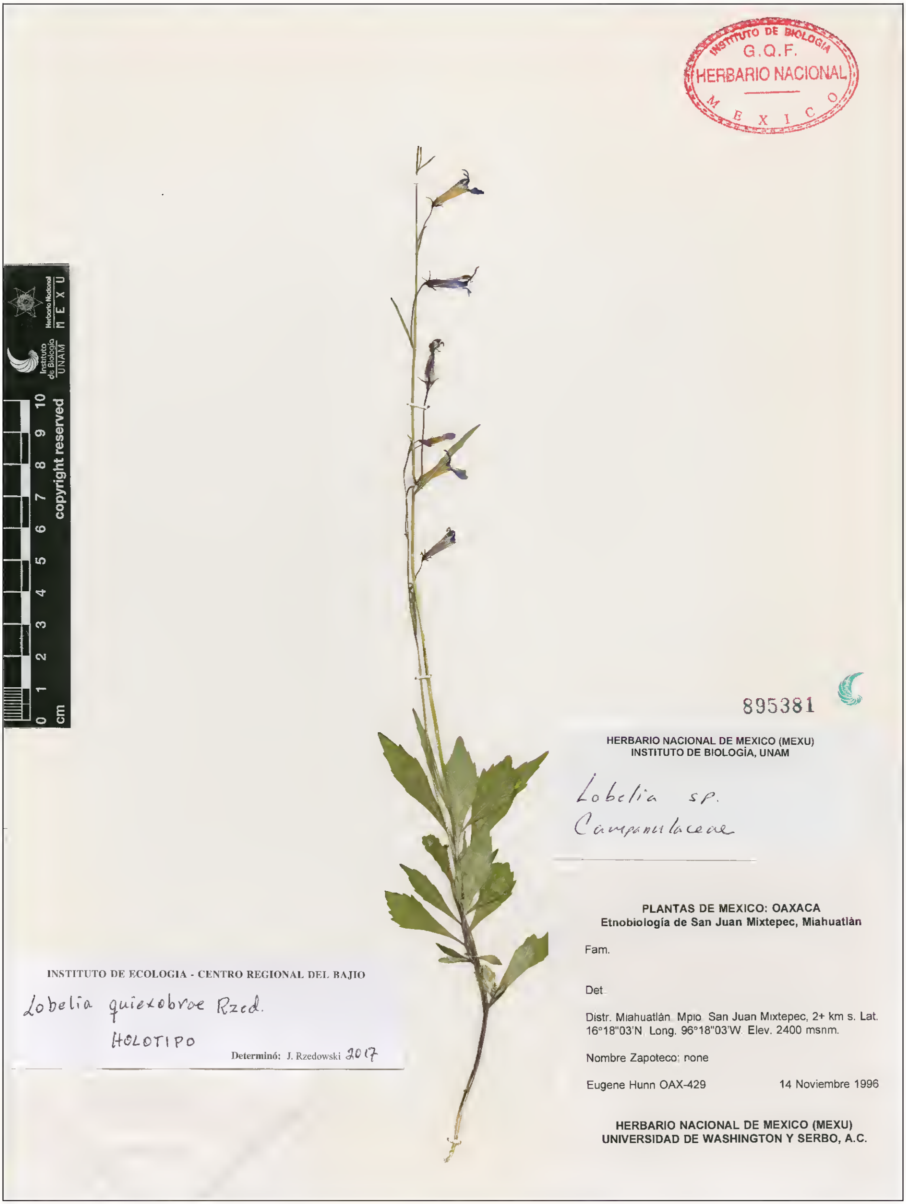


Figura 1. El ejemplar tipo de *Lobelia quiexobrae.*

Planta herbácea probablemente perenne, prácticamente glabra, de 30 a 50 cm de alto; tallo erecto, algo ramificado en su porción inferior, notablemente estriado, con conspicuos tintes morados; hojas elíptico-rómbicas a rómbicas o linear-elípticas, de 2 a 5 cm de largo, de 3 a 9 mm de ancho, agudas a acuminadas en el ápice, aunque con frecuencia con la punta roma, largamente atenuadas hacia una base pecioliforme, de margen serrado en su mitad o tercio superior, entero en la inferior, de textura membranácea; flores dispuestas en racimos laxos secundifloros sobre pedúnculos delgados hasta de 10 cm de largo, raquis de la inflorescencia hasta de 12 cm de largo, con 3 a 8 flores, brácteas lineares, de 6 a 20 mm de largo, pedicelos filiformes, hasta de 3 cm de largo, por lo general ascendentes y sin doblez, sin bracteolas, glabros; hipantio corto, de 0.5 a 1.5 mm de largo y de ancho, segmentos del cáliz lineares a lanceolados, de 2 a 3 mm de largo, morados oscuros, glabros; corola tubular, carente de espolón, de ca. 16 mm de largo, glabra, el tubo de 10 a 11 mm de largo, azul-blanquecino a azul-morado oscuro, no fenestrado, dorsalmente hendido hasta la base, segmentos de color azul-morado oscuro, los del labio superior lineares, de 4 a 5 mm de largo, los del labio inferior oblanceolados, de 5 a 6 mm de largo, columna estaminal de ca. 10 mm de largo, exserta, tubo de anteras de ca. 3 mm de largo, glabro salvo un mechón de pelos blancos en el ápice de las inferiores; fruto de ca. 12 mm de largo, ínfero en menos de la cuarta parte de su longitud; semillas elipsoides, de ca. 1 mm de largo, café-rojizas, lisas.

Material adicional examinado. **MÉXICO**. **Oaxaca**. Distrito Miahuatlán, Quiexobra, 2920 m., mixed forest, fl. dark blue, frequent colonies 0.5 m, 4 Oct 1995, *Hinton 26104* (IEB, TEX).

Lobelia quiexobrae se conoce solamente de los dos ejemplares arriba mencionados, colectados entre sí a unos 30 km de distancia y al parecer representa un estrecho endemismo de la Sierra Madre del Sur de Oaxaca. La etiqueta del primer espécimen carece de mayor información ecológica, pero con el dato de la altitud y la breve descripción ambiental disponible en el trabajo de Hunn (1998: 37), cabe deducir que crece muy probablemente en el bosque de pino-encino, mismo que aparentemente también corresponde al 'mixed forest' de Hinton, aunque es factible que a los 2900 m de altitud estén presentes también *Abies, Alnus* y quizás *Pseudotsuga*, que se ha registrado asimismo de la región.

En virtud de su hábito esbelto, corola azul-morada de menos de 2.5 cm de largo, columna estaminal exserta y anteras inferiores barbadas, la nueva especie se ubica en la secc. *Stenotium* (Lammers, 2011), aproximadamente equivalente a la subsecc. *Leiospermae* de la más antigua clasificación de Wimmer (1953).

Lobelia quiexobrae debe estar cercanamente relacionada con la simpátrica *L. hintoniorum* B.L. Turner (1995) y le es bastante semejante, al grado de que el mencionado autor ubicó el ejemplar paratipo de la primera como correspondiente a la segunda, comentando de que se trata de un espécimen depauperado con hojas relativamente más pequeñas. A su vez, el examen del material herborizado por Hunn permitió apreciar el hecho de la críptica convivencia de dos entidades diferentes.

Ambas especies crecen en semejantes condiciones ecológicas, comparten lo glabro de sus partes vegetativas, la inflorescencia secundiflora, el reducido desarrollo del hipantio y en consecuencia el fruto escasamente ínfero, la corola azul-morada oscura, relativamente grande, carente de espolón y de aperturas laterales, así como las anteras glabras, salvo el mechón de pelos en el ápice de las inferiores. Difieren esencialmente entre sí en la forma de las hojas y en el tamaño de las flores, como se aprecia en el Cuadro 1.

El nombre del taxón nuevo hace alusión a la localidad del ejemplar paratipo. El cerro Quiexobra (también conocido como cerro Nube Flan) es un gran macizo montañoso, el más elevado del estado de Oaxaca y también de toda la Sierra Madre del Sur. Su cumbre alcanza altitud superior a

3700 m. Sus porciones más elevadas ostentan una vegetación de carácter alpino cuya flora, estudiada recientemente por MacDonald (2013), incluye entre varias a otra especie aun más estrechamente endémica: *Lobelia macdonaldii* B.L. Turner, no emparentada en forma cercana con *L. quiexobrae* ni con *L. hintoniorum*.

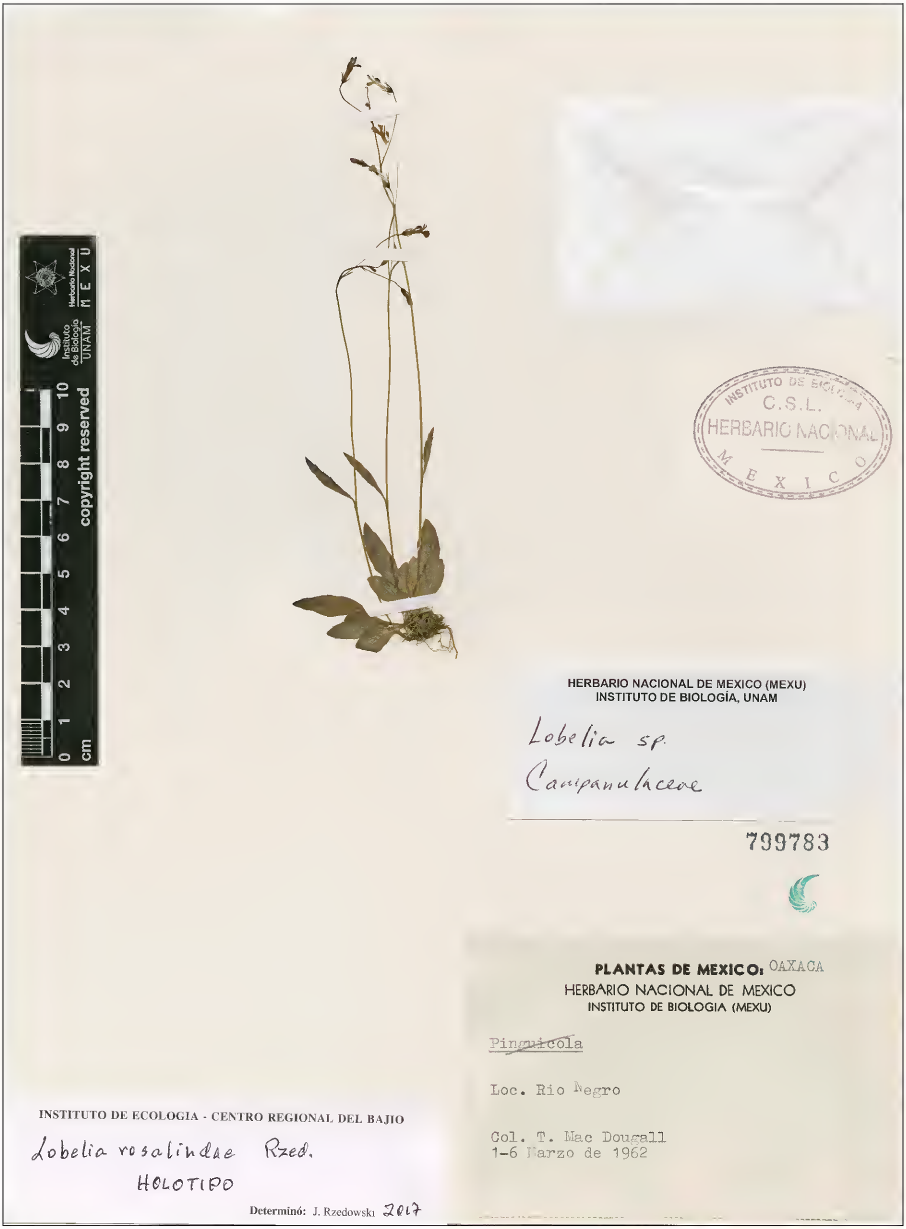
CARACTERES	**Lobelia hintoniorum**	**Lobelia quiexobrae**
Hojas		
forma	angostamente lineares	elíptico-rómbicas a elíptico-lineares o rómbicas
proporción largo/ancho	más de 15/1	menos de 10/1
Segmentos del cáliz		
largo en mm	4 a 6	2 a 3
Tubo de la corola		
largo en mm	12 a 16	10 a 11
profundidad de hendidura	9 a 10 mm	hasta la base
Segmentos del labio superior de la corola		
forma	linear-lanceolados	lineares
Segmentos del labio inferior de la corola		
largo en mm	7 a 10	5 a 6

Cuadro 1. Principales caracteres diferenciales entre *Lobelia quiexobrae* y *L. hintoniorum.*

LOBELIA ROSALINDAE Rzed., **sp. nov.** TIPO: **MÉXICO. Oaxaca**. Rio Negro, 1-6 Mar 1962, *T. MacDougall s.n.* (holotipo: MEXU). Figura 2.

Planta herbacea perennis scapiformis ca. 20 cm alta; caules filiformes glabri; folia principalia ca. 10 rosulatim disposita, breviter petiolata elliptica vel subrhombica 1-2.5 cm longa, 4-6 mm lata, sparse puberula; racemi ca. 4-flori pedicellis ad 2 cm longis ebracteolatis; hypanthium ca. 1 mm longum et latum, brunneo-rubellum, calycis segmenti lineares ca. 2.5 mm longi viriduli; corolla aurantiaco-rubella, tubo ca. 4 mm longo non fenestrato, segmentis labii superi linearibus ca. 2 mm longis, segmentis labii inferi oblanceolatis ca. 3 mm longis; antherarum tubus ca. 1.5 mm longus superne puberulus, antherarum inferarum apices barbati; fructus immaturus semiinferus ca. 3 mm longus; semina ignota.

Planta herbácea perenne erecta, de ca. 20 cm de alto, escapiforme; tallos varios partiendo de la base, filiformes, de ca. 0.5 mm de diámetro, estriados, glabros; hojas principales ca. 10, agrupadas en roseta basal, peciolos hasta de 5 mm de largo, láminas elípticas a casi rómbicas, de 1 a 2.5 cm de largo, de 4 a 6 mm de ancho, agudas a obtusas en el ápice, atenuadas en la base, espaciadamente serruladas a casi enteras en el margen, esparcidamente pubérulas en ambas superficies, de textura membranácea, hoja caulinar una por cada tallo, linear-elíptica, de 14 a 17 mm de largo, de 1 a 2 mm de ancho, atenuada en ambos extremos; inflorescencias en forma de racimos terminales de ca. 4 flores, brácteas lineares, de 2 a 4 mm de largo, pedicelos filiformes, hasta de 2 cm de largo, bracteolas ausentes; hipantio de ca. 1 mm de largo y de ancho, café-rojizo, segmentos del cáliz lineares, de ca. 2.5 mm de largo, verdosos, enteros; corola anaranjado-rojiza, pero blanquecina en la marchitez, tubo



HERBARIO NACIONAL DE MEXICO (MEXU)
INSTITUTO DE BIOLOGÍA, UNAM

Lobelia sp.
Campanulaceae

PLANTAS DE MEXICO: OAXACA
HERBARIO NACIONAL DE MEXICO
INSTITUTO DE BIOLOGIA (MEXU)

Pin~~guicola~~

Loc. Rio Negro

Col. T. Mac Dougall
1-6 Marzo de 1962

INSTITUTO DE ECOLOGIA - CENTRO REGIONAL DEL BAJIO

Lobelia rosalindae Rzed.
HOLOTIPO

Determinó: J. Rzedowski 2017

Figura 2. El ejemplar tipo de *Lobelia rosalindae* de ca. 4 mm de largo, hendido hasta la base, no fenestrado, segmentos del labio superior lineares, de ca. 2 mm de largo, segmentos del labio inferior oblanceolados, de ca. 3 mm de largo, el central notablemente más ancho que los laterales; columna estaminal de ca. 3 mm de largo, exserta, tubo de anteras de ca. 1.5 mm de largo, pubérulo en la mitad superior, ápices de las anteras inferiores barbados; fruto inmaduro semiínfero, de ca. 3 mm de largo; semillas desconocidas.

Lobelia rosalindae solamente se conoce de la localidad tipo, no muy claramente definida, ubicada en las estribaciones montañosas al oriente del Istmo de Tehuantepec, conocidas como Selva Zoque, no lejos de los límites con Chiapas. El río Negro recorre la porción oriental de los municipios de Santa María Chimalapa y de San Miguel Chimalapa, y es en esa zona de difícil acceso donde con toda probabilidad realizó Thomas MacDougall su expedición de principios de marzo de 1962. El área ha sido muy escasamente explorada desde el punto de vista botánico.

De acuerdo con la información obtenida acerca de otras especies de plantas herborizadas en esos días por MacDougall, el ambiente general probablemente corresponde al bosque mesófilo de montaña.

De manera curiosamente convergente, la ubicación taxonómica de *L. rosalindae* tampoco es fácil de discernir. Las características generales de su flor coinciden bastante bien con las de muchos representantes mexicanos de la sección *Stenatium* de la clasificación de Lammers (2011). Sin embargo, todas estas plantas tienen flores moradas, azules o blancas, a veces algo rosadas pero no rojas o rojizas.

El porte escapiforme no es muy raro en *Stenatium*, pero ninguna de las especies conocidas de este conjunto parece mostrar relaciones estrechas con *L. rosalindae*.

El nombre de la especie nueva se está dedicando a Rosalinda Medina Lemos, relevante botánica mexicana, que en forma particular ha destacado en una muy eficiente promoción y realización del trabajo florístico. Tal esfuerzo es de particular trascendencia para el cabal conocimiento de los recursos naturales de nuestro país, pero en la actualidad escasamente apreciado y evaluado.

WIMMERANTHUS Rzed., **gen. nov.** Campanulacearum-Lobelioidearum

Diastatea Scheidw. Torr. similis sed differens ovario fructuque hemiinfero, foliis plerumque basalibus et floribus albis; *Porterella* Torr. pariter affinis sed antheris omnino puberulis, foliis petiolatis plerumque basalibus, floribus albis multo minoribus, bracteis minutis linearibus et seminibus late ellipiticis multo minoribusque discrepans.

Plantas anuales; tallos varios partiendo de la base, simples o ramificados; hojas esencialmente concentradas en rosetas basales o casi basales, elípticas, pecioladas, las caulinares por lo común solitarias y reducidas; inflorescencias en forma de racimos terminales, brácteas lineares, diminutas, bracteolas ausentes; flores invertidas, pequeñas; hipantio turbinado, segmentos del cáliz lineares, de margen entero; corola blanca, bilabiada, su tubo no fenestrado, carente de hendidura dorsal; anteras pubérulas en sus ápices y lados, sin apéndices apicales; ovario y fruto semiínferos; semillas anchamente elípticas, de ca. 0.15 mm de largo, cafés claras, brillantes.

Especie tipo: *Wimmeranthus inopinatus* Rzed.

WIMMERANTHUS INOPINATUS Rzed., **sp. nov.** TIPO: **MÉXICO. Oaxaca**. Distrito de Juxtlahuaca, Caba Cóo (Peña de Serpiente), a 1 km al N de San Juan Mixtepec, mun. San Juan Mixtepec, lat. 17°19’ N, long. 97°49’ W, elev. 1800 msnm, veg. bosque de *Juniperus flaccida, Annona cherimola, Bursera bipinnata,* suelo somero y rocoso, hierba con flores blancas, frecuente, 7 Nov 1988, *J. Reyes Santiago 1019* (holotipo: MEXU). Figura 3.

Planta annua ca. 25 cm alta, caulibus erectis ex base pluribus; folia principalia plerumque elliptica petiolata maximam partem basalia, laminis 0.8-2.5 cm longis; racemi terminales laxi 3-5 floribus, bracteis minutis linearibus, pedicellis ad 2.5 cm longis ebracteolatis: hypanthium turbinatum 1-1.5 mm longum, calycis segmentis linearibus 2-2.5 mm longis erectis; corolla alba tubo ca. 2 mm longo non fisso nec fenestrato, labii superi segmentis spathulatis ca. 1.5 mm longis, labii inferi segmentis oblongis ca. 1.5 mm longis; antherarum tubus ca. 1 mm longus apicibus lateribusque puberulis pilis rigidis ca. 0.1 mm longis; fructus late ellipsoideus vel suborbicularis ca. 4.5 mm longus, hemiinferus; semina late ellipsoidea 0.2 mm longa dilute brunnea nitida.

Planta anual de ca. 25 cm de alto, erecta; tallos varios partiendo de la base, algunos ramificados, rollizos, con frecuencia glabros, a veces esparcidamente pilósulos en el extremo inferior; hojas principales mayormente concentradas cerca de la raíz, un conjunto aglomerado a manera de roseta basal, otro grupo formando especie de roseta a nivel de la ramificación de uno de los tallos ca. 1 cm más arriba, una hoja de regular tamaño presente a unos 8 cm de distancia en la base de otra división caulinar, peciolos hasta de 7 mm de largo, pilósulos, láminas foliares por lo general elípticas, variando a rómbicas o angostamente ovadas, de 0.8 a 2.5 cm de largo, de 3 a 9 mm de ancho, agudas en el ápice, cuneadas en la base, serradas en el margen, esparcidamente pilósulas a casi glabras en el haz, pilósulas a lo largo de las nervaduras en el envés, hoja caulinar una por tallo, mayormente linear-elíptica, de ca. 1 cm de largo, de 1 a 2.5 mm de ancho; inflorescencias en forma de racimos terminales laxos de 3 a 5 flores, glabros, brácteas lineares, hasta de 4 mm de largo, pedicelos filiformes, acrescentes, ascendentes, hasta de 2.5 cm de largo, sin bracteolas; hipantio turbinado, de 1 a 1.5 mm de largo, de ca. 1 mm de diámetro, segmentos del cáliz lineares, de 2 a 2.5 mm de largo, erectos, de margen entero; corola blanca, tubo de ca. 2 mm de largo, carente de hendidura dorsal, sin aperturas laterales, segmentos del labio inferior espatulados, de ca. 1.5 mm de largo, segmentos del labio superior oblongos, de ca. 1.5 mm de largo, columna estaminal de ca. 2.5 mm de largo, tubo de las anteras de ca. 1 mm de largo, pubérulo en sus lados y ápices con pelos rígidos antrorsos de ca. 0.1 mm de largo; ovario semiínfero; fruto anchamente elipsoide a casi esférico, de ca. 4.5 mm de largo, ínfero en más de la mitad de su longitud; semillas anchamente elípticas, de ca. 0.2 mm de largo, cafés claras, brillantes.

La planta se conoce únicamente de la localidad original, ubicada en la región de la Mixteca, y muy probablemente representa un endemismo estrecho.

En su falta de hendidura dorsal de la corola y en su hábito anual *Wimmeranthus inopinatus* es afín a las especies de *Diastatea*, género esencialmente mexicano, sobre todo a *D. micrantha* (Kunth) McVaugh (su identificación original), con la cual coincide también en la pequeñez de las flores. No obstante, no se ubica bien allí, en virtud de carecer de ovario y fruto súperos, así como de hojas bien distribuidas a lo largo del tallo y de flores de color azul-morado, rasgos propios de los componentes de ese género.

En análogas características el taxón nuevo es posiblemente aún más relacionado con *Porterella carnosula* (Hook. & Arn.) Torr., planta conocida del oeste de Estados Unidos, con la cual concuerda asimismo en su ovario y fruto más bien ínferos. Sin embargo, difiere en

- anteras todas pubérulas y carentes de apéndices, vs. solamente barbadas en sus ápices y las dos más pequeñas provistas de proyecciones en forma de cuernos;
- corolas blancas, de menos de 5 mm de largo, vs. azules, de 8 a 18 mm de largo;
- hojas mayormente concentradas cerca de la base de la planta, pecioladas, vs. regularmente distribuidas a lo largo del tallo y sésiles;
- brácteas lineares, diminutas, vs. por lo general más anchas y a menudo más largas que las hojas;
- semillas anchamente elípticas, no apiculadas, de ca. 0.2 mm de largo, vs. fusiformes, apiculadas, de ca. 1 mm de largo.

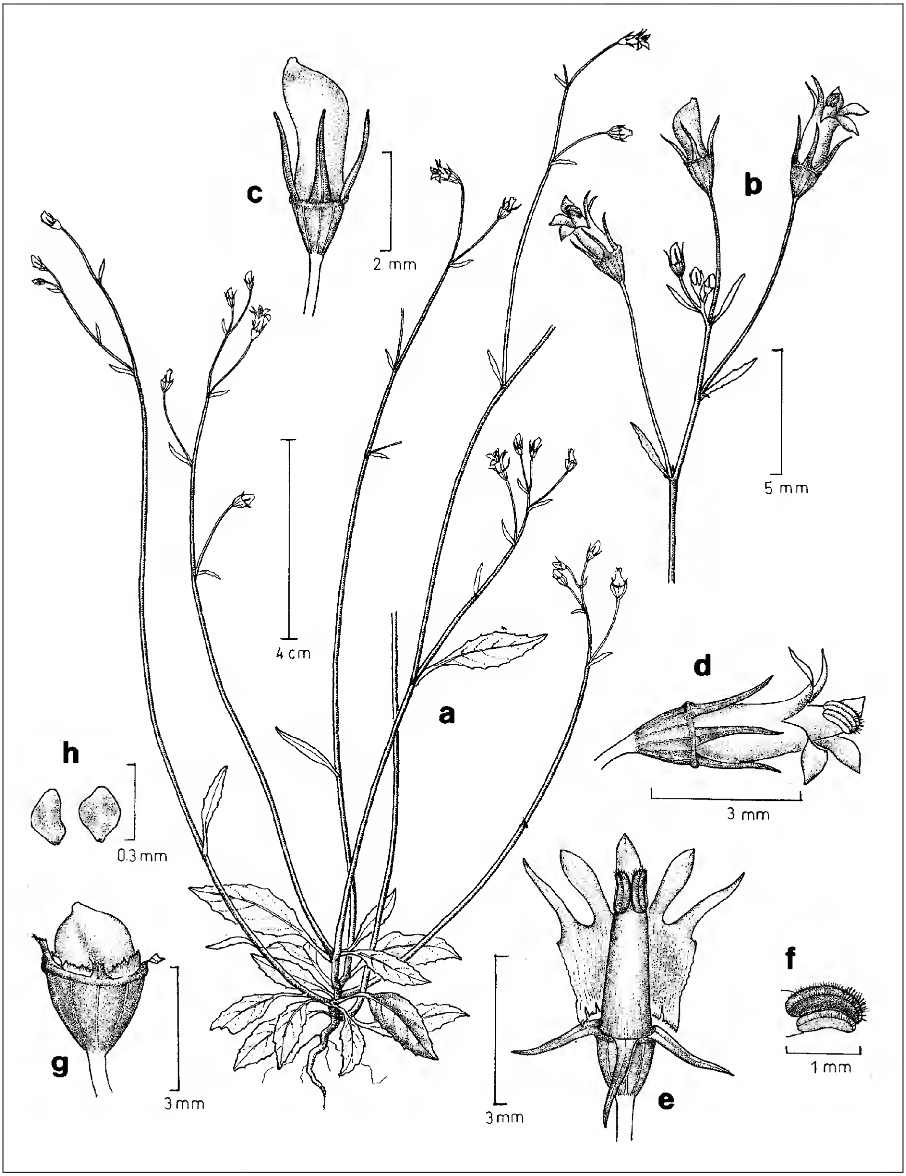


Figura 3. *Wimmeranthus inopinatus*. a. imagen del ejemplar tipo. b. Inflorescencia. c. Flor en botón. d. Flor abierta. e. Flor con corola disecada mostrando el androceo. f. Anteras. g. Fruto. h. Dos vistas de la semilla. Ilustrado por Albino Luna.

Tanto *Diastatea* como *Porterella* pertenecen al grupo de las Lobelioideae que durante muchos años integraba al género *Laurentia*, distribuido en ambos hemisferios, en su concepto más amplio. Posteriormente tal conjunto fue profundamente disgregado. McVaugh (1940) encontró que sus componentes norteamericanos pertenecen a tres entidades distintas: *Diastatea*, *Palmerella*, y *Porterella*. El mencionado autor decidió que la única especie conocida de *Palmerella* quedaba mejor ubicada como parte de *Lobelia*; sin embargo, en la actualidad las tres se reconocen como géneros independientes (Lammers, 2007).

El nombre del género está dedicado a la memoria de Franz Elfried Wimmer (1881-1961), sacerdote y botánico austriaco, quien dedicó más de 25 años de su vida al detallado estudio taxonómico de las Campanulaceae-Lobelioideae en escala mundial, mismo que culminó con la publicación del tomo correspondiente en el marco de la serie Das Pflanzenreich. El epíteto específico hace alusión al inesperado hallazgo de un género nuevo en un grupo de plantas tan ampliamente estudiado.

Las tres descripciones que anteceden están basadas en la observación de los caracteres de muy escaso material de herbario, de manera que con toda probabilidad muchos de los datos, sobre todo los cuantitativos, en realidad representen solamente una fracción de la variación existente.

AGRADECIMIENTOS

Se reconocen a las autoridades y al personal del herbario MEXU las facilidades otorgadas para la consulta de sus acervos. Ma. del Rosario García Peña tuvo la amabilidad de preparar las fotografías de dos ejemplares tipo. Se agradece a Lourdes Rico Arce y a Alejandra Núñez Merchand la información proporcionada sobre localidades de colecta de Thomas MacDougall en Oaxaca. Martha Rzedowski y Ernestina Rzedowski apoyaron la composición tipográfica. El dibujo es obra de Albino Luna.

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THE FIRST NATURALIZED OCCURRENCE OF *JASMINUM* (OLEACEAE) IN THE ARKANSAS FLORA

BRETT E. SERVISS
Department of Biological Sciences
Henderson State University
Arkadelphia, Arkansas 71999
servisb@hsu.edu

BROOK L. OLSEN
Bismarck, Arkansas 71929
brooklolsen@gmail.com

JONATHAN W. HARDAGE
Bismarck, Arkansas 71929
jh201098@reddies.hsu.edu

JAMES H. PECK
Cedar Key, Florida 32625
james.peckck@gmail.com

ABSTRACT

Jasminum nudiflorum Lindl. is reported here as new to the Arkansas flora. A large, naturalized population consisting of 100s of plants/clones was discovered on a hillside and adjacent woods in Hot Spring County. This record also marks the first documentation of the genus *Jasminum* in Arkansas, outside of cultivation. Photographs of *J. nudiflorum*, including naturalized plants in habitat, along with keys for distinguishing *Jasminum* and *Forsythia* species in the state's flora, are provided.

In 2018, a large, naturalized population consisting of 100s of plants/clones of *Jasminum nudiflorum* Lindl. (winter jasmine) was documented from Hot Spring County (Figs. 1–3). Plants occurred on a hillside and adjacent disturbed woods, and were vigorously spreading via clonal offsets/ramets from layering of aerial stems. Some plants also were climbing into the lower branches of trees (Fig. 2). Spread appeared to be limited to clonal offsets, as no isolated plants were observed away from the population (obvious establishment from seeds was not apparent). The population occurred in proximity to an old homesite, and although no discernibly cultivated plants of *J. nudiflorum* were observed in the area, one or more cultivated plants of *J. nudiflorum* that may have once existed at the homesite presumably established the naturalized population via asexual spread.

Voucher specimens. **Arkansas.** Hot Spring Co.: Hwy 84, Prairie Bayou, ca. 1-2 mi NE of Junction 128 and Hwy 84 intersection, 100s of plants/clones on hillside and disturbed woods, spreading via stem layering and the production of clonal offsets, 10 Mar 2018, *Serviss 8613*; 3 Mar 2018, *Olsen 110* (HEND).

Jasminum nudiflorum is a deciduous, colonial shrub with pendulous stems, to 5 m tall, native to China (Bailey 1949; Bailey & Bailey 1976; Krüssmann 1977; Chang et al. 1996—Fig. 4). It sometimes is cultivated in Arkansas; however, this is the first documented occurrence of this species, and of the genus *Jasminum*, outside of cultivation in the state. *Jasminum nudiflorum* previously has been documented outside of cultivation in a number of other states in the eastern USA (Diamond 2013; Yatskievych 2013; Kartesz 2015; Weakley 2015; Keener et al. 2018; USDA, NRCS 2018). Naturalization and establishment (in Arkansas) of *J. nudiflorum* apparently is primarily or exclusively asexual by layering of stems, and it should be expected elsewhere in Arkansas, especially in the vicinity of where plants of the species are cultivated. Diamond (2013) documented it naturalizing in similar fashion (via layering of stems) in Alabama.

Figure 1. Naturalized plants of *Jasminum nudiflorum* from Hot Spring Co., Arkansas. Plants in open area at base of hillside. At least some, if not all, spread is asexual via layering of stems; stem tips that come in contact with substrate produce clonal offsets. Many plants/clones are shown here.

Figure 2. Naturalized plants of *Jasminum nudiflorum* from Hot Spring Co. Notice plants in open area and also at edge and within disturbed woods, several of which have climbed into the lower branches of *Juniperus virginiana* (eastern red cedar).

Jasminum mesnyi Hance (primrose jasmine—Fig. 5) also is cultivated in Arkansas and present in the naturalized floras of several eastern states (Diamond 2013; Kartesz 2015; Weakley 2015; Keener et al. 2018; USDA, NRCS 2018). Although it is not currently documented from the Arkansas flora, it should be expected as escaped or naturalized, similar to *J. nudiflorum*. *Jasminum mesnyi* and *J. nudiflorum* are similar in form and habit and potentially could be confused (see Figs. 4–5 and subsequent key for distinguishing characteristics between the two species).

Figure 3. Naturalized plants of *Jasminum nudiflorum* from Hot Spring Co. Vantage point from upslope. A number of smaller clonal offsets are present at the bottom of the photograph.

Both *Jasminum* species somewhat resemble *Forsythia* in growth form and habit, especially during flowering when the leaves are sometimes absent. Two species of *Forsythia* recently have been documented from the Arkansas flora (Serviss et al. 2015; Serviss et al. 2017—Fig. 6), and these potentially could be confused with *Jasminum*. See below for key to distinguish species of *Jasminum* (including *J. mesnyi*) and *Forsythia* present in the Arkansas flora.

1. Leaves ternately compound (sometimes a few leaves simple at the base of the branchlets), margins of leaflets entire and often pubescent; corolla lobes (4)5–8(11) in number; fruit a berry.

    2. Terminal leaflet 1–3 cm long; corolla lobes shorter than the corolla tube; plant deciduous .... **Jasminum nudiflorum**
    2. Terminal leaflet 2.5–7 cm long; corolla lobes longer than the corolla tube; plant evergreen to semi-evergreen, sometimes with only a few leaves present in late winter .... **Jasminum mesnyi**

1. Leaves simple (occasionally some leaves ternately compound in *F. suspensa*), margins of leaves (or leaflets) prominently toothed; corolla lobes 4 in number; fruit a capsule.

    3. Leaves oblong-elliptic, obovate-elliptic, or lanceolate, margins generally only serrate on the distal one-third to one-half of the lamina, otherwise entire; pith lamellate .... **Forsythia viridissima**
    3. Leaves ovate to ovate-elliptic, margins serrate along most to nearly all of the lamina; pith hollow .... **Forsythia suspensa**

Figure 4. *Jasminum nudiflorum* plant and habit. A–B. Flowers and inflorescences. C. Leaves (notice the two simple leaves at the base of the branchlet). D. Bark. E. Close-up of clonal offsets from the Hot Spring County population.

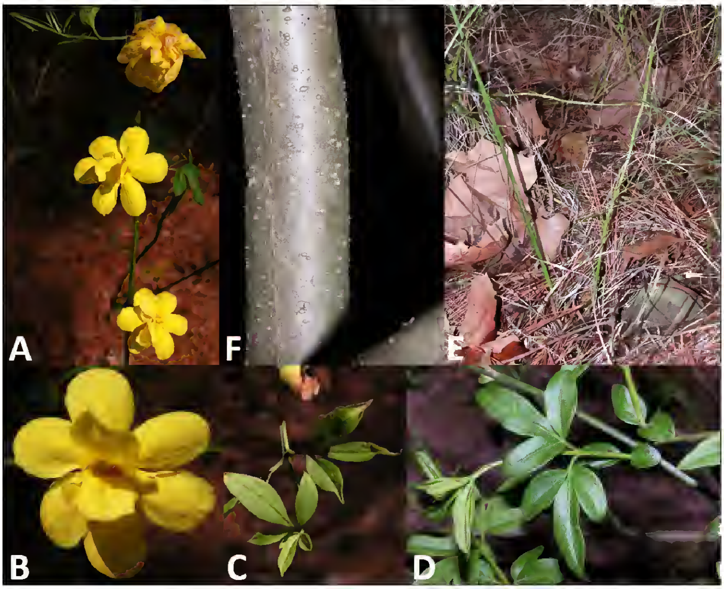

Figure 5. *Jasminum mesnyi* plant and habit. A–B. Flowers and inflorescences. C–D. Leaves (notice the two simple leaves at the base of the branchlet in Fig. D). E. Clonal offset from stem layering. F. Bark.

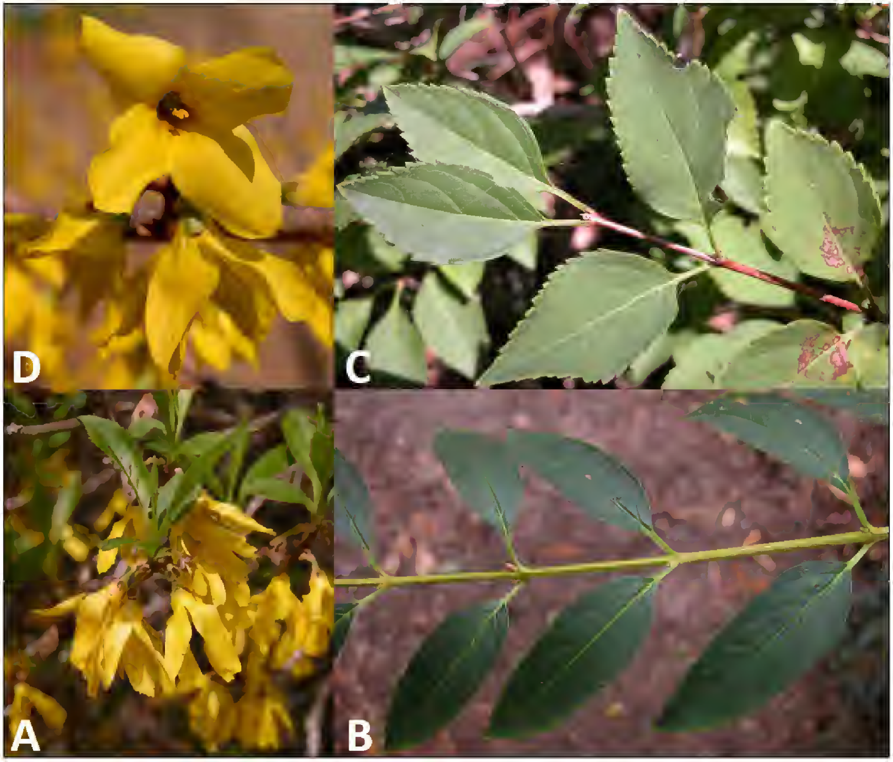

Figure 6. *Forsythia suspensa* (Thunb.) Vahl (weeping forsythia) and *F. viridissima* Lindl. (greenstem forsythia) for comparison with *Jasminum*. A–B. Flowers and leaves of *F. viridissima*. C–D. Leaves and flowers of *F. suspensa*. Both *Forsythia* species are naturalized in the Arkansas flora.

ACKNOWLEDGEMENTS

We are grateful to Mrs. Tricia Serviss for assistance with photography. We also thank the Henderson State University Department of Biological Sciences and the Ellis College of Arts and Sciences for supporting this work.

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ANTIRRHINUM THOMPSONII D.J. KEIL, A NEW NAME TO REPLACE THE ILLEGITIMATE *ANTIRRHINUM MULTIFLORUM* PENNELL (PLANTAGINACEAE)

DAVID J. KEIL
Professor Emeritus
Biological Sciences Department
California Polytechnic State University
San Luis Obispo, California 93407
dkeil@calpoly.edu

ABSTRACT

The binomial **Antirrhinum thompsonii** D.J. Keil, **nom. nov.**, is proposed to replace the illegitimate name *A. multiflorum* Pennell, which is currently in use for a species of *Antirrhinum* (sensu lato) endemic to California. For the same species, the name *Sairocarpus multiflorus* D.A. Sutton is available for use in the segregate genus *Sairocarpus*.

Pennell (1951) proposed *Antirrhinum multiflorum* as a substitute name for *Antirrhinum glandulosum* Lindl., nom. illeg. (1836), which is a later homonym of *A. glandulosum* Lej. (1813). Unfortunately *A. multiflorum* Pennell is itself an illegitimate later homonym of *A. multiflorum* J. Vick (1868), an obscure name published in a 19th century seed catalog.

Sutton (1988) split *Antirrhinum* (sensu lato) into a number of segregate genera, with the New World species being assigned to several genera. He transferred *A. multiflorum* Pennell to *Sairocarpus* as *S. multiflorus* D.A. Sutton. As there was no obstacle to the use of the epithet *multiflorus* in *Sairocarpus*, Sutton's use of the epithet is considered to be a replacement name based on the type of *Antirrhinum glandulosum* Lindl. (ICN Article 58.1—McNeill et al. 2012), with Pennell's name omitted as a parenthetical author. In the same year Thompson (1988) published a monograph of the New World species of *Antirrhinum*, maintaining the genus *Antirrhinum* (sensu lato). Thompson accepted *A. multiflorum* Pennell as the correct name for this California endemic, based on the type of *A. glandulosum* Lindl., apparently unaware of the earlier homonym, and it is the name currently in use in California floras, e.g., *The Jepson Manual* (Wetherwax & Thompson 2012).

Taxonomists are faced with the choice of which generic concept to accept for the New World snapdragons. Thompson (1993) and Wetherwax and Thompson (2012) continued to accept *Antirrhinum* (sensu lato) for the California flora, whereas the upcoming treatment of the Plantaginaceae in the Flora of North America will recognize *Sairocarpus* and other segregate genera for New World species formerly placed in *Antirrhinum* (Barringer 2013, pers. comm.). For botanists who prefer to follow Sutton's taxonomy, the name *Sairocarpus multiflorus* D.A. Sutton is available. For botanists who prefer to recognize *Antirrhinum* in the broad sense, including the New World taxa, there is not a legitimate alternative to *A. multiflorum* Pennell. I therefore am proposing the following replacement name.

ANTIRRHINUM THOMPSONII D.J. Keil, **nom. nov.** *Antirrhinum glandulosum* Lindl., Edwards's Bot. Reg. 22: t. 1893. 1836, nom. illeg. *Antirrhinum multiflorum* Pennell in Abrams, Ill. Fl. Pacific States 3: 780. 1951, nom. illeg. *Sairocarpus multiflorus* D.A. Sutton, Revis. tribe Antirrhineae 467. 1988.

Etymology. The epithet thompsonii honors Dr. David M. Thompson.

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MOHAVEA SUBSUMED WITHIN *ANTIRRHINUM* (PLANTAGINACEAE)

DAVID J. KEIL
Professor Emeritus
Biological Sciences Department
California Polytechnic State University
San Luis Obispo, California 93407
dkeil@calpoly.edu

ABSTRACT

Because the small genus *Mohavea* A. Gray is nested within the New World lineage of *Antirrhinum* L., based on molecular evidence, the two species of *Mohavea* are merged into *Antirrhinum.* The binomial **Antirrhinum mohavea** D.J. Keil, **nom. nov.**, is proposed because the earlier *Antirrhinum breviflorum* Gilib. precludes the use of the specific epithet of *Mohavea breviflora* Coville in *Antirrhinum.* With the addition of the two species from *Mohavea* and the exclusion of *Antirrhinum cyathiferum* Benth. as *Pseudorontium cyathiferum* (Benth.) Rothm., the New World snapdragons (*Antirrhinum* sect. *Saerorhinum* A. Gray) form a monophyletic unit.

Gray (1856) described the genus *Mohavea* and the species *M. viscida* A. Gray to accommodate a peculiar herbaceous annual discovered during the railroad surveys of the 1850s. Coville (1893) described a second species, *M. breviflora.* Heller (1912) noted that *M. viscida* had previously been described as *Antirrhinum confertiflorum* and published the combination *Mohavea confertiflora.* The genus *Mohavea* has been consistently recognized as a distinctive and readily recognizable genus of two species in western American floras, e.g., *The Jepson Manual* (Wetherwax & Thompson 2012).

Antirrhinum (sensu lato) is a genus with a disjunct distribution, comprising species of both the Old World (primarily Mediterranean region) and New World (western North America). Thompson's monograph (1988) of the New World species (sect. *Saerorhinum* A. Gray) included 15 species of annual and perennial herbs and subshrubs. Independently Sutton (1988) in a revision of the tribe Antirrhineae split *Antirrhinum* (sensu lato) into a number of segregate genera, with the New World species being assigned to four genera: *Howelliella* Rothm., *Neogaerrhinum* Rothm., *Pseudorontium* (A. Gray) Rothm., and *Sairocarpus* D.A. Sutton.

Oyama and Baum (2004) investigated the phylogenetic relationships of the New World snapdragons using phylogenetic analyses of sequences of the internal transcribed spacer region (ITS) of nuclear ribosomal DNA from all of the New World species recognized by Thompson (1988), four Old World species, and 13 related genera of the tribe Antirrhineae. They found that the two species of *Mohavea* are nested within the clade that includes most of the New World *Antirrhinum* species. The New World species *A. cyathiferum* Benth. is not at all closely related to the rest of *Antirrhinum.* This species was treated by Sutton (1988) as *Pseudorontium cyathiferum* (Benth.) Rothm., and it is clear from the analyses that its exclusion from *Antirrhinum* and its placement in the monotypic genus *Pseudorontium* are warranted. The phylogenetic analyses of Oyama and Baum (2004) do not support the remaining three genera recognized by Sutton, although relationships among the taxa of *Howelliella*, *Neogaerrhinum*, and *Sairocarpus* were only weakly resolved. With the exclusion of *A. cyathiferum* and the inclusion of *Mohavea*, the remainder of *Antirrhinum* forms a well-supported monophyletic lineage including both the Old and New World species. The remaining American species plus *Mohavea* comprise a monophyletic *Antirrhinum* sect. *Saerorhinum*, albeit only weakly supported.

Ogutcen and Vamosi (2016) also investigated the systematics of the Antirrhineae, using data from multiple DNA regions. Their analysis, like that of Oyama and Baum (2004), recovered a well-supported *Antirrhinum* clade that contains a more weakly supported New World *Antirrhinum* clade in which *Mohavea* is nested. Their sampling included 12 of the New World species but did not include *Pseudorontium cyathiferum* (Benth.) Rothm.

Inclusion of *Mohavea* and the removal of *Antirrhinum cyathiferum* result in a monophyletic lineage of New World *Antirrhinum*. A binomial in *Antirrhinum* already exists for *Mohavea confertiflora*; the species was originally described as *Antirrhinum confertiflorum* (de Candolle 1846). *Mohavea breviflora*, however, has not previously been classified in *Antirrhinum*, and the combination *Antirrhinum breviflorum* Gilib. already exists. I therefore am proposing a replacement name in *Antirrhinum* for this species. Nomenclature for the two species follows.

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ANTIRRHINUM MOHAVEA D.J. Keil, **nom. nov.** *Mohavea breviflora* Coville, Contr. U.S. Natl. Herb. 4: 168, pl. 17. 1893 (non *Antirrhinum breviflorum* Gilib., Fl. Lit. Inch. 1: 137. 1782).

Etymology. The epithet "mohavea" is the former generic name serving as a noun in apposition to the generic name *Antirrhinum* and retains its own gender and termination irrespective of the gender of the generic name (ICN Article 23.5—McNeill et al. 2012).

ACKNOWLEDGEMENTS

I thank Bruce Baldwin for his insightful comments on earlier drafts of the manuscript.

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OBSERVATIONS OF HERMAPHRODITIC LATE-SEASON FLOWERING IN THE RED OAK *QUERCUS AGRIFOLIA*

AL KEUTER
Santa Cruz, California
4keuter@gmail.com

ABSTRACT

For three consecutive years (2015–2017) a single coast live oak (*Q. agrifolia* Née) in the city of Santa Cruz, California, has produced bisexual (perfect) flowers on crown twigs emerging mid to late summer. By the end of each year many of these flowers developed into small acorns, though none of the fruit ever matured completely or survived until the following year.

True oaks (*Quercus*) are normally monoecious. Nevertheless, hermaphroditic flowers have been documented in white oaks (sect. *Quercus*) by a number of researchers, but only once in red oaks (sect. *Lobatae*).

The earliest described California white oak with perfect flowers was '*Quercus dumosa* Nutt.' (Greene 1889; now *Q. pacifica* Nixon & C.H. Mull.). John Tucker subsequently provided detailed reports of hermaphroditic flowers in other California white oaks –– '*Q. turbinella* subsp. *californica*' (now *Q. john-tuckeri* Nixon & C.H. Mull.), *Q. durata* Jeps., and *Q. dumosa* (Tucker 1972), and also the white oak *Q. gambelii* Nutt. in Utah (Tucker et al. 1980). Papper (pers. comm., 2015) has more recently observed late-season bisexual flowers in *Q. durata*.

Other authors have documented bisexual flowers in white oaks elsewhere in the world: *Quercus coccifera* L., an oak with biennial fruit from the Mediterranean (Scaramuzzi 1958), green oak—a likely *Q. cerris* L. × *Q. suber* L. hybrid—from Croatia (Borzan & Želimir 2000), *Q. ilex* L. (Borzan & Stabentheimer 2002), and *Q. glaucoides* M. Martens & Galeotti and *Q. rugosa* Née from Mexico (Romero et al. 2000, 2007).

However, the only previously described instance of a red oak producing hermaphroditic flowers was a single coast live oak (*Quercus agrifolia* Née) on Santa Cruz Island, a California Channel Island south of Santa Barbara and west of Ventura (Greene 1889, p. 8):

> "I observed, in 1885, a well grown tree of this species, in which all the flowers were borne on rigidly erect, stout, spike-like peduncles, each flower seeming to have been perfect, and the usual pendulous staminate aments entirely absent; so that the young acorns were all spicate."

Observations

A volunteer tree of *Quercus agrifolia* in my Santa Cruz back yard bloomed copiously early in 2015, as it has done every spring, but I was surprised to notice it flowering for a second time late in the summer of that year. Beginning with that initial observation in 2015 the tree has produced late-season hermaphroditic flowers for three consecutive years. No damage to the tree was noted during that time; the amount of rainfall was markedly inconsistent from year to year.

The spring flowering of this tree was typical of what I have observed in California red oaks (Figure 1).

- Male and female flowers are always located on reproductive shoots, male catkins emerging first at the bottom of the shoot, either clustered together near the bud scar or less commonly distributed in the axils of the most proximal leaves. Female flowers if present appear later and more distally in leaf axils of the same shoot.
- Reproductive shoots may have male flowers only but never female flowers only.

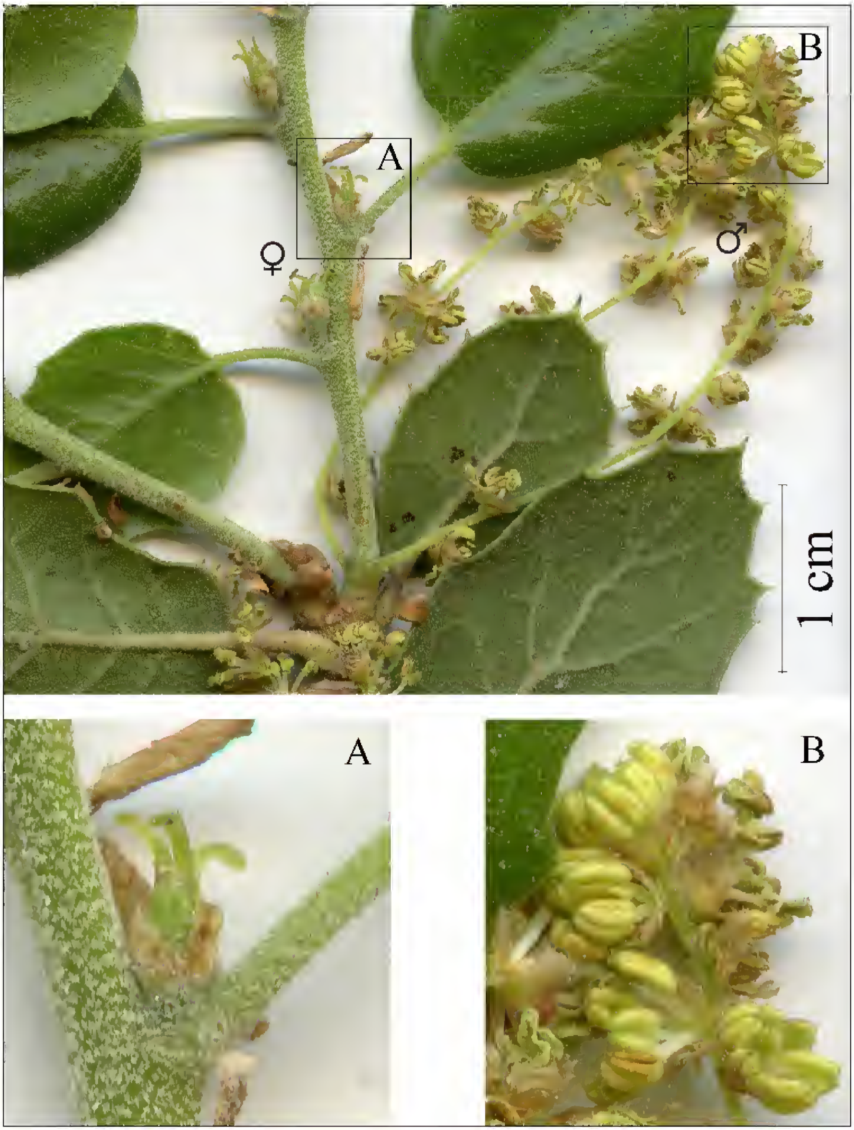

Figure 1. *Quercus agrifolia*, Santa Cruz, 13 March 2014. Typical non-hermaphroditic spring flowers. A. Female flowers, in the leaf axils of the reproductive shoot, generally in pairs. B. Male flowers, on catkins sprouting from the base of the reproductive shoot just above the bud scar.

The late-season flowering I observed, however, was quite different from the spring flowering. Reproductive shoots bore numerous female-only flowers, while structures suggestive of depauperate male catkins were only occasionally present.

By mid-August 2015 three different types of fruit were simultaneously present on the tree in my back yard: type **1**—nearly mature acorns from spring flowers; type **2**—small immature acorns with the nut barely protruding from the cupule from late season flowers; and type **3**—even smaller fruit with the nut fully enclosed by the cupule, also from late season flowers. Whereas fruit types 1 and 2 were arranged 1 or 2 per leaf axil on stout peduncles as is typical for *Quercus agrifolia*, type 3 fruit were often more numerous—sometimes 10 or more—and occasionally clustered on slender peduncles similar to those bearing spring male flowers (Figure 2).

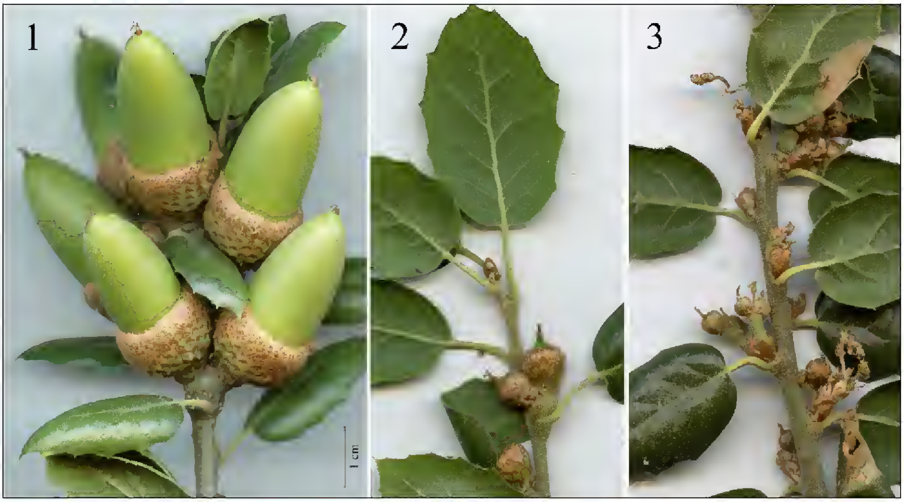

Figure 2. *Quercus agrifolia*, Santa Cruz, 14 August 2015. 1. Large fruit from spring flowers, nearly mature, fully-emerged nuts. 2. Small fruit from late summer flowers, immature, newly-emerging nuts. 3. Smallest fruit with non-emerging nuts, from late summer flowers, often numerous, sometimes on slender peduncles, occasionally mixed with type 2 fruit.

It was only later upon closer examination of the smallest fruit (type 3) in early September 2015 that unexpectedly I discovered many of them to be bisexual (Figure 3).

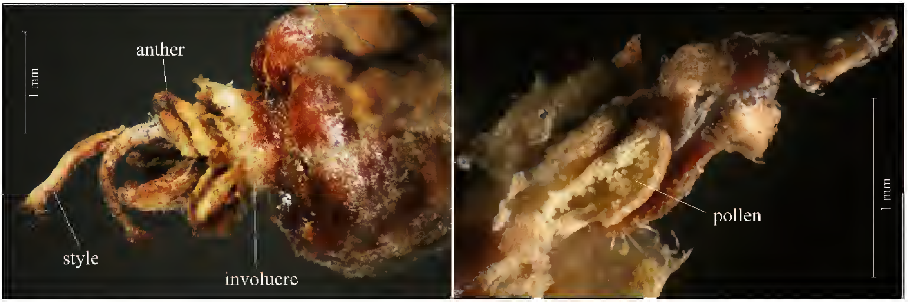

Figure 3. *Quercus agrifolia*, Santa Cruz, 05 September 2015, bisexual flowers.

The following year, after the usual heavy spring bloom and during the subsequent maturation of a large crop of acorns, fast growing twigs appeared in the tree's crown at midyear. By the end of July 2016, the new growth bore clusters of both female and bisexual flowers for a second consecutive year of late summer flowering (Figure 4).

Figure 4. *Quercus agrifolia*, Santa Cruz, 28 July 2016, newly bloomed female and bisexual flowers. Bottom A is detail from photo above.

Figure 5. *Quercus agrifolia*, Santa Cruz, CA, 28 August 2017, third consecutive crop of late season bisexual flowers.

In 2017 spring bloom and acorn maturation took place as in previous years. Mid-year twig growth in the tree's crown and subsequent late summer flowering occurred again. For a third consecutive year the tree in my back yard bore a crop of late season flowers, some hermaphroditic (Figure 5). As in prior years, none successfully matured.

Causes of hermaphroditic flowering

It is unclear what instigates the formation of bisexual flowers in oaks. Tucker (1980) suggested hermaphroditic flowering in *Quercus* might be caused by unusual environmental cues activating normally suppressed ancestral gene combinations. Atypical temperature, precipitation, or light could be factors.

Kevin Nixon (pers. comm., 2015) has speculated that damage to individual trees may cause hermaphroditism by triggering premature maturation of buds, resulting in only partially differentiated flowers. Although reproductive buds are normally formed during the previous year (Conrad 1990; Turkel et al. 1955), buds producing late-season flowers appear to form during the spring of the same year (Tucker 1980).

ACKNOWLEDGEMENTS

Special thanks to Prahlada Papper and Dr. Kevin Nixon for sharing their hermaphroditic oak flower observations and to Roberta Keuter and Ray Wootten for their comments on manuscript drafts.

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HYMENAEA OSANIGRASEMINAE: UN NUEVO GUAPINOL (FABACEAE) DEL PACÍFICO CENTRAL Y SUR DE COSTA RICA

REINALDO AGUILAR FERNÁNDEZ
Los Charcos de Osa
Centro de Diversidad de Plantas Regionales
Osa, Costa Rica
raguilar@osaresearch.org

LUIS J. POVEDA ÁLVAREZ
Universidad Nacional, Campus Omar Dengo
Avenida 1, Calle 9, Apartado Postal 86-3000.
Heredia, Costa Rica

DANIEL SANTAMARÍA-AGUILAR
Shirley C. Tucker Herbarium
Biological Sciences Department
Louisiana State University
Baton Rouge, Louisiana 70803-1705
&
Missouri Botanical Garden
St. Louis, Missouri 63166

RESUMEN

Se describe e ilustra una nueva especie de *Hymenaea,* hasta ahora conocida del Pacífico Central y Sur, en la provincia de Puntarenas, Costa Rica. Árbol de gran tamaño de 30 a 55 metros de alto, con gambas; los folíolos son grandes (12.6–13.8 × 4.5–6.1 cm) y frutos con semillas negras. Crece sobre colinas, en el bosque muy húmedo. La única especie anteriormente conocida de este género en Costa Rica es *H. courbaril,* cuyo nombre común es guapinol, la cual ha sido confundida con **Hymenaea osanigraseminae** Aguilar, Poveda, D. Santam., **sp. nov.**, por muchos años. *Hymenaea courbaril* se diferencia de *H. osanigraseminae* por el hábito, la morfología de las hojas, las flores, los frutos y las semillas; además del hábitat. También se compara con: *H. longifolia* y *H. reticulata,* ambas de Suramérica, especies similares en su morfología. Se incluyen fotografías de *H. osanigraseminae* y de *H. courbaril,* así como notas de la historia natural y etnobotánica.

La subfamilia Detarioideae comprende 84 géneros, alrededor de 760 especies y se encuentra casi en su totalidad en las zonas tropicales (Legume Phylogeny Working Group 2017). *Hymenaea* L. es uno de los 10 géneros y 18 especies de esta subfamilia presentes en Costa Rica, de acuerdo con el tratamiento de la familia Fabaceae, escrito por Zamora (2010) para el *Manual de Plantas de Costa Rica.*

Hymenaea comprende alrededor de 18 especies y hay especies aún no descritas (Pinto et al. 2017). El género se distribuye desde México hasta Argentina y las Antillas. La especie *H. verrucosa* Gaertn. se encuentra en el este de África, Madagascar y las Islas Mascareñas. Los fósiles descritos de México y República Dominicana están relacionados con esta especie Africana (Lee & Langenheim, 1975; Poinar & Brown 2002; Mackinder 2005; Souza et al. 2014; Ribeiro et al. 2015; Pinto et al. 2017).

El mayor número de especies de este género se encuentra en Brasil, donde ocurren 15 especies (Pinto et al., 2017). Una especie es endémica de Cuba, *H. torrei* León. Mientras que *Hymenaea courbaril* L. es la especie de más amplia distribución, desde el oeste de México hasta Paraguay y las Antillas, además es cultivada en China y África (Lee & Langenheim 1975; Mackinder, 2005; Souza et al. 2014; Dezhao et al. 2010; African Plant Database 2017).

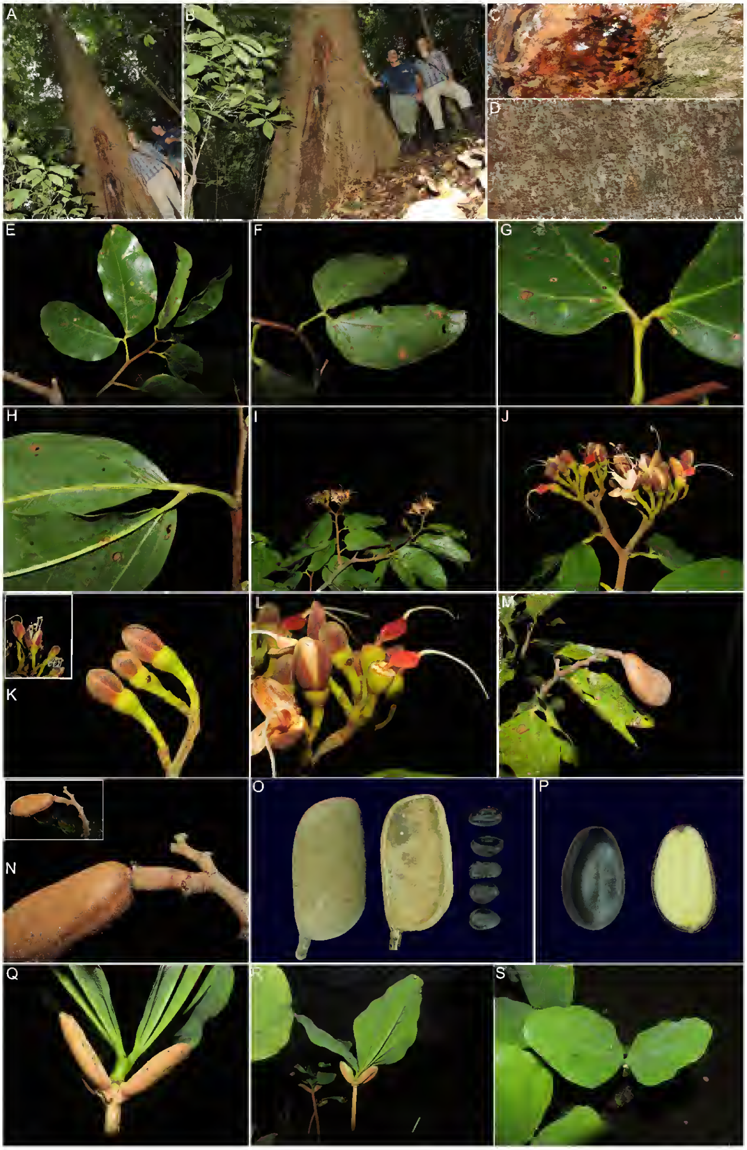

Figura 1. *Hymenaea osanigraseminae*. **A** y **B.** Hábito, corteza y gambas. **C.** Resina solidificada. **D.** Detalle de la corteza. **E.** Haz de los folíolos. **F.** Envés de los folíolos. **G.** Pecíolo y base de los folíolos por la haz. **H.** Base de los folíolos por el envés y venas laterales. **I.** Rama con inflorescencia. **J.** Inflorescencia. **K.** Botones florales. **L.** Hipanto, ovario y estilo. **M.** Rama con fruto inmaduro. **N.** Detalle del fruto (base y pseudopedicelo) y la resina fresca. **O.** Fruto por ambos lados y semillas. **P.** Semilla. **Q–S.** Plántulas. En la figura A y B, R. Jiménez y K. Bohm. Fotos por R. Aguilar, A–L de *R. Aguilar 15446;* M–N de *R. Aguilar 15451.*

Hymenaea se caracteriza por sus hojas bifolioladas, con puntos traslúcidos y pecíolos retorcidos; flores de cáliz con cuatro lóbulos, corola con cinco pétalos, hipanto robusto; frutos indehiscentes y leñosos, con una pulpa harinosa y semillas grandes (Lee & Langenheim 1975; Zamora, 2010).

En la Península de Osa, especímenes en colecciones y observaciones de campo con material infértil, *Hymenaea* podría ser confundido con *Cynometra* L. y *Peltogyne* Vogel (ambos de la subfamilia Detarioideae). Sin embargo, en ambos géneros los folíolos carecen de puntos traslúcidos; en *Cynometra* las hojas tienen los pecíolos más cortos y el ápice de los folíolos es retuso; mientras que en *Peltogyne* el ápice de los folíolos es de acuminado a caudado (Schembera 2004; Zamora 2010).

Lee y Langenheim (1975) revisaron el género, la taxonomía actual está basada en gran parte de su trabajo. Estos autores separaron el género en las secciones *Hymenaea* y *Trachylobium*. En la sección *Hymenaea* reconocieron 11 especies y 13 variedades, caracterizadas por las inflorescencias corto paniculadas (8–15 cm de longitud), botones florales maduros 12–35 mm de longitud, pétalos blanco-crema o raramente rojos, el ovario de densamente lanoso-tomentoso a glabro, frutos con 3–8 semillas o más, raramente 1 o 2. Mientras que en la sección *Trachylobium*, reconocieron tres especies y cuatro variedades, con inflorescencias largo paniculadas (18–35 cm de longitud), botones florales maduros de 10–15 mm de longitud, pétalos blanco-crema o teñidos de rojo, el ovario pubescente o densamente hirsuto en la base, y frutos que por lo general tienen 1–2 semillas.

En la sección *Hymenaea*, Lee y Langenheim (1975) ubican *H. courbaril* la que consideran como una especie polimórfica, con una amplia distribución y en ella reconocen las siguientes seis variedades: *H. courbaril* var. *altissima* (Ducke) Y.T. Lee & Lang., *H. courbaril* var. *courbaril*, *H. courbaril* var. *longifolia* (Benth.) Y.T. Lee & Langenh., *H. courbaril* var. *stilbocarpa* (Hayne) Y.T. Lee & Langenh., *H. courbaril* var. *subsessilis* Ducke, y *H. courbaril* var. *villosa* Y.T. Lee & Langenh.

Sin embargo, el género en los últimos años ha sido objeto de nuevos estudios taxonómicos. Así, Souza et al. (2014) basados en análisis morfométricos, elevan a nivel de especie *Hymenaea altissima* Ducke y *H. longifolia* (Benth.) I.M. Souza, Funch & L.P. Queiroz, como ya fue mencionado, fueron tratadas por Lee & Langenheim (1975) como variedades de *H. courbaril*; mientras que Ribeiro et al. (2015) y Pinto et al. (2017), describen nuevas especies y proporcionan una clave para identificar las especies que acontecen en Mata Atlántica y Caatinga respectivamente. Por otro lado, Pinto et al. (2015) restablecen *H. travassosii* Kuhlm. ex L.E. Paes, una especie endémica del Chaco boliviano, considerada por Lee & Langenheim (1975; como *H. travassii*) como un nombre dudoso; mientras que Souza et al. (2016), brindan un tratamiento taxonómico para las especies del estado de Bahia (Brasil).

Hymenaea courbaril históricamente ha sido el único miembro nativo de este género en América Central (Standley 1922, 1928, 1937; Standley & Steyermark 1946; Schery 1951; Molina 1975; Croat, 1978; Lasseigne 2001; Zamora 2010), aunque Hemsley (1888) trato *H. courbaril* y *H. candolleana* Kunth, este último un sinónimo de *H. courbaril* (Lee & Langenheim 1975). Además, en la Zona del Canal, Panamá, se encuentra de forma plantada *H. verrucosa*.

En Costa Rica, *Hymenaea courbaril*, es popularmente conocido como guapinol, aunque también llamado algarrobo y nancitón. La etimología, guapinol, proviene del lenguaje náhuatl, que significa árbol que produce pinol (quauitl: árbol y pinolli: aserrín o pinol) (Pittier 1978; León & Poveda 2000). Y es bien sabido el potencial de este árbol por sus propiedades alimenticias, medicinales, la excelente calidad de su madera, y como árbol para embellecer zonas urbanas; para mayor información de los usos ver: Standley (1937), Pittier (1978), León (1987), Flores (1999: 270), León y Poveda (2000) y Chízmar Fernández (2009).

Este trabajo tiene como objetivo describir e ilustrar una nueva especie de *Hymenaea* del Pacífico Central y Sur de Costa Rica, resultado obtenido de las muchas exploraciones llevadas acabo por el primer autor de este artículo en la Península de Osa. Para tal efecto se estudiaron los tipos y colecciones generales depositadas en los siguientes herbarios: A, BM, CR (incluido ex-INB), F, GH, K, JVR, LSU, MO, NO, NY y USJ; también las imágenes disponibles en las bases de datos: P (science.mnhn.fr/), JSTOR Global Plants (http://plants.jstor.org/) y Reflora-Virtual Herbarium (http://reflora.jbrj.gov.br/reflora/herbarioVirtual/). Por medio de observaciones y recolecciones de campo de la nueva especie en la Península de Osa, y de *H. courbaril* en las siguientes localidades en Costa Rica: San Rafael de Escazú, Zona Protectora El Rodeo, San Isidro del General, en la provincia de San José; Buenos Aires y Paso Real en la provincia de Puntarenas; y el Parque Nacional Santa Rosa, en el Área de Conservación Guanacaste, con el fin de entender mejor la variación morfológica y ecológica prevaleciente entre las dos especies, para confirmar que no hay estados intermedios en los caracteres morfológicos más importantes tales como: hábito, forma y tamaño de los folíolos, inflorescencias, botones florales, semillas y hábitat. La descripción de la nueva especie esta basada en especímenes de herbario y observaciones de campo.

HYMENAEA OSANIGRASEMINAE Aguilar, Poveda, D. Santam., **sp. nov.** **TIPO. COSTA RICA. PUNTARENAS.** [Cantón de Osa], [distrito Sierpe]: Reserva Forestal Golfo Dulce, Aguabuena, Aguabuena Sur, sector Oeste, 08°42'00"N, 083°31'30"W, 50–150 m, 16 Ene 1992 (bot. fls.), *R. Aguilar 828* (holotipo: CR-7387 [ex INB]; isotipo: CR-159066, MO-5889572). Figuras 1, 4, 6A–C, 7A.

Hymenaea osanigraseminae is morphologically similar to the recently established *H. longifolia*. Both species have more or less the same size of leaflets and glabrous abaxial surface; flowers with calyx lobes densely pubescent on both sides, with golden to brown, petals white, sessile to inconspicuously unguiculated; and fruits with more than 4 seeds per fruit. The new species differs in its larger leaflets (12.6–13.8 × 4.5–6.1 vs. 8–12 × 4–7 cm), flowers with small calyx lobes (1–1.3 × 0.6–1.1 cm vs. ca. 2.2 × 1.8 cm), small anthers (0.4–0.6 cm vs. ca. 0.8 cm long), ovary with fewer of ovules (8–10 vs. 12–18+), short style 2–2.3 cm long (vs. 3.5 cm long), fruits 11.5–14.7 × 5.8–6.5 × 0.7–1 cm (15 × 5.5 × 4.2 cm), and it is ecologically confined to very wet forest (vs. caatinga or cerrado).

Árbol (15–) 30–55 m × 40–90 cm DAP, con la copa hemisférica y densa; el fuste es recto, con pequeñas gambas tabulares y de lomos redondeados; la corteza externa pardo-rojiza y escamosa; la corteza interna emana una resina gomosa y cristalina, la cual se solidifica con el tiempo; ramitas jóvenes de 0.5–0.9 cm de grueso, usualmente pardo-rojizas, algunas veces levemente exfoliantes, teretes, lenticeladas, glabras; estípulas no vistas en individuos adultos, con una diminuta cicatriz en la ramita justo en la base del pecíolo de 0.1–0.3 cm de ancho, cuando las plantas son jóvenes (aproximadamente 2 años) y en condición de invernadero, la estípula es de ca. 7.5 × 0.7 cm, verde claro, glabra. **Hojas** bifolioladas, alternas; el pecíolo 1.7–2.4 cm de longitud, glabro, articulado basal y apicalmente, rugoso, levemente retorcido, ligeramente pulvinado en ambos extremos, los pulvínulos usualmente negruzcos; los peciólulos 0.6–1 cm de longitud (medidos de la parte interna), glabro, rugoso, negruzcos; los folíolos 12.6–13.8 × 4.5–6.1 cm, oblongo-ovados, glabros en ambas caras, el envés con numerosos puntos rojizos (muy inconspicuos a casi ausentes contra la luz natural); el ápice acuminado; el margen no revoluto, entero, levemente lobulado en plantas jóvenes; la base oblicua, el lado interno agudo, el lado externo ligeramente redondeado, no revoluto; la vena central y las laterales visibles sobre ambas caras, prominentes en el envés y en especial en plantas jóvenes, planos por la haz, las venas terciarias apenas visibles en ambos lados. **Inflorescencia** corimboso-paniculadas, usualmente terminales, 5.7–7 cm de longitud, compuesto de 9–30 flores y/o botones, todos los ejes cortamente pubescentes, los tricomas dorados, el eje principal terete, 0.4–0.5 cm de grueso (ca. 0.8 cm de grueso en frutos), las ramas laterales levemente anguladas, ca. 0.3 cm de grueso; los pedicelos 0.4–0.6 cm de longitud, usualmente rectangulares, pubescentes; brácteas y bractéolas no vistas, posiblemente rápidamente caducas. **Flores**: botones florales 1.2–1.6 × 0.6–0.9 cm, lisos, densamente pubescente, los tricomas dorados; hipanto 0.4–0.6 × 0.4–0.6 cm, verde claro, densamente pubescentes por fuera, campanulado, el pseudopedicelo 0.6–0.8 cm de longitud; los lóbulos del cáliz 4, 1–1.3 × 0.6–1.1 cm, oblongo a ampliamente ovados, densamente pubescentes en ambas caras, lisos, la superficie interna sobre la parte media con tricomas más largos, los tricomas amarillentos a dorados, cuando vivos los lóbulos pardo-rojizos que contrastan con el verde del hipanto, caducos durante la antesis; pétalos 5, 1.2–1.5 × 0.4–0.7 cm, lanceolados a oblanceolados, blancos, glabros en ambas caras, con numerosas puntuaciones, inconspicuamente unguiculados (ca. 0.05 cm de longitud); estambres 10, incurvados en el botón, filamento 1.8–3.2 cm de longitud, glabro, blanco, la antera 0.4–0.6 cm de longitud, glabra, amarillenta; el ovario 0.6–0.7 × 0.25–0.3 cm, con 8–10 óvulos, glabro, blanco-crema, o rojizo cuando posiblemente es fertilizado (en vivo), oblicuamente-oblongo, obtuso en unos de los lados, tanto en la base como el ápice, el ovario estipitado, el estípite 2.5–5 mm de longitud, glabro; el estilo 2–2.3 cm de longitud, saliendo a un lado del ovario, conspicuamente ampolloso, estigma capitado, blanquecino. **Fruto** 11.5–14.7 × 5.8–6.5 × 0.7–1 cm, tipo cámara, indehiscente, oblongo a rectangular, obtuso en el ápice, sin estípite, con el pseudopedicelo 1.8–2.1 × 0.6–1.2 cm (de grueso en el ápice); exocarpo leñoso, débilmente verruculoso, pardo claro, opaco, no constricto entre las semillas, glabro; mesocarpo fibroso, resinoso; endocarpo harinoso, amarillento, con mal olor, pero dulce y comestible. **Semillas** 4–8 por fruto, de 2.2–3.5 × 1.4–2 cm, oblongas a elipsoides, con 4 cantos, la testa siempre negra y brillante, los lados levemente hundidos o planos.

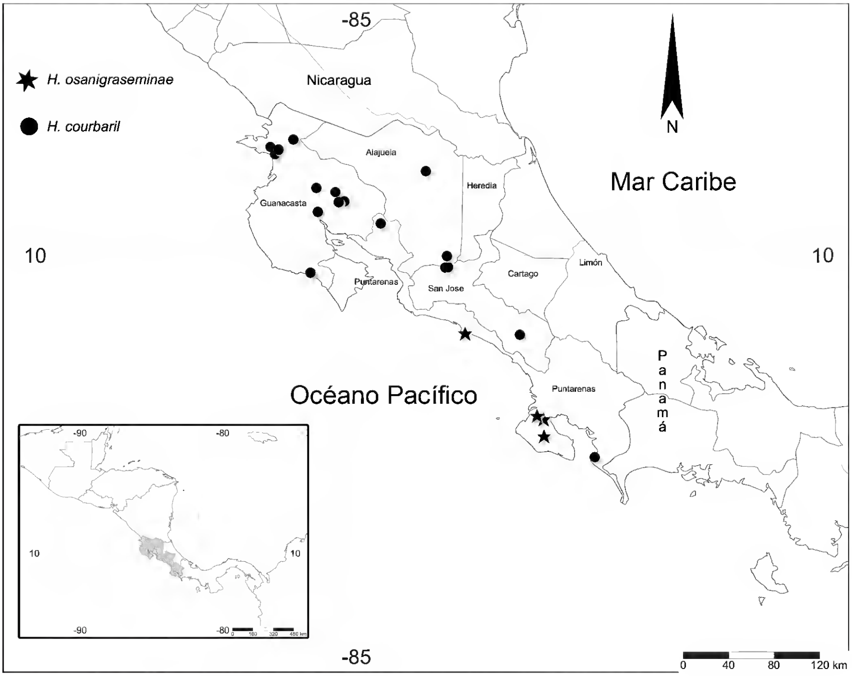

Figura 2. Distribución de *H. courbaril* y *H. osanigraseminae* en Costa Rica.

Hábitat y distribución. *Hymenaea osanigraseminae* se conoce únicamente de Costa Rica, donde ha sido recolectada en el Pacífico Central en el Parque Nacional Manuel Antonio y en el Pacífico Sur en Golfito y la Península de Osa, en la provincia de Puntarenas (Fig. 2); también la hemos observado en las lomas de Piro, en la Península de Osa y en Herradura, en el cantón de Garabito. Habita en bosques muy húmedos entre 25–200 (–350) m de elevación. En la Península de Osa, se le encuentra creciendo en bosque primario, sobre las filas de las montañas en suelos arcillosos.

Fenología. Especímenes con botones florales y flores de *Hymenaea osanigraseminae* han sido recolectados en los meses de enero y diciembre; mientras que con frutos maduros en enero y con frutos inmaduros en abril y en agosto.

Historia natural. Alrededor de los gigantescos árboles de *Hymenaea osanigraseminae* no se observa regeneración ni brinzales, ni latizales, esto quizá debido a los insectos que minan las semillas o a que los frutos caen inmaduros, las loras (*Amazona* sp.) llegan a comerse los frutos maduros y los que caen son comidos por chanchos de monte (*Tayassu pecari*), tepezcuintles (*Cuniculus paca*) o guatusas (*Dasyprocta punctata*), entre otros animales. En el Pacífico Central en Herradura de Puntarenas, en un relicto de bosque maduro donde los árboles estaban con flores, las lapas rojas (*Ara macao*) se estaban alimentando de estas partes reproductivas. En la Península de Osa se ha observado que los árboles botan las hojas paulatinamente en agosto y diciembre, y que por un corto período quedan completamente defoliados (R. Aguilar y E. Fletes, obs. pers.); además los frutos duran aproximadamente hasta un año para madurar (R. Aguilar, obs. pers.). Janzen (1991), hizo anotaciones de la historia natural de este árbol en los bosques caducifolios y pluviales de Costa Rica; él menciona que la historia natural es muy similar en ambos ecosistemas. Sin embargo y partiendo del hecho que las poblaciones de los bosques pluviales mencionadas por este autor correspondan con *H. osanigraseminae*, en los botones florales de los árboles de la provincia de Guanacaste de *H. courbaril*, se desarrollan tres especies de larvas de gorgojos (Coleoptera. Curculionidae: *Anthonomus*), y en los frutos hay dos especies de *Rhinochenus* (Coleoptera. Curculionidae). Mientras que en el Parque Nacional Corcovado aún no ha sido encontrado el gorgojo *Anthonomus*, y en los frutos hay tres especies *Rhinochenus*.

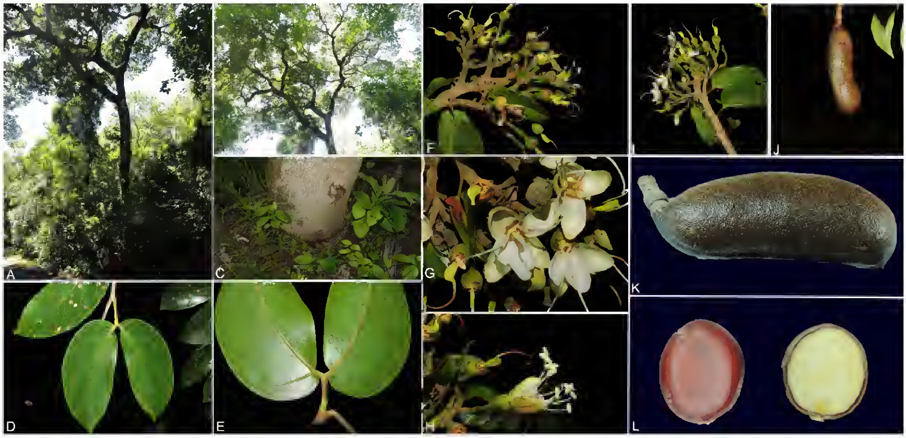

Figura 3. *Hymenaea courbaril*. **A.** Hábito. **B.** Copa del árbol. **C.** Corteza y ausencia de gambas. **D.** Haz de los folíolos y pecíolo. **E.** Envés y base de los folíolos. **F, I.** Inflorescencia. **G.** Flor después de la antesis. **H.** Flor en la antesis. **J, K.** Fruto (notar la base, el ápice y la coloración). **L.** Semilla.

Etnobotánica. En la Península de Osa los pobladores conocen *Hymenaea osanigraseminae* como guapinol negro; también aprecian mucho su madera por densa y durable; y de la pulpa farinácea aunque tiene un olor desagradable, en Puerto Jiménez la utilizan para hacer panecillos, rosquillas y queques; y con las atractivas semillas negras hacen bellísimas artesanías como aretes, collares y pulseras.

Hymenaea osanigraseminae tiene como caracteres morfológicos diagnósticos los folíolos grandes, glabros en ambas caras, con las venas laterales conspicuas en el envés, así como numerosos puntos rojizos, los puntos translúcidos son casi indistintos contra la luz natural; sus inflorescencias con pocas flores; las flores con el hipanto campanulado y lóbulos del cáliz densamente pubescentes, con tricomas amarillentos a dorados, los pétalos blancos e inconspicuamente unguiculados, el ovario glabro; sus frutos sin estípite, con el ápice obtuso, el exocarpo pardo claro; y semillas negras con 4 cantos. También es un árbol de gran tamaño con gambas, la corteza externa rojiza y escamosa.

Por la morfología de los folíolos, la ausencia de tricomas en las ramitas y en el envés de la lámina, las inflorescencias con pocas flores y el hábito de árbol de gran tamaño, *Hymenaea osanigraseminae* también se asemeja a *H. reticulata* Ducke, de Perú y Brasil, además reportada de manera dudosa para Bolivia (Lee & Langenheim 1975; Vásquez Martínez 1997; Neill et al. 2014). Sin embargo, se puede diferenciar, ya que las venas terciarias son muy prominentes y reticuladas en ambas caras de la lámina en *H. reticulata*, además Lee & Langenheim (1975) y Vásquez Martínez (1997), describen los frutos como oblongo-romboidales y semillas con la testa pardo oscura; en tanto que en *H. osanigraseminae* las láminas foliares tienen las venas terciarias apenas visibles en ambas caras, los frutos son oblongos a rectangulares, y las semillas tienen la testa negra.

Las recolecciones costarricenses de esta nueva especie fueron previamente determinadas y tratadas como *Hymenaea courbaril* (Fig. 3; Fig. 5; Fig. 7B). Sin embargo, en *H. courbaril*, los árboles por lo general son de menor estatura (6–20 [–35] m vs. [15–] 30–55 m de altura), carecen de gambas y la corteza externa del tronco es lisa y grisácea (vs. con gambas, la corteza escamosa y rojiza [Fig. 1A–B]) (Fig. 3A–C). Las láminas foliares son más pequeñas (4–10 × 2.4–3.3 cm vs. 12.6–13.8 × 4.5–6.1 cm), y cuando son expuestos a la luz natural muestran numerosos puntos traslúcidos (vs. muy inconspicuos o ausentes contra la luz natural), la base es redondeada (vs. ligeramente redondeado [Fig. 1E–H]) (Fig. 3D–E), y los peciolos tienden hacer más cortos (1–1.9 cm vs. 1.7–2.4 cm de longitud), y diminutamente pubescentes, el mismo indumento se extiende por la vena media (vs. peciolos y vena media glabros). Los botones florales usualmente son más grandes (1.5–2 × 0.6–1 cm vs. 1.2–1.6 × 0.6–0.9 cm), mientras que las flores tienen el hipanto redondeado (vs. campanulado [Fig. 1K–L; Fig. 4A–B) (Fig. 3F–I; 5A–B), y los lóbulos del cáliz tienen tricomas de color amarillento a grisáceo y con la superficie ampollosa sobre la parte externa (vs. con tricomas amarillentos a dorados [Fig. 4B]) (Fig. 5B, G) y la superficie externa lisa. Los frutos por lo general son pardo oscuro y brillantes (vs. pardo claro, opaco), con un corto estípite (vs. sin estípite [Fig. 1N–O]) (Fig. 6A–B), y las semillas son redondas a ovoides con 2-cantos y la testa pardo claro (vs. oblongas a elipsoides, con 4-cantos y la testa negra [Fig. 1P; Fig. 6C]) (Fig. 5J–L; 6D–F). También las inflorescencias en *H. courbaril* usualmente son más densas con 50–150 flores y/o botones (vs. 9–30), y los folíolos tienen las venas terciarias muy finamente reticuladas (Fig. 5E, F, I). Además, en Costa Rica es una especie con preferencias ecológicas distintas, que por lo general se encuentra en la zonas bajas y secas, entre los 0–1200 m de elevación, en la vertiente Pacífica en las llanuras de Guanacaste, la Península de Nicoya y Santa Elena, en las faldas de las cordilleras de Guanacaste y Tilarán, el Valle Central, las regiones de Turrubares y Puriscal, y el Valle del General (Fig. 2), y sobre suelos de origen volcánico (vs. bosques muy húmedos y sobre suelos arcillosos). Para información más detallada sobre la distribución de *H. courbaril* ver: Langenheim (1967) y Janzen (1991).

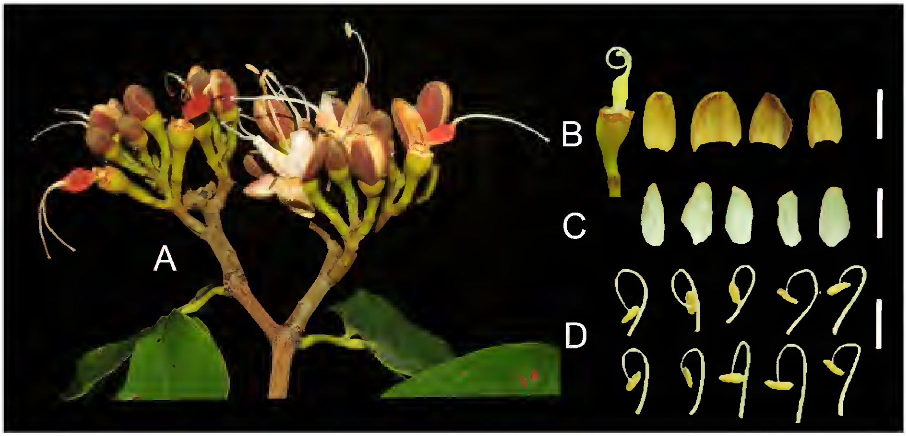

Figura 4. *Hymenaea osanigraseminae*. **A.** Inflorescencia. **B.** Hipanto, ovario y sépalos. **C.** Pétalos. **D.** Estambres. Fotos por R. Aguilar, A–D de *R. Aguilar 15446*. Escala: B, C, D=1 cm.

Figura 5. *Hymenaea courbaril*. **A.** Inflorescencia. **B.** Hipanto, ovario y sépalos. Pétalos. **D.** Estambres. Fotos por R. Aguilar. Escala: B, C, D=1 cm.

Con la información disponible hasta ahora, se puede decir que en los bosques de la Península de Osa (como delimitada por Cornejo et al. 2012), solo se encuentra la nueva especie. No se debe descartar la presencia en forma natural de *Hymenaea courbaril*, ya que en la Península se encuentran áreas relativamente secas (p.ej., Carbonera, Piro) con elementos florísticos de ese tipo de ecosistema, tales como: *Acrocomia aculeata* (Jacq.) Lodd. ex Mart. (Arecaceae), *Bernoullia flammea* Oliv. (Malvaceae), *Byrsonima crassifolia* (L.) Kunth (Malpighiaceae), *Cnestidium rufescens* Planch. (Connaraceae), *Curatella americana* L. (Dilleniaceae), *Miconia argentea* (Sw.) DC. (Melastomataceae), *Microdesmia arborea* (Seem.) Sothers & Prance (Chrysobalanaceae), *Syngonium wendlandii* Schott (Araceae), *Xylopia frutescens* Aubl. (Annonaceae).

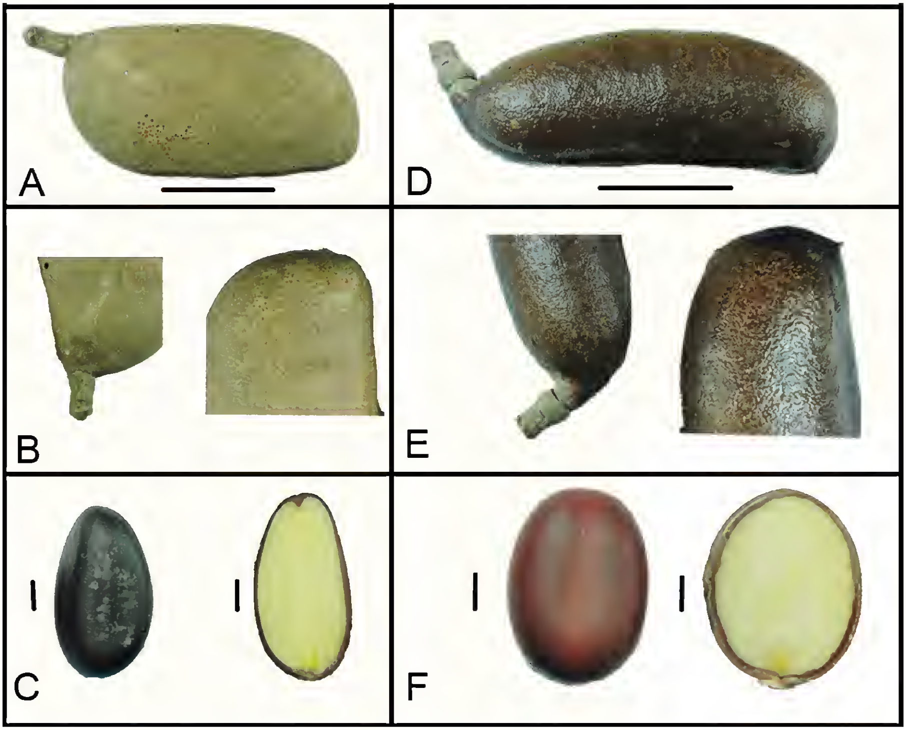

Figura 6. Comparación de los frutos de *Hymenaea osanigraseminae* (A–C) y *H. courbaril* (D–F). **A y D**. Forma y coloración. **B y E.** Base y ápice. **C y F.** Semillas y coloración de la testa. Escala: A y D=5 cm; C y F=0.5 cm.

Las descripciones y posiblemente algunas de las ilustraciones presentadas en algunas referencias bibliográficas parecen corresponder con *Hymenaea osanigraseminae* (p.ej., Hartshorn & Poveda 1991; Quesada et al. 1997; Schembera et al. 2001; Harmon 2004; Schembera 2004; Cornejo et al. 2012). También el testigo *J. Marín 447*, citado por Zamora (2010), corresponde con la nueva especie. La germinación de la nueva especie fue descrita por Ley López & Chacón Madrigal (2017; ver bajo *H. courbaril*); mientras que para *H. courbaril* es descrita por Flores & Benavides (1990).

Especímenes examinados. COSTA RICA. Puntarenas. Cantón de Aguirre: Parque Nacional Manuel Antonio, sendero a Playa Gemelas, 09°22'48"N, 084°08'28"W, 25 m, 30 Nov. 2006 (est.), *Acosta & Villalobos 5711* (CR); cantón de Golfito, P. N. [Parque Nacional] Corcovado, Península de Osa, Estación Los Patos, 08°34'00"N, 083°31'00"W, 200 m, 13 Ene. 1994 (fr., sin fr. en MO), *Aguilar et al. 3028* (CR, MO); cantón de Osa: Rincón, 500 m. al Oeste de la Quebrada Aparicio, frente a Punta Chorro, 08°43'51"N, 083°29'07"W, 43 m, 06 Ago. 2015 (est.), *Aguilar & Jiménez 15347* (MO); Rincón, cuenca de la Quebrada Agua Buena, 08°41'28"N, 083°31'05"W, 249 m, 12 Dec. 2015 (fl.), *Aguilar 15446* (MO, NY); Banegas camino a Rancho Quemado, en la primer cuesta, 08°40'34"N, 083°32'11"W, 192 m, 07 Ago. 2015 (fr. imm.), *Aguilar 15451* (CR); Fila a Cerro Chocuaco, sector Sur de Estero Guerra, Sierpe, 08°43'40"N, 083°34'20"W, 100 m, 04 Abr. 1992 (fr.

inm.), *Marín 447* (CR-2 cartulinas, MO); Aguabuena, 3.5 km W of Rincón, 08°43'N, 083°31'W, 350 m, 24 Ene. 1993 (est.), *Thomsen 430* (CR).

Figura 7. **A.** Isotipo de *Hymenaea osanigraseminae* (*Aguilar 828*, MO). **B.** Espécimen de *Hymenaea courbaril* (*Hammel 17295*, MO).

AGRADECIMIENTOS

Estamos agradecidos con los siguientes herbarios: A, BM, CR, F, GH, JVR, K, LSU, MO, NY y con sus curadores por su hospitalidad y por permitirnos el estudio de sus colecciones. También agradecemos a Rayner Araya, Katja Bohm, Roberto Espinoza (Lupo), Eida Fletes, Eugenia Flores, Daniel Janzen, Juan José Jiménez, Ricardo Jiménez, Ricardo Kriebel, Scott Mori, Dreidin Ortiz (Mi Tigre) por la ayuda en este trabajo. También estamos agradecidos con Roxana Madrigal e Isidro Chacón por la revisión filológica del texto. Daniel Santamaría-Aguilar desea agradecer a L.P. Lagomarsino, A.K. Monro por el apoyo brindado; a Jim Solomon y al Jardín Botánico de Missouri por el préstamo de especímenes y las facilidades brindadas durante la estancia en dicha institución; además a Jennie Kluse (LSU) por la ayuda con los préstamos; y finalmente desea agradecer al Royal Botanic Gardens' Bentham Moxon award (K) por la beca que me permitió una pasantía en esa institución.

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THREE REMARKABLY DISJUNCT FERN SPECIES DISCOVERED IN PICKENS COUNTY, SOUTH CAROLINA

PATRICK D. MCMILLAN
South Carolina Botanical Garden
Clemson University
Clemson, South Carolina 29634

EDWARD B. PIVORUN
South Carolina Botanical Garden
Clemson University
Clemson, South Carolina 29634

RICHARD D. PORCHER
The Citadel
Charleston, South Carolina 29409

CODY DAVIS
South Carolina Botanical Garden
Clemson University
Clemson, South Carolina 29634

DAN WHITTEN
South Carolina Native Plant Society
Greenville, South Carolina 29602

KAY WADE
Jocassee Lake Tours
Salem, South Carolina 28676

ABSTRACT

Three species of fern in the family Pteridaceae are reported as new to South Carolina: *Astrolepis sinuata* (Lag. ex Sw.) Benham & Windham subsp. *sinuata*, *Bommeria hispida* (Mett. ex Kuhn) Underw., and *Pellaea wrightiana* Hook. One of these, *Bommeria hispida*, is the first record for eastern North America. All three occur in a cliff habitat in Pickens County created in 1968-1971 by quarrying of granite to build the adjacent Jocassee Dam. All three are native to the western USA and are hypothesized to have colonized this site along the leading edge of the Blue Ridge Escarpment as winds from the Southwest continue to bring in spores.

In 2017 Ms. Kay Wade located a large population of a strange fern growing on outcrops near the Jocassee Dam in Pickens Co., South Carolina. She brought this population to the attention of local native plant enthusiast and South Carolina Native Plant Society member Mr. Dan Whitten. Dan visited the site with Kay and confirmed that the plants were a species of *Pellaea*, possibly *Pellaea atropururea* (L.) Link. Mr. Whitten was aware that *Pellaea atropurpurea* was found on calcareous or mafic substrata and thus sent a photograph of the fern to retired University of South Carolina, Upstate professor Gillian Newberry. Dr. Newberry suggested the species was a western species, likely *Pellaea wrightiana*, not *Pellaea atropurpurea.*

Wade took McMillan to the site on December 3, 2017 and McMillan immediately recognized the plant as *Pellaea wrightiana* Hook., a species with which he was intimately familiar from his work in western Texas and North Carolina. McMillan managed to scale up the rock face to secure a sample of the fronds and confirmed this identification upon returning to Clemson University. A return visit with Kay Wade, Edward Pivorun and Richard Porcher on December 6, 2017 allowed a more thorough examination of the cliff with binoculars. The group identified two additional species: *Astrolepis sinuata* (Lag. ex Sw.) Benham & Windham subsp. *sinuata* and *Bommeria hispida* (Mett. ex Kuhn) Underw. (this determination was suggested by Alan Weakley of the University of North Carolina after examining photographs). McMillan collected one frond from each of these species but most of the cliff was outside the range of hands and binoculars. The team returned to the site on 13December 2017 with a member of McMillan's staff, Mr. Cody Davis, an expert climber. Mr. Davis secured fronds of all three species and thoroughly explored the extent of the cliff for other oddities that might be encountered.

All determinations were confirmed by George Yatskievych via a loan of specimens to the University of Texas at Austin. Taxonomy follows Weakley (2015). Vouchers are as follow.

ASTROLEPIS SINUATA (Lag. ex Sw.) Benham & Windham subsp. *sinuata*

South Carolina. Pickens Co.: Approximately 300-400 vigorous clumps growing along approximately 50 meters of shoreline of Lake Jocassee on exposed granitic outcrops created during the construction of Lake Jocassee dam; plants located in vegetation mats and fissures in the rock face on west and southwest-facing exposures, with *Pellaea wrightiana*, *Bommeria hispida, Woodsia obtusa, Asplenium platyneuron, Andropogon virginicus, Chrysopsis mariana, Solidago canadensis*, and various bryophytes, 34°58'11.59" N 82°54'45.27" W, 6 Dec 2017, *McMillan s.n.* with Wade, Porcher, and Pivorun (CLEMS); same location, 14 Dec 2017, *McMillan s.n.* with Davis, Maddox, Pivorun, and Huffman (CLEMS, NCU).

BOMMERIA HISPIDA (Mett. ex Kuhn) Underw.

South Carolina. Pickens Co.: Two clumps located shoreline of Lake Jocassee on exposed granitic outcrops created during the construction of Lake Jocassee dam; plants found in fissures in the rock face on south and southwest-facing exposures, with *Astrolepis sinuata*, *Pellaea wrightiana, Woodsia obtusa, Asplenium platyneuron, Andropogon virginicus, Chrysopsis mariana, Solidago canadensis*, and various bryophytes, 34°58'11.59" N 82°54'45.27" W, 14 Dec 2017, *McMillan s.n.* with Davis, Maddox, Pivorun, and Huffman (CLEMS, NCU).

PELLAEA WRIGHTIANA Hook.

South Carolina. Pickens Co.: Over 2000 vigorous clumps growing along approximately 150 meters (0.1 mile) of shoreline of Lake Jocassee on exposed granitic outcrops created during the construction of Lake Jocassee dam; plants dominant in fissures in the rock face on south, southwest and west-facing exposures, with *Astrolepis sinuata*, *Bommeria hispida*, *Woodsia obtusa, Asplenium platyneuron, Andropogon virginicus, Chrysopsis mariana, Solidago canadensis*, and various bryophytes, 34°58'11.59" N 82°54'45.27" W, 3 Dec 2017, *McMillan s.n.* with Wade and Whitten (CLEMS); same location, 14 Dec 2017, *McMillan s.n.* with Davis, Maddox, Pivorun, and Huffman (CLEMS, NCU).

Discussion

All three of these species typically occur far to the west of Lake Jocassee. These discoveries add three species to the flora of South Carolina as well as the first record for *Bommeria hispida* in eastern North America.

The occurrence of ferns in the Southeast with a much more western distribution is not without precedent. *Pellaea wrightiana* is known from two locations in the piedmont of North Carolina, *Myriopteris rufa* Fée from Virginia and West Virginia, *Myriopteris gracilis* Fée from Virginia, *Astrolepis sinuata* subsp. *sinuata* from a single location in Georgia, *Astrolepis integerrima* (Hook.) D.M. Benham & Windham from Alabama, and most remarkably *Pellaea ternifolia* (Cav.) Link subsp. *arizonica* Windham from approximately 7.25 miles northeast of the Lake Jocassee site in Pickens County (Wagner 1965; Knobloch & Lellinger 1969; Wiebolt & Bentley 1982; Mellichamp et al. 1987;

Benham & Windham 1993; Allison & Stevens 1999; Heafner 2001). The Jocassee Gorges region has long been known for the remarkable diversity of ferns found there. One species, the mostly tropical *Hymenophyllum tunbrigense* (L.) J.E. Smith, which was located during surveys of the nearby Eastatoe River gorge (approximately 6.7 miles northeast of the Lake Jocassee site), is still known from only this single metapopulation in the continental USA (Taylor 1938). *Asplenium monanthes* L., another species with a mostly tropical distribution, is present at many locations in the Jocassee Gorges region. A review of published records and herbarium specimens, combined with field work for the preparation of this article indicates that the area of Pickens/Oconee counties now hosts 68 species of fern and fern relatives. Pickens County alone is home to 65 species. The discovery of three additional species certainly places this small region into a category of extremely high regional pteridophyte diversity.

Most, if not all, of the locations of fern species that are far disjunct to the east from more western ranges are reports of a single species per locale. The Jocassee site is remarkable for the presence of three species displaying such a pattern.

Pellaea wrightiana is a common species found on acidic-reaction outcrops in Texas, Oklahoma, New Mexico, Arizona, southern Colorado, and southern Utah and was formerly known from only two other populations east of Texas. It was erroneously reported for South Carolina by Platt and Townsend (1996). The plants originally thought to be *P. wrightiana* from Pickens County were found to be the first record of *Pellaea ternifolia* Link subsp. *arizonica* in eastern North America (Heafner 2001). The population reported here is the first record for South Carolina and is the most extensive population in eastern North America. The closest populations to the Lake Jocassee site are in Alexander Co., North Carolina (roughly 120 miles northeast), with an initially reported population of approximately 100 clumps growing on granite and Stanly Co., North Carolina (roughly 140 miles east-northeast), with an initially reported population of approximately 500 plants. Since their initial discovery, both of the North Carolina populations have apparently declined. Heafner (2001) found the Alexander County population had dropped to only around 25 clumps while the Stanly County population had also declined by half. The Lake Jocassee site is estimated to consist of no less than 2000 clumps. The discovery of the South Carolina population indicates that this species should be searched for on other acidic-reaction rock outcrops throughout the southern Appalachian region. Heafner (2001) reported that there was very little variation in the allozymes between the two North Carolina populations and they were likely to represent dispersal from a single eastward immigration event. Among the populations sampled from the western range, he found that plants in North Carolina were most similar to those sampled from Jeff Davis Co., Texas.

Astrolepis sinuata subsp. ***sinuata*** is also a common species on acidic-reaction outcrops in Arizona and New Mexico east to central Texas. The species is remarkably disjunct from central Texas to a bridge piling in Beauregard Par., Louisiana, and Merriweather Co., Georgia, where it was found on a granite flatrock next to a natural gas distribution station (Benham & Windham 1993; McMillan et al. 2013; L.L. Gaddy, pers. comm. 2017). The Pickens County location is the first for South Carolina and only the second report from east of the Mississippi River; it is the largest population east of central Texas.

The Pickens County location represents the first known station in the eastern USA for ***Bommeria hispida***. This species is remarkably disjunct from the nearest known populations in Brewster Co., Texas (more than 1200 miles to the southwest). This staggering distance might at first seem unique but it is identical to the disjunction in range found in the nearby population of *Pellaea ternifolia* subsp. *arizonica*.

Establishment at the Pickens County site

The site at which all of the observations were made is a human-created habitat. The cliff habitat was created in 1968-1971 by quarrying activity for the material to build the adjacent Jocassee

Dam. The area is known as "The Wall" and is a 10–40 meter high quarry of granitic rock. The entire hill and face of the mountain was denuded with no natural vegetation left during construction. For a better idea of the scale of disturbance, the construction of the site can be seen on video during the opening minutes of the movie *Deliverance*. The habitat these ferns have colonized was barren, newly exposed rock during the construction of the dam.

The resulting cliff forms a horseshoe shape with the upstream portion facing south and ranging to southwest, west, and northwest exposures as it proceeds downstream. All three of the species are limited to southwest and west-facing faces. The base of the cliff extends to the water for the entire length and is well over 150 feet tall along a large portion of its length. This shape, in addition to the fact that the widest portion of the lake extends from the cliff habitat, has created conditions that receive the full impact of the predominant southwest winds that dominate the region. The winds eddy and swirl in this cove and may provide the opportunity for enhanced settling of the spores that brought these ferns to the cliff.

Astrolepis sinuata subsp. *sinuata* (2n = 87, triploid) relies on apogamous reproduction while *Pellaea wrightiana* (2n = 116, allotetraploid) and *Bommeria hispida* (2n = 60) both reproduce sexually (Benham & Windham 1993; Gastony & Haufler 1976). Spore resiliency and longevity has been shown to be high in members of the family Pteridaceae, with spores preserved on herbarium sheets remaining viable for over 40 years (Windham, Wolf, & Ranker 1986). It is hypothesized that spores were transported along prevailing southwest winds and settled on the newly exposed cliff face where competition with local species was reduced or absent due to the disturbance. The site is along the leading edge of the Blue Ridge Escarpment.

An alternative hypothesis is that nearby populations of these species provided spores for colonization of the newly exposed habitat, but we searched thoroughly along the entire shoreline outcrop habitats of Lake Jocassee and located no other populations. We also searched the exposed rock outcrops above the cliff. The area above the cliff was completely denuded during dam construction.

An alternative hypothesis could include the introduction of spores via machinery used in the construction. Several factors argue against this, notably the absence of any non-pteridophyte species from farther west on the site or nearby. Weed seeds would seem to just as easily be moved. Finally, the presence of another nearby species of fern with a similar distribution (*Pellaea ternifolia* subsp. *arizonica*) and the presence of *Pellaea wrightiana* at two sites in North Carolina, where they are assumed to have naturally colonized their habitats, supports the fact that spores must travel these distances and be able to successfully colonize new habitats.

ACKNOWLEDGEMENTS

The authors would like to thank George Yatskievych of the University of Texas for confirming our identifications and his patient search for intact sporangia to determine the subspecies of *Astrolepis sinuata*. Alan Weakley of the University of North Carolina was extremely patient and helpful in discussions concerning these ferns. We also would like to thank Brooks Wade of Jocassee Lake Tours for helping to provide the opportunity to make such discoveries possible, Zachary Maddox for providing boat transportation to the site and Rick Huffman of the South Carolina Native Plant Society for joining us and always encouraging, promoting, and participating in the continued discovery of our native flora. Guy Nesom reviewed and edited the paper.

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Singhurst, J.R., J.N. Mink, and W.C. Holmes. 2018. *Ranunculus parviflorus* (Ranunculaceae) naturalized in Kansas.
Phytoneuron 2018-22: 1–3. Published 25 April 2018. ISSN 2153 733X

RANUNCULUS PARVIFLORUS (RANUNCULACEAE) NATURALIZED IN KANSAS

JASON R. SINGHURST
Wildlife Diversity Program
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744
jason.singhurst@tpwd.texas.gov

JEFFERY N. MINK
3229 Cole Avenue
Waco, Texas 76707
jeffreynormanmink@gmail.com

WALTER C. HOLMES
Department of Biology
Baylor University
Waco, Texas 76798-7388

ABSTRACT

Ranunculus parviflorus is documented here in the naturalized flora of southeast Kansas, where it was collected at two locations in the town of Neodesha.

Ranunculus parviflorus L. (Ranunculaceae) (smallflower buttercup) (Figure 1) is a herbaceous annual native to Europe (Salisbury 1931; Fernald 1950; Fitzgerald 2002). The species is naturalized in subtropical and temperate areas of North and South America (Benson 1948; Hernandez 1993) and Australia and New Zealand (Bock 1979).

Ranunculus parviflorus is now found from California north through Oregon and Washington (to British Columbia) and in the eastern USA from western Florida north to New York, west through the Midwest to central Missouri, south through eastern Oklahoma and eastern Texas, east to Florida, including Hawaii (Brouillet et al. 2006; Hickman 1993; Lowe 1921; Mohr 1901; Stone et al. 1992; Wunderlin et al. 1996). Early collections in the USA were made by Chickering at Ft. Monroe, Virginia, in 1878 (KANU) and Curtiss in Gadsden Co., Florida, in 1889 (USFH 6400) (Wunderlin et al. 2018).

Ranunculus parviflorus has not been included in floras or checklists for Kansas (Brooks 1986; Haddock et al. 2015; McGregor et al. 1986; Kartez 2015; USDA, NRCS 2018). This report is the first documentation of the species in the state.

Vouchers. **USA**. **Kansas**. Wilson Co.: Neodesha, jct. of Elm Street and N 5th Street, in frequently mowed right of way, 26 May 2017, *Singhurst 21,182* (BAYLU, KANU); Neodesha, jct. of E Spruce Street and N 12th Street, 0.1 mi N of on N 12th St and E 0.1 mi, in frequently maintained lawn and grassland, 28 May 2017, *Singhurst 21,183* (BAYLU, KANU).

Populations of *Ranunculus parviflorus* at both locations were growing with *Carex* sp., *Cynodon dactylon*, *Duchesnea indica*, *Geranium pusillum*, *Lamium purpureum*, *Lotus corniculatus*, *Medicago minima*, *Nothoscordum bivalve*, *Schedonorus arundinaceus*, *Sherardia arvensis*, *Trifolium repens*, and *Viola missouriensis*. The first vegetative observation of these two *Ranunculus parviflorus* populations occurred in March of 2016 and March of 2017 and it was not until May 2017 when flowering and fruiting specimens were obtained. The Kansas location is approximately 100 km (65 miles) from a southwestern Missouri location in Jasper Co., Missouri and 90 km (60 miles) from the nearest location in northwest Oklahoma location in Rogers Co. (both locations are based on distributions in Kartesz 2018).

Figure 1. *Ranunculus parviflorus* in flower and fruit, Wilson Co., Kansas.

ACKNOWLEDGEMENTS

The authors thank Craig Freeman, Senior Scientist of the Kansas Biological Survey and Senior Curator of the R.L. McGregor Herbarium, for reviewing the preliminary manuscript and making editorial suggestions.

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ERRATUM: *CENCHRUS ALOPECUROIDES*

NEIL SNOW
Department of Biology
Pittsburg State University
Pittsburg, Kansas 66762
nsnow@pittstate.edu

I recently reported three new taxa of vascular plants from Kansas (Snow 2017), including (incorrectly) "*Cenchrus atropurpuroides* (L.) Thunb." Its correct name is *Cenchrus alopecuroides* Thunb.

Although the specific epithet reported was simply incorrect, the nomenclature associated with this name is not straightforward and is summarized on TROPICOS at <http://www.tropicos.org/Name/25526770>.

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Published 30 May 2018. ISSN 2153 733X

AQUILULA (ASTERACEAE: ASTEREAE), A NEW GENUS FOR *ERICAMERIA RISKINDII*

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109

ABSTRACT

Aquilula Nesom, **gen. nov.**, is established to comprise the single species *Ericameria riskindii* ≡ *Xylothamia riskindii* ≡ *Gundlachia riskindii* as **Aquilula riskindii** (Turner & Langford) Nesom, **comb. nov.** It is segregated from a group of four North American species recently considered to be members of *Gundlachia*, based primarily on molecular evidence. The remaining three species are retained in the genus *Xylothamia* (as *X. diffusa*, *X. triantha*, and *X. truncata*). *Gundlachia* is regarded here a genus of seven species restricted to the Caribbean region. A phylogenetic hypothesis is proposed for these three genera, based on morphology and with the underlying assumption (based on molecular evidence) that they comprise a single clade. Photographs are provided for all of the taxa under consideration (*Aquilula*-1, *Xylothamia*-3, *Gundlachia*-7).

The genus *Xylothamia* was proposed to include nine species traditionally associated with *Ericameria* (Nesom et al. 1990; Nesom 1992). All but one (*X. riskindii*) are species of the Chihuahuan and Sonoran deserts. Molecular data show that these nine species are divided between two separate clades (Roberts 2002; Urbatsch et al. 2003; Brouillet et al. 2009). Five of the species, as the genus *Medranoa* Urbatsch & Roberts (Nesom 2007; mapped here in Fig. 11), are part of a clade that includes *Amphiachyris*, *Bigelowia*, *Euthamia*, *Gutierrezia*, *Gymnosperma*, and *Thurovia.* The other four species, including the *Xylothamia* type, are closely related to the Caribbean genus *Gundlachia* (sensu Lane 1996). The *Gundlachia* clade is sister to the *Amphiachyris* et al. clade.

Based primarily on the molecular data, Urbatsch and Roberts (2004) formally expanded *Gundlachia* to include the four North American species closely related to it –– I suggested that morphological and geographical disparities support keeping *Xylothamia* and *Gundlachia* separate in taxonomy (Nesom 2007), with the caveat that the distinction of *X. riskindii* might justify its segregation from the other three North American species. The current paper formally recognizes *X. riskindii* at generic rank and retains the remaining three species within *Xylothamia* sensu stricto (mapped here in Fig. 10).

Molecular data (Roberts 2002; Urbatsch et al. 2003) did not resolve the topology of relationships among *Gundlachia* (represented in their analysis by only 1 species) and the four *Xylothamia* species. Results differed depending on optimality criteria used in the DNA sequence analysis. In the PAUP ratchet analysis of the combined ITS/ETS sequences, *X. riskindii* occupies a basal position in the *Gundlachia* clade. In the parsimony-derived trees that included indels, the Caribbean and North American species are resolved as sister lineages, with *X. riskindii* basal to the 3 desert species. When indels were excluded, *X. riskindii* is basal to all of the *Gundlachia* clade. *Gundlachia* sensu stricto is paraphyletic without the North American species in only one of their various analyses.

In any case, molecular data indicate that the four American species form a single clade with *Gundlachia*, thus their treatment as a single genus (i.e., *Gundlachia*) is reasonable. Three groups, however, are represented among them –– the North American species are distinct from Caribbean *Gundlachia* in morphology, geography and ecology, and *X. riskindii* stands apart from the three desert species (*Xylothamia* sensu stricto). A phylogenetic hypothesis is presented in Figure 1, based on conspicuous apomorphies.

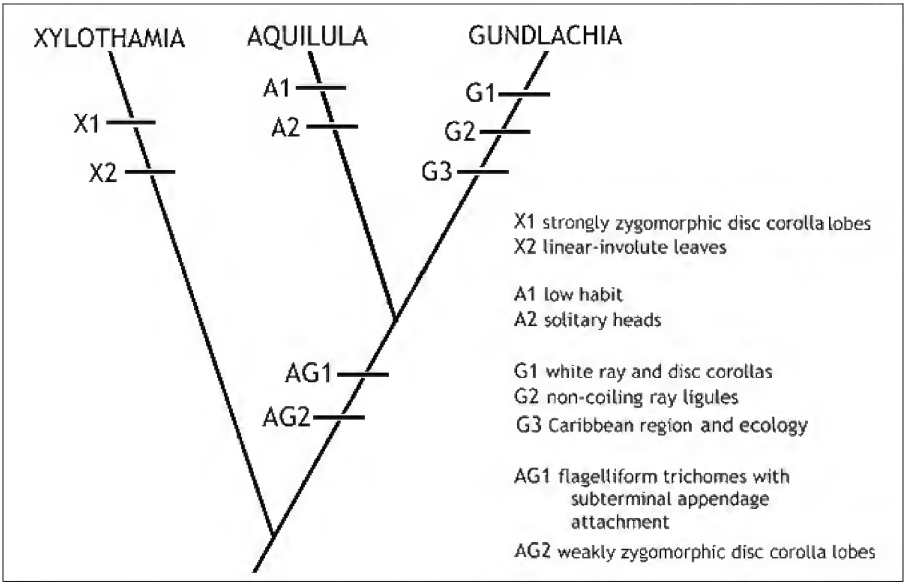

Figure 1. Phylogenetic hypothesis for the *Gundlachia* clade, based on conspicuous apomorphies. Zygomorphic disc corollas in this group were discussed by Nesom et al. (1990) and Nesom (2007). Variation in flagelliform trichomes was discussed and illustrated by Urbatsch et al. (2003) and Urbatsch and Roberts (2004). Strongly zygomorphic disc corolla lobes (X1) also are characteristic of *Medranoa,* seemingly in parallel.

Paired contrasts between Aquilula, Xylothamia, and Gundlachia

A. Leaves flat, narrowly obovate to spatulate; heads solitary; involucres 7–8 mm in diam.; ray florets 7–13; disc florets 30–50, corollas weakly zygomorphic; achenes strigose; montane habitats ... **Aquilula**

A. Leaves involute, appearing terete; heads sessile to subsessile, loosely arranged in weak corymbs or (in *X. truncata*) sessile in groups of 2–3 at branch apices; involucres 2.5–4 mm in diam.; ray florets 0 or 1–3 and obscured within the involucre; disc florets 3–7, corollas strongly zygomorphic (two of the sinuses cut nearly to the base of the throat, one very shallow [1/4–1/3 as deep as the former], and the other two intermediate in depth, the two short lobes erect, the others reflexed-coiling); achenes sericeous; desert habitats .... **Xylothamia**

B. Plants ca. 8–15 cm tall; leaves 8–10 mm x 3–5 mm; heads terminal and solitary, sessile to subsessile; involucres broadly turbinate to subhemispheric, 7–8 mm in diam.; ray florets 7–13, disc florets 30–50, corollas yellow; disc corolla lobes cut ca. 1/5 the length of the throat; achenes without discernible nervation; Mexico .... **Aquilula**

B. Plants 30–200 cm tall; leaves 10–80 mm x 2–11 mm; heads mostly short-pedicellate, densely arranged in distinctly corymboid clusters or (in *G. domingensis*) in dense, elongate-paniculate panicles; involucres cylindric to narrowly obconic, 2–4 mm in diam.; ray florets 3–8, disc florets 3–10, corollas white; disc corolla lobes cut ca. 1/3–2/3 the length of the throat; achenes 5-nerved; Caribbean region .... **Gundlachia**

C. Plants 20–100(–150) cm tall; leaves more or less terete with involute margins, linear, 2–15(–25) mm x 0.3–1 mm; heads sessile to subsessile, loosely arranged in weak corymbs or (in *X. truncata*) sessile in groups of 2–3 at branch apices; ray florets 0 or 1–3 and obscured within the involucre; ray and disc corollas yellow; disc corollas zygomorphic (two of the sinuses cut nearly to the base of the throat, one very shallow [1/4–1/3 as deep as the former], and the other two intermediate in depth, the two short lobes erect, the others reflexed-coiling); xeric habitats in the Chihuahuan and Sonoran deserts .... **Xylothamia**

C. Plants 30–200 cm tall; leaves distinctly laminar with flat margins, linear-lanceolate to narrowly spatulate, narrowly obovate-spatulate, obovate, or ovate, 10–80 mm x 2–11 mm; heads mostly short-pedicellate, densely arranged in distinctly corymboid clusters or (in *G. domingensis*) in dense, elongate-paniculate panicles; ray florets 3–8, conspicuous; ray and disc corollas white; disc corollas symmetrical; coastal thickets, dunes, pinelands, and river, pond, and swamp edges in the Caribbean region .... **Gundlachia**

AQUILULA Nesom, **gen. nov.**
Type species, *Aquilula riskindii* (Turner & Langford) Nesom

Different from *Gundlachia* in its low habit and smaller leaves, relatively large, solitary heads, yellow corollas, coiling ray ligules. Different from *Xylothamia* in its flat, narrowly obovate to spatulate leaves, solitary, large heads with prominent ray florets, stiffly strigose achenes, and montane habit.

Aquilula is the Latinized form of "Aguililla" (little eagle), the name of the Hinton rancho in northern Nuevo León, from which James C. Hinton and George S. Hinton (the son and grandson, respectively, of botanist G.B. Hinton) have studied the flora of northeastern Mexico. George continues his studies there, especially focused on south-central Nuevo León and adjacent Coahuila. The herbarium at Rancho Aguililla houses collections made by the three generations primarily in Coahuila, Nuevo León, Tamaulipas, Oaxaca, Michoacán, Guerrero, and Edo. México.

Aquilula riskindii (Turner & Langford) Nesom, **comb. nov.** *Ericameria riskindii* B.L. Turner & Langford, Madroño 29: 234. 1982. *Xylothamia riskindii* (Turner & Langford) Nesom, Sida 14: 113. 1990. *Gundlachia riskindii* (Turner & Langford) Urbatsch & Roberts, Sida 21: 249. 2004. TYPE: **MÉXICO**. **Coahuila**. Ca. 28 air mi E of Saltillo, S side of the Sierra de la Viga, ca. 4 mi E of Jamé along woodcutters' road, in *Pinus arizonica*, *Quercus greggii*, *Pseudotsuga*, *Agave macroculmis*, *Pinus cembroides*, *Arbutus* woodland, 10,000 ft, exposed limestone areas, low-rounded aromatic shrublets, 15 May 1977, *J. Henrickson et al. 16156b* (holotype: TEX!; isotypes: MEXU, RSA).

Low, rounded subshrubs, aromatic. **Stems** ca. 8–30 cm high, hispidulous with short, translucent, papillose projections (erect, sharp-pointed, 3–5-celled hairs 0.05–0.1 mm long), internodes 1–5 mm long. **Leaves** linear-oblanceolate to narrowly obovate or spatulate with an attenuate to subpetiolate base, 8–10 mm long, 1.5–5 mm wide, 1-veined, flat or the narrower boat-shaped, relatively even-sized along the stems, both surfaces densely punctate with sunken glands, usually densely and evenly resinous, otherwise glabrous, margins scabrous with short trichomes like the stem, apex obtuse to acute, often falcate-apiculate. **Heads** terminal, solitary, sessile to subsessile, broadly turbinate to subhemispheric, 7–8 mm wide; phyllaries graduate in 3–4 series, ovate-lanceolate to oblong, oblong-oblanceolate, or oblong-lanceolate, base white, distal 2/3 with a broad, elongate, green patch, punctate, densely resinous, otherwise glabrous, innermost 6–7 mm long; receptacles deeply alveolate, cup margins with spike-like projections. **Ray florets** 12–16, ligules 4–5 mm long, yellow, becoming purplish upon drying, coiling. **Disc florets** 30–50, corollas yellow, 4.5–6 mm long, tube weakly delimited from throat, lobes triangular, three cut deeply (ca. 1/5 the length of the throat), two shallowly; style branches appendages linear-lanceolate, 2 mm long, collecting appendages 1–1.5 mm long. **Achenes** subcylindric, 2–2.8 mm long, without discernible nervation, densely strigose, the surface not obscured; pappus 3–5 mm long 1-seriate, persistent. Chromosome number, 2n = 18 (see Additional collections). Figure 2.

Figure 2. *Aquilula riskindii.* A. Holotype (*Henrickson 16156b*, TEX). B. Enlargement of paratype (*Hinton 18192*, MEXU 355123). C. Paratype (*Hinton 18192*, MEXU 807481). Ruler for A and C.

Figure 4. *Xylothamia* species. A. *Xylothamia diffusa* (holotype of *Linosyris sonoriensis*, *Palmer 11*, GH). B. *Xylothamia truncata* (from holotype, *Nesom 5254*, TEX). Ruler for both.

Figure 5. *Xylothama triantha* (holotype of *Haplopappus trianthus, Warnock 1126*, US). The type is from Brewster Co., Texas, the only place the genus *Xylothamia* reaches the USA.

Figure 6. Representative collections of *Gundlachia corymbosa* sensu stricto. Ruler for both.

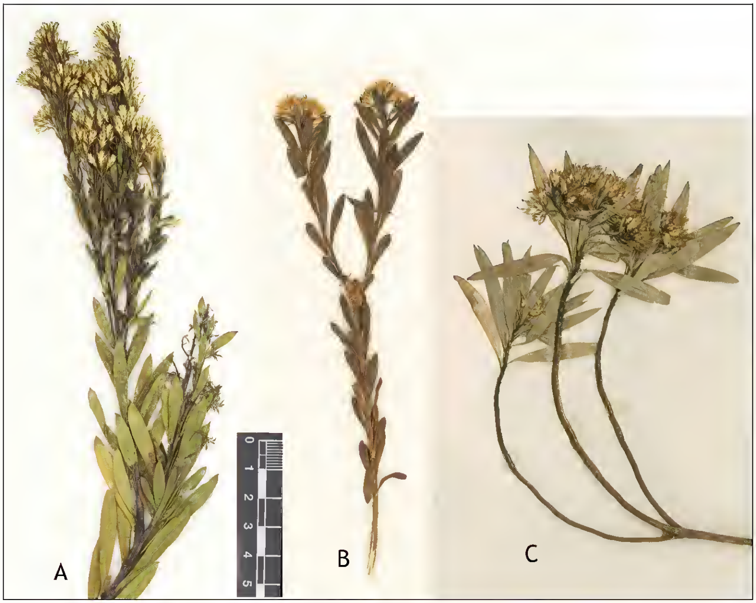

Figure 7. Representative collections of *Gundlachia*. A. *Gundlachia apiculata*. B. *Gundlachia cubana*. C. *Gundlachia ocoana*. Ruler for all three.

Figure 8. Representative collections of *Gundlachia*. A. *Gundlachia compacta*. B. *Gundlachia foliosa*.

Figure 9. *Gundlachia domingensis* (isotype of *G. floribunda*, *Ekman 3512*, S). The elongate-paniculate capitulescence probably is derived -- in all the other species of *Gundlachia* it is strongly corymboid.

Coahuila, Nuevo León, Zacatecas; pine-fir-oak woodlands in limestone and gypsum areas, 2100–3000 m; flowering Apr–May. Figure 10.

Additional collections examined. **Nuevo León**. Mpio. Arteaga. Sierra Zapaliname, among rocks in rockslide, 2945 m, 19 May 1990, *Hinton 20261* (TEX-2 sheets). Mpio. Galeana: Santa Rita, rocky limestone hillside, 2100 m, 25 Apr 1981, *Hinton 18192* (TEX); above La Becerra, gypsum and limestone hillside, 2100 m, 12 Sep 1989, *Hinton 19683* (TEX); Santa Rita, gypsum hillside, 2030 m, 23 Mar 1993, *Hinton 22718* (TEX); ca. 20 km N of San Rafael, W-facing slope and W edge of mountains, ca. 2 km E of village of La Becerra, gypseous limestone, with pinyon pine, *Mortonia, Dasylirion, Yucca, Lindleya, Cowania, Ephedra,* and cacti, 2040 m, scattered, 21 Sep 1993, *Nesom 7697* with M. Mayfield and G.S. Hinton – voucher for chromosome count of n=9, not previously reported (TEX).

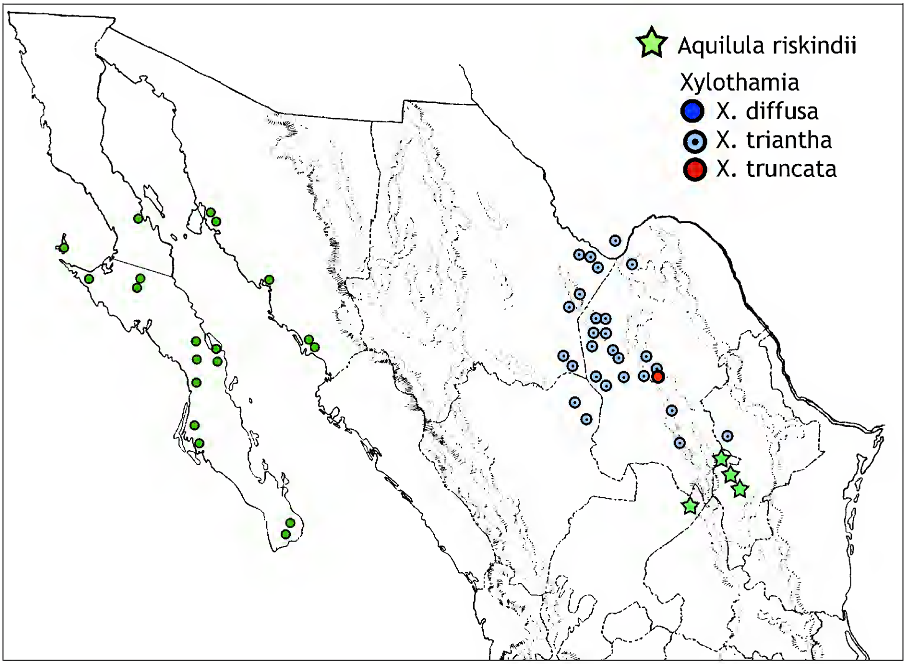

Figure 10. Distribution of *Xylothamia* and *Aquilula*. *Gundlachia* occurs in the Caribbean region.

Note on the taxonomy of *Gundlachia* sensu stricto

Lane (1996) collapsed the taxonomy of Caribbean *Gundlachia* into two species, *G. domingensis* (Spreng.) A. Gray and *G. corymbosa* (Urb.) Britt. ex Bold., the latter comprising 6 varieties. The rationale for her approach was given solely in the two paragraphs quoted here:

> "Examination of the technical characters of these specimens revealed seven taxa. Two groups of specimens differ sufficiently in reproductive characters to warrant recognition at specific rank, and are recognized here as *G. domingensis* and *G. corymbosa*. Among the specimens referable to the latter, differences in vegetative characters––coupled with geographic, topographic, and edaphic adaptations––provide the the basis for recognition of six taxa. The technical features of these groups of specimens, however, are so similar to one another that there is no justification for

giving these taxa specific rank. Therefore, *G. corymbosa* is treated below as having six varieties" (p. 532).

"Though the taxa presented below as varieties have been treated as species by other workers, I cannot find sufficient differences in their technical characters to warrant such status. Each of the characteristics used here to distinguish the varieties can also be found among specimens of the typical variety, though not consistently or in the same combinations. Most of the differences among the varieties are vegetative and attributable to effects of soil type and elevation; the number of florets and larger corollas of *Gundlachia corymbosa* var. *compacta* (more or less twice as many, and twice as large) are like gigas features correlated with polyploidy, but unfortunately the chromosome number is not known" (Lane 1996, pp. 536–537).

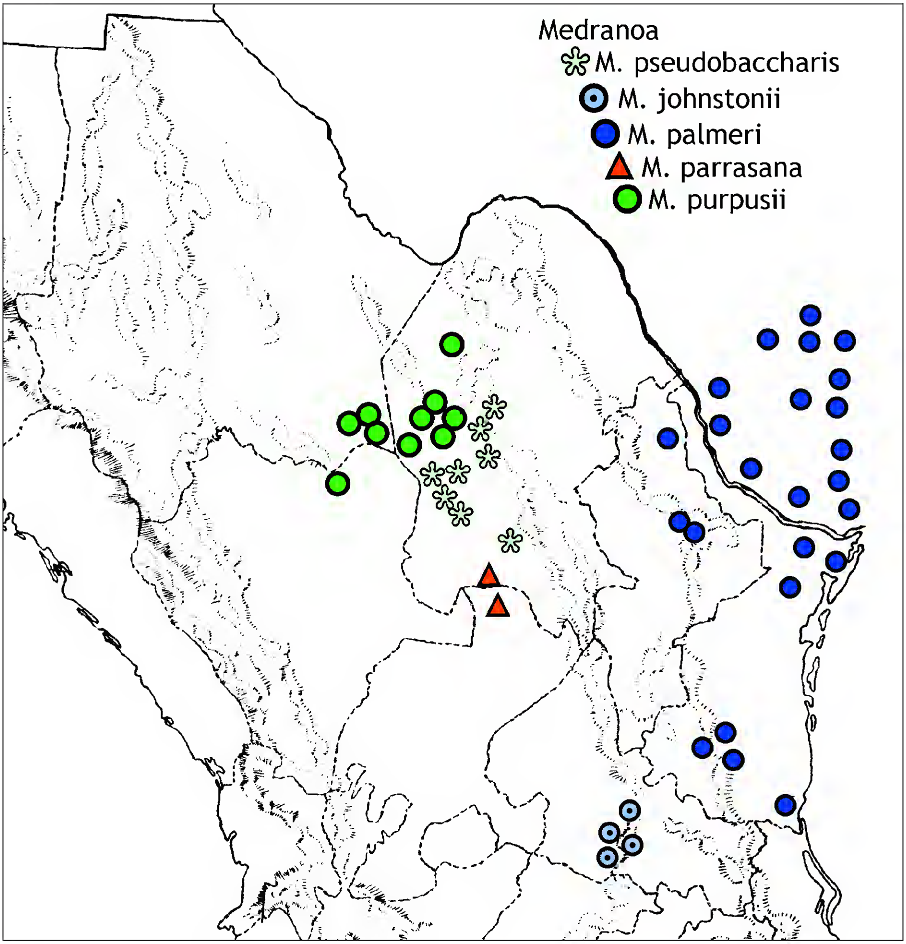

Figure 11. Distribution of the *Medranoa* species.

Reliance on the degree of morphological difference for assignment of rank (specific vs. infraspecific) is not suited to providing an accurate picture of the biological situation, especially without consideration of sympatry, hybridization, or intermediate forms. Species across many genera and families are known to be separated by a wide range of differences, quantitatively and qualitatively. Lane weighted "reproductive characters" (apparently alluding to the shapes of capitulescence, involucre, and phyllaries; see the 1st couplet in her key, p. 535) in deciding that only two species could be recognized. Varieties were distinguished by differences in "vegetative characters." Her observation that vegetative differences (presumably she meant as adaptive responses) among varieties reflect variation in soil type and elevation is without substantiation, and in any case, the point of the observation is not clear, as many evolutionary changes are adaptive.

I have not studied the full range of collections available to Lane, but there appears to be justification for the treatment of *Gundlachia* as a genus of 7 species (Figs. 6–9) –– the widespread *G. corymbosa* and 6 others of narrower distribution –– following botanical assessments prior to Lane's (e.g., Alain 1962) and as still followed (e.g., Acevedo-Rodríguez & Strong 2007). There perhaps are more than 7 species, as Urbatsch et al. (2003, p. 645) noted that "Branch lengths for the two populations of *G. corymbosa* var. *corymbosa* from different islands [Hispaniola vs. Puerto Rico, fide supplementary data] ... are as great as or greater than ones often observed for distinct species and indicate significant genetic differentiation and possibly cryptic species."

ACKNOWLEDGEMENTS

I'm grateful for the opportunities to study at TEX-LL and BRIT-SMU-VDB and the hospitality of the staffs there.

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Nesom, G.L. 2018. *Aster gypsophilus* (Asteraceae) segregated as the monotypic genus *Sanrobertia*. Phytoneuron 2018-25: 1–8. Published 30 May 2018. ISSN 2153 733X

ASTER GYPSOPHILUS (ASTERACEAE) SEGREGATED AS THE MONOTYPIC GENUS *SANROBERTIA*

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109
guynesom@sbcglobal.net

ABSTRACT

Aster gypsophilus is segregated as the monotypic genus **Sanrobertia** Nesom, **gen. nov.**, with the combination **Sanrobertia gypsophila** (Turner) Nesom, **comb. nov.** These plants are distinct from species of *Symphyotrichum* in their combination of diminutive, rhizomatous habit, glandular vestiture, spinulose-tipped leaves and phyllaries, solitary heads at the ends of long, leafy branches, phyllaries with a weakly demarcated green apical patch, alveolate receptacles, accrescent pappus in 2–3 series, and chromosome number of 2n = 18. Molecular data place the species as a basal member of subtribe Symphyotrichinae, along with the monotypic genera *Canadanthus* and *Ampelaster*. *Sanrobertia gypsophila* is rare, known only from gypsum flats and llanos in the vicinity of Entronque San Roberto, south of Monterrey in Nuevo León.

After a period of intense molecular study of American Astereae and corresponding modification of taxonomic concepts (many authors, mostly summarized in Brouillet et al. 2009), issues remain unresolved. This paper and others (in this posting, and to follow) address problems in the Mexican flora, preceding a summary of Mexican Astereae.

SANROBERTIA Nesom, **gen. nov.**

Type species, *Sanrobertia gypsophila* (Turner) Nesom ≡ *Aster gypsophilus* B.L. Turner

Distinct from species of *Symphyotrichum* in its combination of rhizomatous habit, stipitate-glandular vestiture, spinulose-tipped leaves and phyllaries, solitary heads at the ends of long, equably leafy branches, phyllaries usually with a weakly demarcated green apical patch and basal white-indurate zone, elongate disc corollas, alveolate receptacles, accrescent pappus bristles in 2–3 series, and chromosome number of 2n = 18.

Sanrobertia gypsophila (Turner) Nesom, **comb. nov.** *Aster gypsophilus* B.L. Turner, Southw. Naturalist 19: 123. 1974. *Symphyotrichum gypsophilum* (Turner) Nesom, Phytologia 77: 283. 1994. TYPE: **MEXICO**. **Nuevo León**. Ca. 28 mi N of Entroque San Roberto on Hwy 57, near KM 162, white gypseous soil, 5 Sep 1971, *J.D. Bacon 1103* (holotype: TEX!; isotypes: ENCB image!, GH image!, MEXU image!, MICH image!).

Perennial herbs, 4–20 cm tall, arising from slender, woody rhizomes; phyllaries and at least the upper stems and leaves mostly minutely stipitate-glandular to sessile glandular, sometimes also sparsely and loosely strigose with white, sharp-pointed, closely appressed hairs 0.1–0.5 mm long. **Leaves** apparently all cauline, often slightly subclasping, entire, with a spinulose, recurved apiculum, mostly oblong-lanceolate, 4–7 x 1–2 mm, sessile, 1-nerved, even-sized and evenly distributed from stem base to tip, overlapping adjacent nodes. **Heads** terminal, solitary on primary and secondary branches, peduncles bracteate with gradually reduced leaves to immediately below heads. **Involucres** turbinate-campanulate, 8–11 mm wide; phyllaries strongly graduated in 4–5 series, oblong-lanceolate to oblong-oblanceolate, apex acute to obtuse, outer with a strongly to weakly demarcated apical herbaceous patch and basal white-indurate zone, outer with a distinct apiculum, margins scarious or the innermost nearly completely scarious, inner phyllaries becoming linear-oblong and usually purplish; receptacles flat, weakly alveolate to more conspicously lacerate-alveolate. **Ray florets** 12–16, pistillate, fertile, ligules lilac, ca. 5–6 mm long, 0.8–1.2 mm wide, coiling. **Disc florets** yellow, tubular, 6–7 mm long with a weakly delimited throat, lobes deltate to triangular-deltate, ca. 0.75 mm long; style branches 1.5 mm long, linear, collecting appendages ca. 0.8 mm long, apex acute. **Achenes** 3 mm long, fusiform, narrowly cylindric to somewhat 4-sided with 7–12 ribs, sparsely pubescent with short, ascending hairs, eglandular; pappus of minutely setose bristles in 2–3 series, accrescent and becoming 7–9 mm long. **Chromosome number**, 2n = 18 (Turner 1974).

Nue; known only from gypsum flats and llanos in the vicinity of Entronque San Roberto, 1800–2200 m; Aug–Oct.

Entronque San Roberto (San Roberto Junction) is well known to botanists who have studied the flora of Nuevo León. At the junction, from north-south Highway 57, Highway 58 goes east through the mountains toward Linares, providing access to Galeana, Pablillo, and Iturbide, each famously situated in the endemic-rich gypsum habitats of that region.

Figure 1. *Sanrobertia gypsophila* in natural habitat, near the type locality south of Entronque San Roberto. Photos by George S. Hinton, 12 Aug 2017, as posted on iNaturalist. <https://www.inaturalist.org/observations/7551414> These plants are (estimated) 10–15 cm tall.

Additional collections examined. **Nuevo León**. Mpio. Galeana: Hwy 57, ca. 24 mi N of San Roberto at Km 162, gypsum flats, abundant in small area at edge of hwy, 10 Aug 1976, *Hartman & Funk 4018* (TEX); El Refugio -> west + 3K, gypseous llano, 1795 m, 28 Oct 1976, *Hinton 25991* (TEX-2 sheets); N of Rancho Aguililla, llano, 1840 m, large colony, 19 Jun 1997, *Hinton 27098* (TEX); N of Rancho Aguililla, llano at edge of cultivated field, 1883 m, large colony, 1000's of plants, 3 Aug 2000, *Hinton 27655* (TEX); Hwy 57, 20.6 mi N of San Roberto Junction, desert floor, along E side of road, moist area near culvert, 10 Oct 1984, *Sundberg 3135* (TEX).

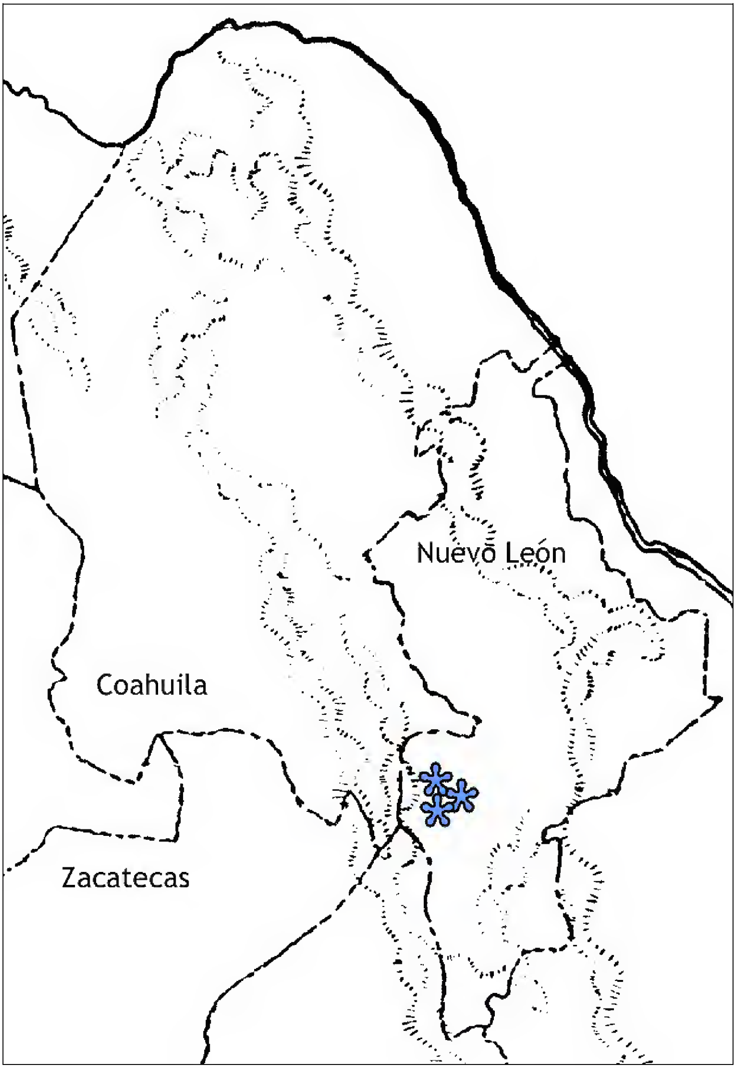

Figure 2. Distribution of *Sanrobertia gypsophila*, known only from the type locality and close vicinity.

Figure 3. *Sanrobertia gypsophila*, from GH isotype.

Figure 4. *Sanrobertia gypsophila*, from MICH isotype.

Figure 5. *Sanrobertia gypsophila*, from MICH isotype.

Figure 6. *Sanrobertia gypsophila* heads, from GH isotype. Note accrescent pappus, alveolate receptacles, and phyllaries with a more or less sharply delimited apical patch and basal white-indurate zone.

Turner (1974) reckoned that *Aster gypsophilus* was most closely related to *Leucosyris carnosa* (subtr. Machaerantherinae), a species of desert habitats in the southwestern USA and adjacent Mexico. I hypothesized (Nesom 1989, 1994) that the closest relatives of *A. gypsophilus* were the x=5 virguloid species of *Symphyotrichum*, despite the different chromosome number, emphasizing similarities in glandular vestiture and the sessile, even-sized, oblong leaves, apiculate phyllaries, and subterete, multinerved achenes. Molecular data, however, unequivocally place *A. gypsophilus*, along with *Canadanthus modestus* (x=9) and *Ampelaster carolinianus* (x=9) as "the earliest diverging members of Symphyotrichinae" (Morgan & Holland 2012).

ACKNOWLEDGEMENTS

I'm grateful to staff at TEX-LL for their hospitality during recent study there.

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CONYZA MICROCEPHALA AS *ERIGERON* (ASTERACEAE, ASTEREAE)

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109
guynesom@sbcglobal.net

ABSTRACT

The Mexican species *Conyza microcephala* Hemsley is transferred to *Erigeron* as **Erigeron columnaris** Nesom, **nom. nov.** (use of "microcephala" as an epithet blocked by earlier names in *Erigeron*). A lectotype is designated for the name.

In order to complete the reunion of ligulate and eligulate species of Mexican *Erigeron*, *Conyza microcephala* Hemsl. is brought into the nomenclatural fold of *Erigeron*. Evidence indicates unequivocally that *Conyza* species have arisen at least twice from within the phylogenetic topology of *Erigeron* (see Nesom 2018 for other comments).

The eligulate *Erigeron* species were treated as *Conyza* in the Flora of North America North of Mexico (Strother 2006), as the Mesoamerican species also have been (Pruski 2018). Recent California floristic summaries (e.g., Keil & Nesom 2012, 2017), however, have identified them as *Erigeron*, and they will be included there for the Astereae of Mexico (Nesom, in prep.).

Conyza microcephala is the only "conyzoid" species endemic to Mexico (Fig. 1). It was included among the Mesoamerican species by Pruski (2018) on the basis of its occurrence in Chiapas. Nash (1976) included it for Guatemala, noting that it would be expected there, but there have been no reports of its occurrence. Cuatrecasas (1969) included it among the Astereae of Colombia, but Pruski (2018) has noted that the South American record could be based on a different species.

Erigeron columnaris Nesom, **nom. nov.** (non *Erigeron microcephalus* Sch. Bip., Linnaea 34: 534. 1865 [nom. nud.]; non *Erigeron microcephalus* Gand., Contr. Fl. Terr. Slav. Merid. 1: 16. 1883). *Conyza microcephala* Hemsl., Biol. Centr. Amer. Bot. 2: 126. 1881. **LECTOTYPE** (designated here): **MEXICO**. **San Luis Potosí**. Ex convalli San Luis Potosí, in montibus San Miguelito, Sep 1876, *J.G. Schaffner 221* (K image!; isolectotype: GH image!). The label on the K sheet has printed "Ex. Herb. A. Gray" and handwritten (by A. Gray) "Schaffner 221 = P. & P. 396, Conyza what spec.?" –– the plants apparently separated from the GH material and given to K by Gray. The GH label supplies the fuller information as cited here. Specimens at P and M have printed labels (HERBARIUM v. A. VIGENER) identical to each other, each with August 1879 and with two handwritten numbers, 221 and 662 (see Fig 1).

Protologue: "NORTH MEXICO, San Luis Potosi (*Schaffner*, 221; *Parry & Palmer*, 396). Hb. Kew." The Parry & Palmer collection is cited here.

Mexico. **San Luis Potosí**. Chiefly in the region of San Luis Potosí, 22° N. Lat., altitude 6000-8000 ft, 1878, *C.C. Parry & E. Palmer 396* (GH image!, K-not seen but as least as implied by Hemsley, MO-as cited on Tropicos, P image!).

Annuals or biennials from a taproot or fibrous roots. **Stems** usually unbranched until the inflorescence, sparsely to moderately hirsute with spreading, coarse, multicellular hairs. **Leaves** lanceolate-oblong to lanceolate, entire to toothed near the apex, less commonly pinnately lobed, ascending, gradually decreasing in size distally, eglandular, the lower sometimes subclasping. **Heads** in compact corymboid clusters; involucres 2.5–5 mm wide; phyllaries with a prominent golden-brown midrib. Ray (pistillate) florets with eligulate corollas.

The new epithet alludes to the column-like stems with closely ascending leaves.

Figure 1. *Erigeron columnaris* (= *Conyza microcephala*), *Schaffner 662/221* (P) -- see comments in the typification summary.

Figure 2. *Erigeron columnaris* (= *Conyza microcephala*), *Rzedowski 44280* (MEXU) from Michoacan.

Chi, Sin, Dur, Zac, Agu, San, Hid, Que, Jal, Mic, Mex, Gue, Oax, Cps, western Guatemala; montane cloud forests in Oax and Cps but more commonly pine-oak woodlands; 1500–2700 m; Jun–Nov.

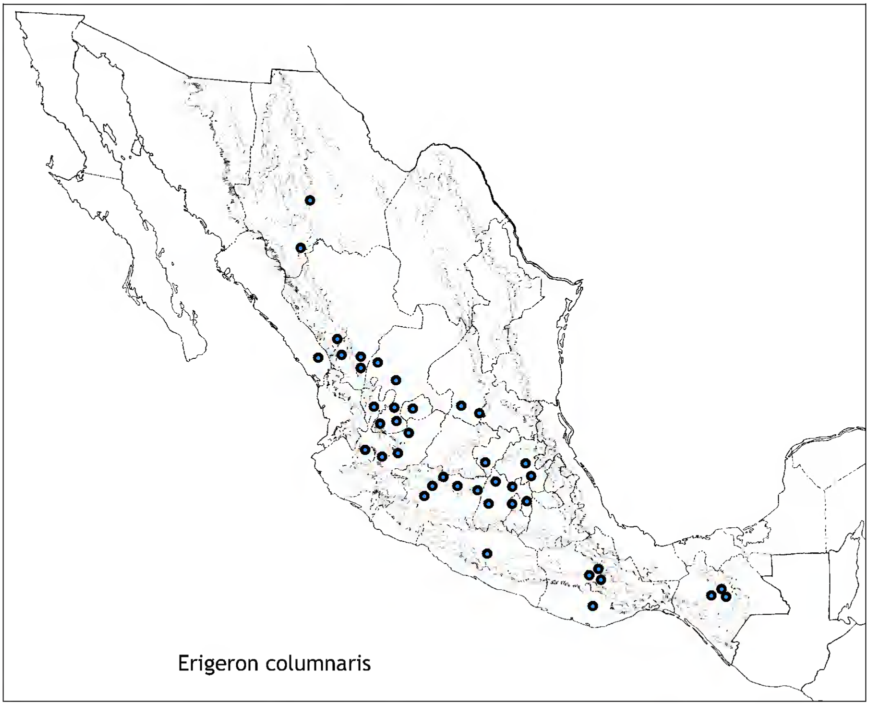

Figure 3. Distribution of *Erigeron columnaris* (= *Conyza microcephala*), an endemic of Mexico. Records from floristic studies of Mexican Astereae, many herbaria, augmented by UNAM Portal (2018).

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ERIGERON FLORIBUNDUS AND *E. SUMATRENSIS* (ASTERACEAE) IN THE USA AND MEXICO

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109
guynesom@sbcglobal.net

ABSTRACT

Erigeron sumatrensis Retz. is widely naturalized both in California and the southeastern USA (Texas, Louisiana, Mississippi, Alabama, Florida, Georgia, and South Carolina) as well as in southern Mexico. *Erigeron floribundus* (Kunth) Sch. Bip. is naturalized in California and Mexico. County-level maps (USA) are provided for the geographic range of both species, which are compared with the more widespread *E. bonariensis* by a key and illustrations. The three species also are mapped for Mexico. A formal nomenclatural summary provides typification and synonymy; a lectotype is designated for *Conyza bilbaoana* Remy (synonym of *E. floribundus*) and for *Erigeron linifolius* Willd. (synonym of *E. bonariensis*).

The South American native and worldwide weed *Erigeron bonariensis* L. (=*Conyza bonariensis* (L.) Cronq.) has become established in the USA from coast to coast. Two other conyzoid non-native species also have colonized California –– *E. floribundus* (Kunth) Sch. Bip. and *E. sumatrensis* Retz. (Maps 1 and 2) –– but their identifications have been inconsistent. The first inclusion of either species in a major California floristic treatment apparently was in Munz (1959), where it was identified as *Conyza floribunda.* Keil (1993) reported both species, identifying them as *C. floribunda* and *C. bilbaoana* Remy, but subsequent versions of the Jepson Manual (Keil & Nesom 2012, 2017) have identified only *Erigeron sumatrensis* Retz., with *E. floribundus* as a synonym, *C. bilbaoana* as misapplied). Strother (FNANM 2006) recorded only *E. floribundus* (as *Conyza*) for California (with *C. bilbaoana* as a synonym).

A naturalized population of *Erigeron sumatrensis* was documented for southeast Texas (Singhurst & Holmes 2013, as *Conyza floribunda*), but its occurrence in the southeastern USA has been mostly unnoticed. Early floras for the Southeast (e.g., Mohr 1901; Lowe 1921) included only *E. bonariensis* (as *Leptilon linifolium* (Willd.) Heller). Small's treatment (1933) of *Leptilon* included *L. linifolium* ("Waste-places, Coastal Plain, Fla. to Miss. and S.C.") and *L. bonariense* ("Waste-places, Fla."), which heretofore has seemed peculiar, but in the context of the present paper, it seems that Small probably used the name *Leptilon bonariense* to identify *E. sumatrensis* –– perhaps referring to an early Curtis collection from Pensacola (see Collections examined). Duncan and Kartesz (1981) included *Conyza bonariensis* along with *C. floribunda* in a checklist of Georgia plants. Strother's inclusion of *Conyza floribunda* for Florida (2006, FNANM) referred to the Curtis collection from Pensacola (J. Strother, pers. comm.) identified and cited here as *E. sumatrensis.*

Erigeron sumatrensis clearly does occur in states east of Texas (Map 3) and study of existing collections probably will show it to be more widespread than documented here. Like *E. bonariensis*, it has become a world-wide weed. Good photos and other references are provided by Verloove (2018).

These three species also occur in Mexico (Maps 4, 5, and 6), although their distributions there are not continuous with those in the USA. Apparently in contrast to the USA, *Erigeron bonariensis* is the least common of the three –– it is characteristic of urban habitats, particularly big cities.

Identification

Plants of *Erigeron floribundus* are immediately distinct in their glabrous to glabrate phyllaries, often chestnut brown in color and reduced vestiture of the stems and leaves. The capitulescence is broadly paniculate. In *E. canadensis* var. *pusillus* (Nutt.) Boivin, which also has glabrous phyllaries, the heads are smaller, phyllaries narrower, and the pistillate florets are distinctly ligulate.

Erigeron floribundus and *E. sumatrensis* both produce broadly columnar panicles, but those of *E. floribundus* usually are broader with fewer and more widely arranged heads and the leaves are less densely arranged.

1. Phyllaries glabrous to subglabrous, hyaline margins slightly wavy, sometimes shallowly lacerate; stems sparsely strigose, often with minute hairs, to nearly glabrous; leaf subglabrous to sparsely short-strigose .... **Erigeron floribundus**

1. Phyllaries loosely strigose, hyaline margins not wavy or lacerate; stems coarsely hirsute-strigose to hirsute-villous or villous; leaf surfaces densely and evenly hirsute .... **Erigeron sumatrensis**

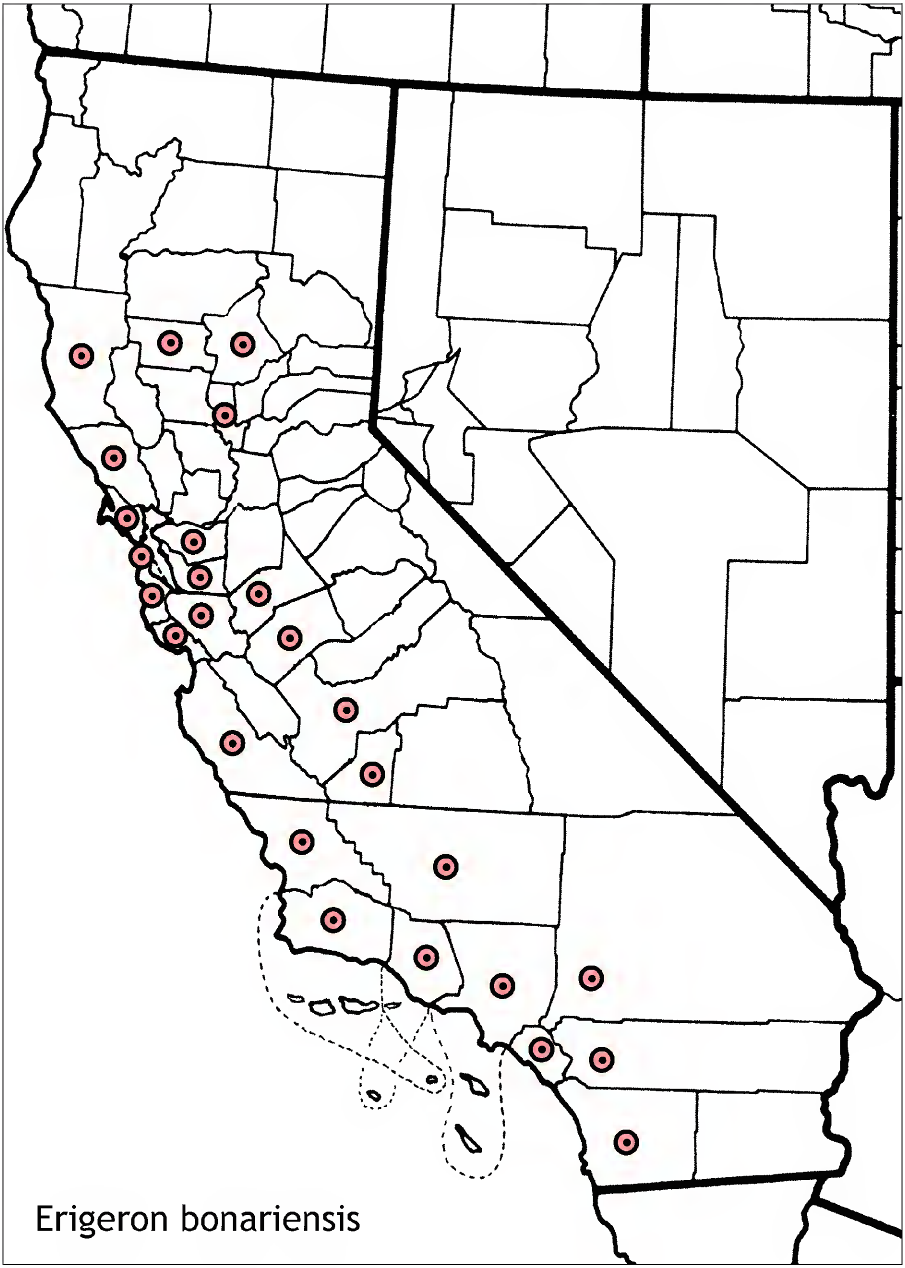
The difference between *Erigeron bonariensis* and *E. sumatrensis* is more problematic, especially since many collections of *E. sumatrensis* have been identified as *E. bonariensis.* Plants of *E. sumatrensis* often reach a meter tall and produce a broadly paniculate-thyrsoid capitulescence with more numerous heads. The heads are characteristically smaller (width of fruiting receptacles an indication) with pistillate florets fewer in number, phyllaries are flatter and thinner, strigose with thin-based hairs, and with a broad yellow-brown midportion, and the receptacles are shallowly alveolate (usually distinctly so but not always).

Plants of *Erigeron bonariensis* characteristically produce linear, closely ascending cauline leaves and the heads usually are mostly produced distally. With a greater number of florets and quickly accrescent pappus, the heads characteristically appear distinctly larger.

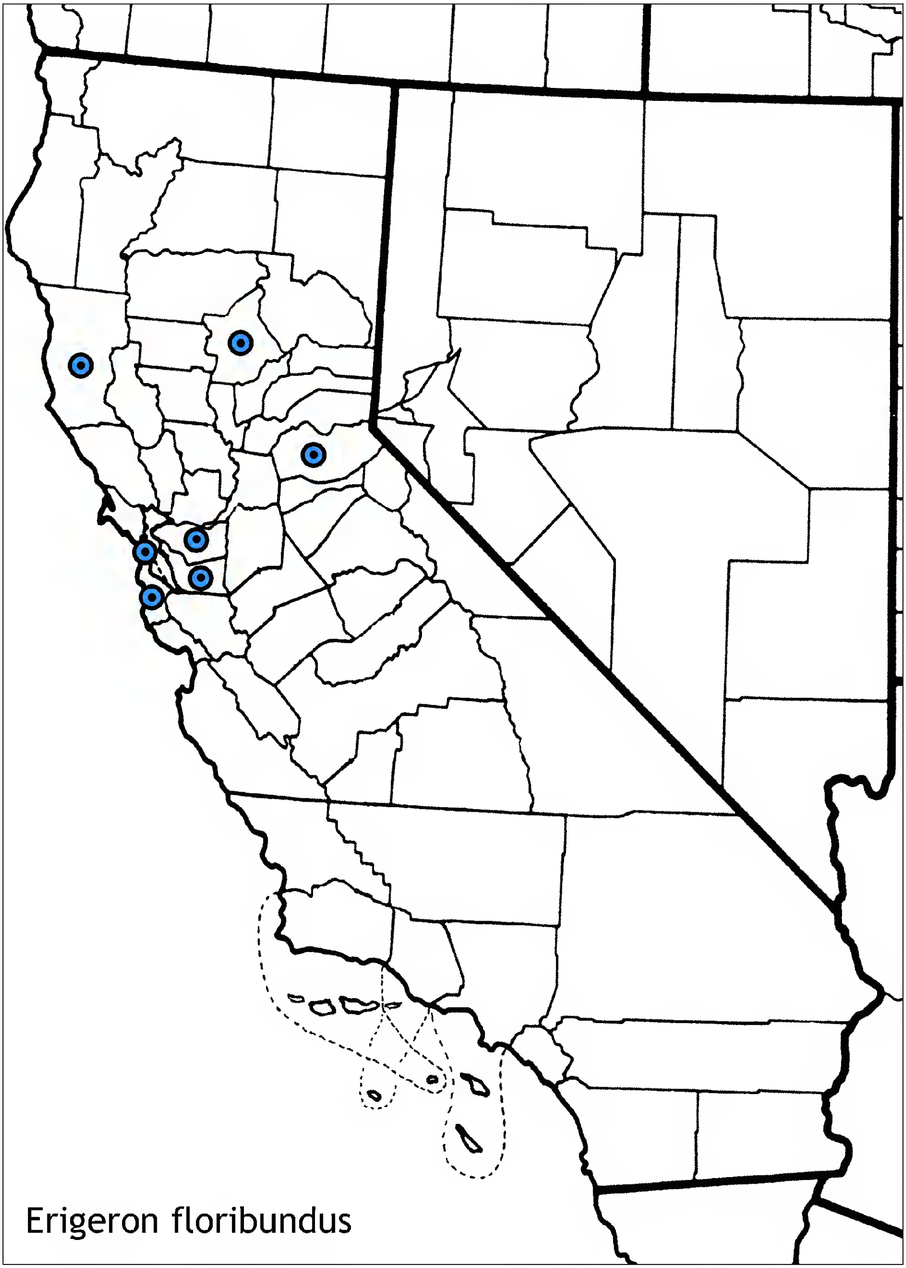
1. Cauline leaves characteristically linear to linear-oblanceolate; capitulescence corymbiform to racemiform, less commonly thyrsoid-paniculate; fruiting receptacles (2–)2.5–4(–5) mm wide, not alveolate or sometimes the innermost 2–4 floret sockets barely so; phyllaries linear to linear-lanceolate, relatively thick and opaque, 0.3–0.5 mm wide, green to greenish brown with a narrow, orange-resinous midvein, hispid-hirsute to strigose-hirsute with thick-based hairs, inner often purple-tipped, inserted on a ring of fused tissue; pistillate florets ca. 40–150, in (2–)3–6 series .... **Erigeron bonariensis**

1. Cauline leaves characteristically narrowly lanceolate-elliptic to lanceolate or oblanceolate; capitulescence usually thyrsoid-paniculate; fruiting receptacles 1.5–2.5 mm wide, weakly but distinctly alveolate (lens), outer to inner florets; phyllaries triangular to narrowly ovate, relatively thin and translucent, 0.5–0.8 mm wide, central part yellow-brown with an inconspicuous midvein, loosely strigose with thin-based hairs, never purple-tipped, inserted at apex of peduncle; pistillate florets ca. 20–50, in 2–3 series .... **Erigeron sumatrensis**

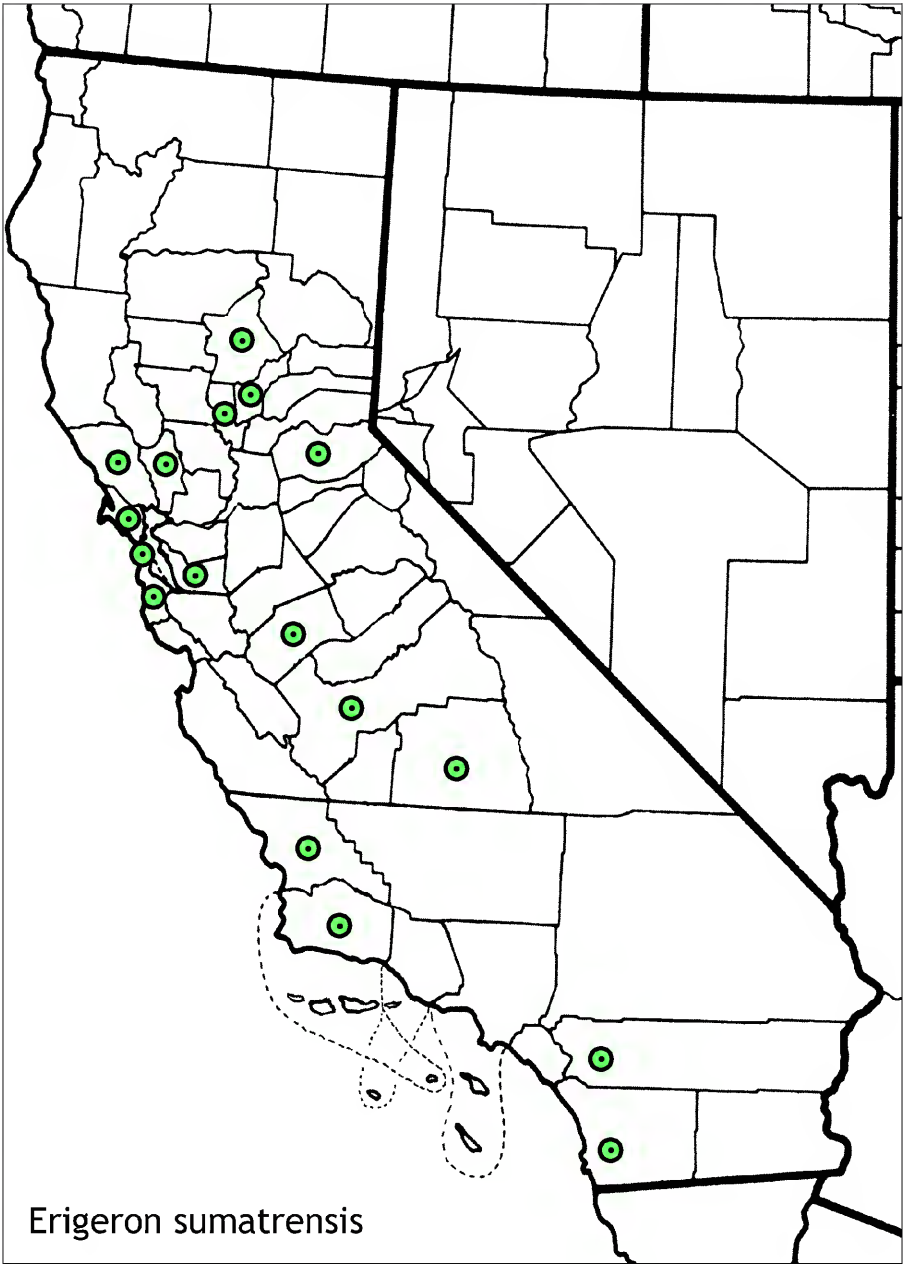
Representative habits, capitulescence forms, and involucral morphology for the three species are shown in Figures 1-4. A tentative guess at identification usually is possible with just a glance at the habit –– with study of more technical features, identifications usually can be made with good confidence.



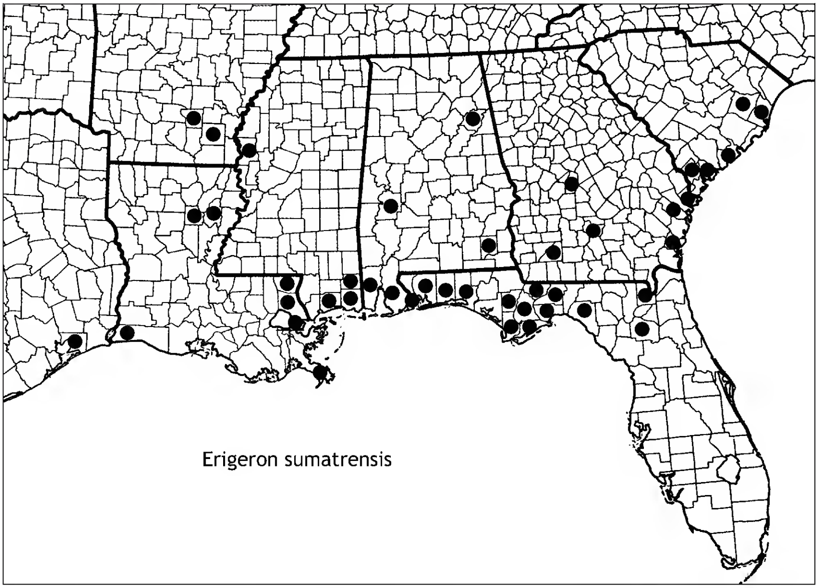
Map 1. Distribution of *Erigeron bonariensis* in California. Records from CAS-DS and UC-JEPS.



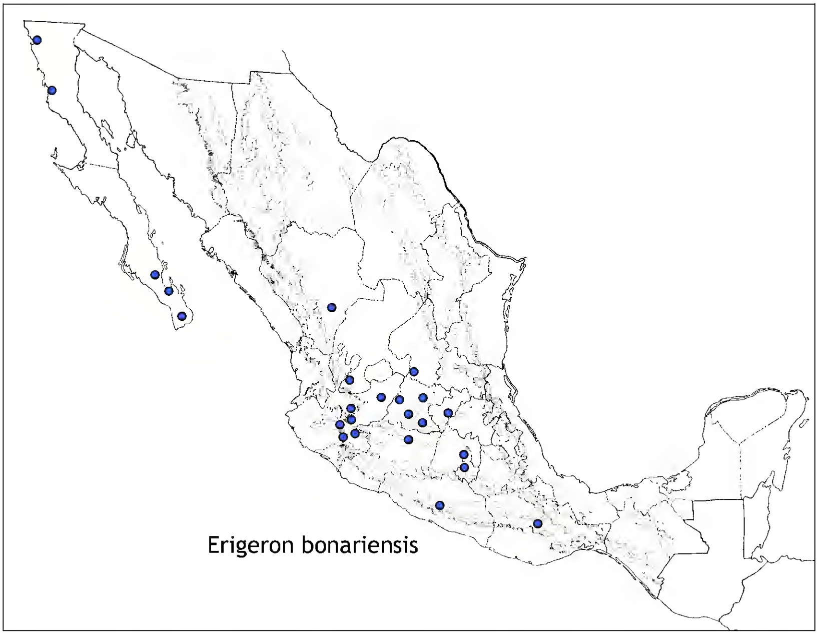
Map 2. Distribution of *Erigeron floribundus* in California. Records from CAS-DS and UC-JEPS.



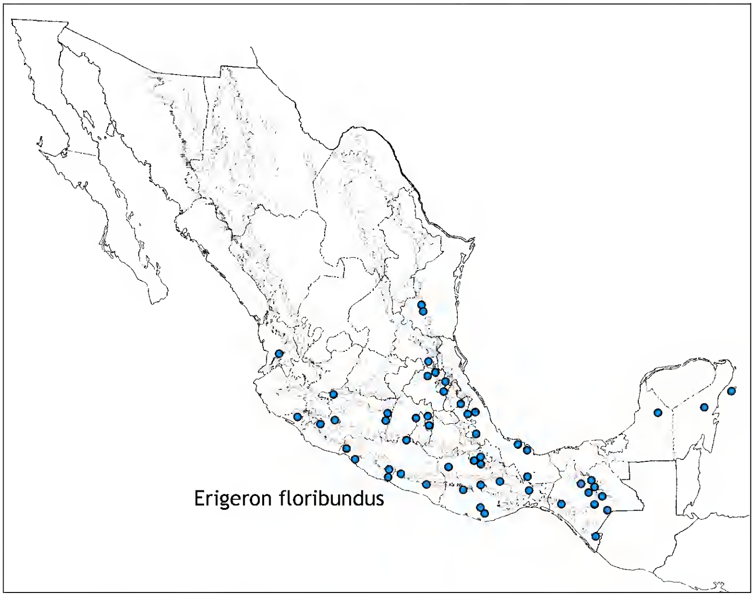
Map 3. Distribution of *Erigeron sumatrensis* in California. Records from CAS-DS and UC-JEPS.



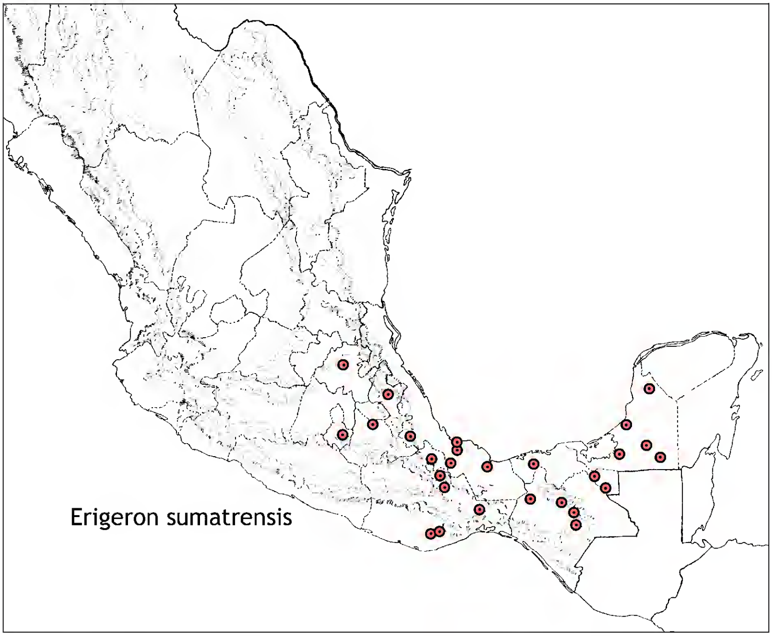
Map 4. Distribution of *Erigeron sumatrensis* in the southeastern USA. Vouchers cited in text.



Map 5. Distribution of *Erigeron bonariensis* in Mexico. Records from various herbaria.



Map. 6. Distribution of *Erigeron floribundus* in Mexico. Records from various herbaria.



Map. 7. Distribution of *Erigeron sumatrensis* in Mexico. Records from various herbaria.

Figure 1. Characteristic habit and capitulescence of *Erigeron bonariensis.*

Figure 2. Characteristic habit and capitulescence of *Erigeron floribundus*.

Figure 3. Characteristic habit and capitulescence of *Erigeron sumatrensis*.

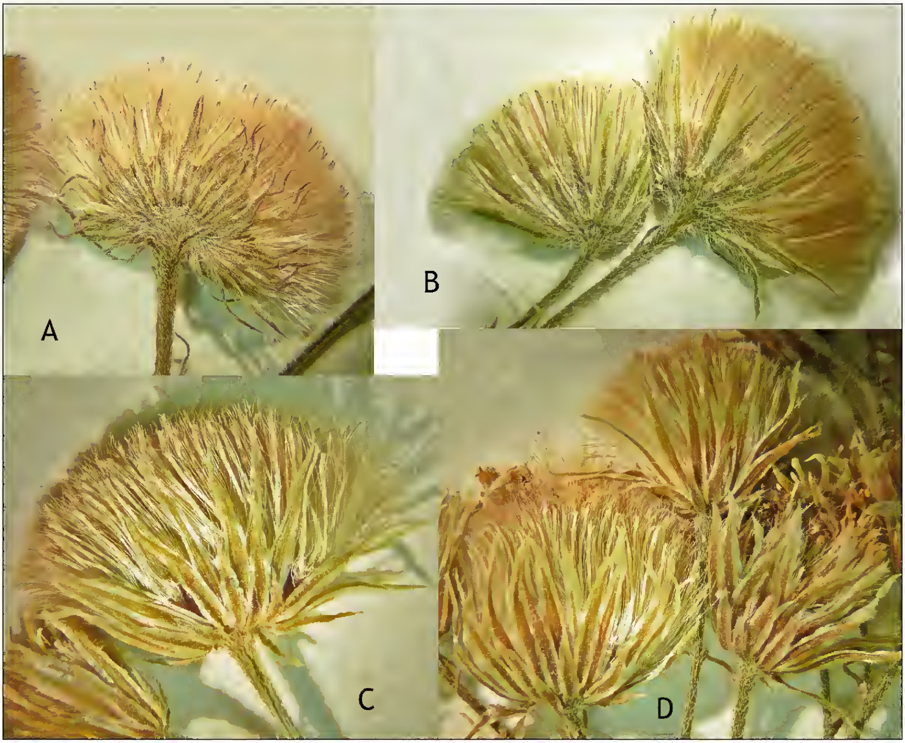


Figure 4. Characteristic involucres. A. *Erigeron bonariensis*. B. *Erigeron sumatrensis*. *C, D. Erigeron floribundus.*

1. **Erigeron bonariensis** L., Sp. Pl. 2: 863. 1753. *Leptilon bonariense* (L.) Small, Fl. S.E. U.S., 1340. 1903. *Conyza bonariensis* (L.) Cronq., Bull. Torrey Bot. Club. 70: 632. 1943. LECTOTYPE (D'Arcy 1975, p. 1021): "Habitat in America australi." (LINN 994.11 image!).

Erigeron undulatus Moench, Methodus (Moench) 598. 1794 [nom. illeg., *Erigeron bonariense* L. cited as synonym].

Erigeron crispus Pourret, Hist. & Mém. Acad. Roy. Sci. Toulouse 3: 318. 1788. *Conyza crispa* (Pourr.) Rupr., Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Pétersbourg 14: 235. 1856. TYPE: **FRANCE**. "Frequens circa narbon et monspelium," 1779, *P.A. Pourret s.n.* (holotype: MPU image!). Protologue: "Dans les champs, aux environs de Narbonne & de Montpellier."

This sheet was annotated in 2013 by Danièle Domeyne as *Conyza bonariensis* (L.) Cronq.

Erigeron linifolius Willd., Sp. Pl. 3(3): 1955. 1803. *Conyzella linifolia* (Willd.) Greene, Fl. Francisc. 4: 386. 1897. *Leptilon linifolium* (Willd.) Small, Fl. S.E. U.S., 1340. 1903. *Conyza linifolia* (Willd.) Täckh., Stud. Fl. Egypt, 53. 1956 (nom. illeg., not *Conyza linifolia* L., 1753). LECTOTYPE (designated here): South America ("Habitat in America australi"), no data on the sheet (B-W 15685-03 image!; http://herbarium.bgbm.org/object/BW15685030).

There are 6 sheets of *Erigeron* '*linifolium*' at B-W (Willdenow folder 15685, images!). The first 4 clearly are *Erigeron bonariensis* as identified here and are marked with Willdenow's "W." Sheets 5 and 6, "ex Mus. Paris," have relatively broad cauline leaves and are likely to be *Conyza apurensis* Kunth (*Erigeron laevigata* Rich. ≡ *Conyza laevigata* (Rich.) Pruski) or some other species.

Conyza rufescens Hoffmanns. & Link, Fl. Portug. [Hoffmannsegg] 2: 253. [1820-1834]. **TYPE**: **SPAIN**. Protologue: "Fréquente aux environs de Lisbonne le long des chemins et dans les champs incultes. Été" (not seen). *Erigeron bonariensis*, from the description.

Erigeron bonariensis var. *angustifolius* Cabr., Revista Mus. La Plata, Secc. Bot. 4: 88, fig. 24. 1941. *Conyza bonariensis* var. *angustifolia* (Cabr.) Cabr., Man. Fl. Alred. Buenos Aires, 481. 1953. **TYPE**: **ARGENTINA**. **Chaco**. Colonia Benítez, Feb 1932, *A.G. Schulz 217* (holotype: presumably LP, not seen - cited as in Cabrera's herbarium). Figure 24 is diagnostic.

Erigeron bonariensis is widespread in the USA, including California, sympatric with *E. floribundus* and *E. sumatrensis*. It is mapped here for Mexico and California but not the rest of the USA. (Washington, Oregon, Idaho, Nevada, Utah, Arizona, New Mexico, Texas, Louisiana, Arkansas, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina). Because of its confusion with *E. sumatrensis*, collections previously identified as *E. bonariensis* need to be reexamined for an accurate geographic assessment.

2. **Erigeron sumatrensis** Retz., Observ. Bot. 5: 28. 1789[1788]. *Conyza sumatrensis* (Retz.) E. Walker, J. Jap. Bot. 46: 72. 1971. **NEOTYPE** (McClintock & Marshall 1988, p. 172): **INDONESIA**. **Sumatra**. Berastagi, Feb 1921, *H.N. Ridley s.n.* (K image!). McClintock and Marshall (p. 172) noted that "there is no type or other specimen of Retzius' to check the application of the name ... [thus] ... we here designate a neotype."

Conyza ambigua DC., Fl. Franç. (ed. 3) 6: 468. 1815. *Erigeron ambiguus* (DC.) Sch. Bip., Hist. Nat. Îles Canaries 3(2): 208. 1836[1845] [non *Erigeron ambiguus* Nutt. 1818]. **TYPE**: **FRANCE**. "Cette plante a été trouvée aux environs de Nismes et de Montpellier, dans les prairies artificiells." The handwritten label says only "Montpellier," *A.P de Candolle s.n.* (holotype: P image!).

Conyza ambigua has sometimes been considered a synonym of *E. bonariensis*, but the relatively reduced vestiture, elongate inflorescence (though immature), small heads, and characteristic phyllaries place it with *E. sumatrensis*.

Conyza erigeroides DC., Prodr. 5: 378. 1836. **TYPE**: **BRAZIL**. Bahia, Apr 1831, *J. Lhotsky s.n.* (holotype: G-DC 00452596 image!). Protologue: "In Brasilia circa Bahiam."

Conyza naudinii Bonnet, Bull. Soc. Bot. France 25: 208. 1878. *Erigeron crispus* subsp. *naudinii* (Bonnet) Bonnier, Fl. Illus. France 5: 72. 1922. *Erigeron naudinii* (Bonnet) Humbert, Fl. Madagasc. 189: 264. 1960. **TYPE**: **FRANCE**. Collioure, in Naudin's personal garden, Aug 1877, *C.V. Naudin s.n.* (possible holotype: MPU 024005 image!). Protologue: "Floret idibus augustis. Patria ignota. Planta, habitu *C. floribundae* H.B.K. sed longe diversa, in horto Caucolliberitano cl. Naudin, cui hanc eximiam speciem dicatam volui, sponte derepenteque enata et ibi per aliquot annos culta, nunc circa urbem, sua sponte, frequens recrescit."

Of 2 sheets at MPU, one (MPU 024005) has a handwritten label as "Conyza naudini Hort. M -- H.M. aout 1877." Both collections were annotated in 2013 by Danièle Domeyne as *Erigeron sumatrensis* Retz. Naudin lived in Collioure, about 80 miles south of Montpellier, from 1865 to 1879 and maintained a garden there (Marza & Cerchez 1967).

Conyza gracilis Hoffmanns. & Link, Fl. Portug. [Hoffmannsegg] 2: 254. [1820-1834]. **TYPE**: **SPAIN**. Protologue: "Aux environs de Lisbonne avec la *Conyse roussatre* mais plus rare, Été. (not seen). *Erigeron sumatrensis*, from the description.

Conyza altissima Naudin ex Debeaux, Bull. Soc. Agr. Sci. Lit. Pyr.-Orien. 23: 151. 1878. **TYPE**: **FRANCE**. Collioure, in Naudin's personal garden, Aug 1877, *C.V. Naudin s.n.* (possible holotype: MPU 024005 image!). Apparently the same type as for *Conyza naudinii* Bonnet (see Guédès & Jovet 1975). Protologue: "Les vignes et les cultures de M. Naudin à Collioure, où cette plante se propage sponanément, ainsi que dans les vignes avoisinantes. ... Le *Conyza altissima* s'est montré tout-à-coup et en abondance dans les cultures de M. Naudin, il y a quelques années."

Conyza x flahaultiana Sennen, Bol. Soc. Aragonesa Ci. Nat. 4: 319. 1905. **TYPE**: **SPAIN**. Catalogne. Vilarnadal et Cabanas [Barcelone added in pencil], champs, Oct-Nov 1905-1906, *F. Sennen 164* (possible type material: DAO image!).

Described (in the protologue) as a hybrid, *Erigeron canadense* x *Conyza ambigua*, and so indicated on the specimen label.

Conyza x daveauana Sennen, Bol. Soc. Aragonesa Ci. Nat. 11: 194. 1912. *Erigeron daveauanus* (Sennen) Greuter, Willdenowia 37: 142. 2007. **TYPE MATERIAL**: Protologue: "Catalogne: Le Perthus; environs de Barcelone par les premières pentes du Tibidado." **ISOSYNTYPE** (fide annotation by Danièle Domeyne, 2013): **SPAIN**. Le Perthus (ferr. espagn.) lieux rag[ur], 1 Oct 1904, *Fre. Sennen s.n.* (MPU image!).

Described (in the protologue) as a hybrid, *Conyza naudinii* x *Conyza ambigua*, and so indicated on the specimen label. See comments by Verloove (2018).

Erigeron bonariensis var. *microcephalus* Cabr., Revista Mus. La Plata, Secc. Bot. 4: 88, fig. 23. 1941. *Conyza bonariensis* var. *microcephala* (Cabr.) Cabr., Man. Fl. Alred. Buenos Aires, 481. 1953. **TYPE MATERIAL**: **ARGENTINA**. **Buenos Aires**. Sierra de la Ventana, vertiente, 22 Apr 1939, *A.L. Cabrera 5160* (syntypes: LP, LPD, Cabrera's personal herbarium -- as cited by Cabrera; none seen). Figure 23 is diagnostic; identified as *Conyza sumatrensis* by Pruski and Sancho (2006).

Conyza bonariensis forma *subleiotheca* Cuatrec., Webbia 24: 227. 1969. *Conyza floribunda* var. *subleiotheca* (Cuatrec.) J.B. Marshall, Watsonia 9: 372. 1973. **TYPE**: **COLOMBIA**. **Boyacá**: Valle de Soatá, vert. árida, exp. E, 2130 m, 6 Sep 1938, *J. Cuatrecasas & H. García Barriga 1026* (holotype: US image!; isotypes: COL image!, F).

Conyza groegeri Badillo, Ernstia, ser. 2, 10: 5. 2000. **TYPE**: **VENEZUELA**. **Amazonas**. Atures, de Samariapo 100 km arriba El Orinoco, San Juan de Ucata, 1.5 km al NE, tobogán con una laja plana, 30 May 1993, *A. Gröger 956* (holotype: VEN image!).

Collections examined of *Conyza sumatrensis* from the southeastern USA (Map 3). **Alabama**. Baldwin Co.: E of Elberta, S of US Hwy 98, ca. 1 mi E of Prince of Peace Cemetary, roadside, 2 Aug 1987, *Burkhalter 10657* (UWF image); Battleship Park by causeway US 90-98, E of Mobile on the Bay, sandy area, 20 Aug 1968, *Kral 32756* (SMU); Magnolia Beach in Fairhope along Mobile Bay, jct of Laurel Ave and Mobile St. below American Legion, disturbed sandy beach, 10 Jun 2008, *Spaulding 12945* (TROY image, UWAL-2 sheets images). Calhoun Co.: Saks, corner of Saks Rd and Lenlock Rd, roadside, 12 Sep 2008, *Spaulding 13067b* (TROY image, UWAL image). Dale Co.: 1 mi S of intersection of Hwys 57 and 60, open grassy field, 20 Jul 2000, *Pennington 904* (TROY image). Marengo Co.: 3.6 air mi SSE of Magnolia, along W side of Ala Hwy 25 ca. 0.8 mi S of jct with Co. Road 32, clearcut near roadside, 28 Jun 2011, *England 2987* (UWAL); 1.8 air mi SE of Pin Hook, along N side of Ala Hwy 28 ca. 0.3 mi W of jct with Co. Road 19, roadside ditch, 16 Sep 2008, *England 1134* (UWAL). Mobile Co.: Dauphin Island, corner of Iberville Dr. and Bienville

Blvd, roadside, 2 Aug 1965, *Deramus D642* (MISSA image); Mobile, SE of Three Mile Creek Univ. of South Alabama property, sandy, longleaf pine woods, 29 Aug 1966, *Lelong 4038* (USAM image); upper part of Moore Creek between I-10 overpass and L&N RR bridge, weedy, marshy area, 15 Aug 1980, *Lelong 11302* (USAM image). **Arkansas**. Cleveland Co.: W of New Edinburg at Calhoun Co. line, Ark Hwy 8 at Moro Creek, along elevated roadbank, 10 Jul 1998, *Thomas 157,108* (NLU). Drew Co.: Monticello, wood margin, 2 Sep 2006, *Sundell 17448* (UARK image); Jerome, common along roadside of US Hwy 165, 1 Oct 1999, *Thomas 163,797* (BRIT). **Florida**. Alachua Co.: Kanapaha Botanical Gardens, roadside, W side of entrance road near parking lot, 28 Jul 2004, *Davis 1145A* (FLAS image); S of Gainesville, ca. 0.2 mi E of Hwy 121 (SW 34th street) & 1 mi SW of Hwy 441, mixed hardwood forest next to Williston Rd (Hwy 331), 27 Jun 1999, *Slaughter 11112* (FSU image). Baker Co.: Sand Bluffs S of St. Marys River and end of St. Marys Cove Rd, 4.3 mi E of State Rd 121, 14 Aug 2007, *Slaughter 15838* (FSU image, USF image). Calhoun Co.: Blountstown, Myers Dairy Rd, 0.6 mi N of Abe Springs Rd, weedy grassy field, 17 Aug 2006, *MacClendon 521* (FSU image, USF image). Escambia Co.: near Pensacola, W of University Mall shopping plaza, near drainage ditch, sandy, 11 Aug 1976, *Burkhalter 4463* (UWF image); near Pensacola, campus of Univ. of W Florida, corner of sewage treatment pond, 29 Jul 1990, *Burkhalter 12184* (UWF image); W end of Santa Rosa Island, Gulf Islands Natl Seashore, Ft. Pickens area, W of camping loop E, 25 May 2009, *Burkhalter 22289* (UWF image); Pensacola, 29 Jul 1899, *Curtiss 6499* (DS, UC); Pensacola, open, disturbed upland area, 6 Sep 1975, *Godfrey 74409* (FSU image); Gulf Islands Natl Seashore, Fort Pickens Unit, campground area including Loops B-E just N of Campground Store, 18 Oct 2005, *Gunn and Ferguson FP-192* (LSU image); Pensacola, 1/4 mi W of Pace Avenue bridge across Bayou Chico, sandy vacant lot, 11 Aug 1976, *Hansen 3905* (FSU image). Franklin Co.: just S of the Marshall House on bayside of island, coastal hammock beside West Gulf Road, 6 Sep 1985, *Anderson 8781* (FSU image); N side of town of Apalachicola, N side of Mill Pond of Scipio Creek, loamy sand of spoil site, 29 Aug 1986, *Anderson 9878* (FSU image); St. George Island, Dr. Julian Bruce State Park, sand and shell mixture of parking spaces in campground area just W of Sugar Hill, 26 Jun 1987, *Anderson 10713* (FSU image). Gadsden Co.: E side of road between Chattahoochee and Resrouce Manager's Office (Lake Seminole), clay soil, 6 Sep 1975, *Gholson 429* (FLAS image); W side of road between US 90 (at Chattahoochee) and the Lake Seminole Project Area, shoulder of paved road, 13 Aug 1976, *Gholson 3633* (FLAS image); E side of paved road on W side of Apalachee Game Mgt Area on Lake Seminole, near Salem Church, previously a cultivated field, 13 Aug 1976, *Gholson 3635* (FLAS image); on State Rd 279, ca. 1/4 mi W from jct of State Rds 270 and 269, fallow field with sandy loam, 13 Aug 1977, *Gholson 6533* (FLAS image); ca. 7 mi S of Chattahoochee, along Fla Hwy 270, just W of jct with Fla Hwy 269, dry sandy loam of fallow field, 13 Aug 1977, *Ward 9172* (FLAS image). Gulf Co.: 1 mi N of Wewahitchka, sandy, fallow field, 15 Aug 1970, *Godfrey 69894* (FSU image); vicinity of Wewahitchka, sandy fallow field, 4 Aug 1976, *Godfrey 75323* (FSU image). Leon Co.: ca. 2.5 air mi SW of Tallahassee Municipal Airport, by parking area on E shoreline of Dog Lake in Apalachicola Natl Forest, loamy sand of clearing, 15 Aug 2013, *Anderson 27323* (FSU image); Tallahassee, Timberlane Ravine Park, between interstate and fenceline (just S of I-10, W of Timberlane School Rd), disturbed site near trailhead, 30 Jun 2015, *Anderson 29001* (FSU image); Tall Timbers Research Station, frequent in fallow fields intermixed with an abundance of *C. canadensis* var. *canadensis* and *C. canadensis* var. *pusilla*, 9 Aug 1979, *Godfrey 77115* (FSU image, TTRS image). Liberty Co.: Torreya State Park, eroding bank of Apalachihola River, 24 Aug 1988, *Godfrey 82822* (FSU image). Okaloosa Co.: near Ft. Walton Beach, N of US Hwy 98, across from Beaseley State Park, roadside, 23 Jan 1988, *Burkhalter 10850* (UWF image); just S of Crestview town, intersection of US Hwy 89 and I-10, weedy lots, 26 Aug 1997, *Miller et al. 9199* (TEX). Santa Rosa Co.: Navarre, E of jct of US Hwy 98 and Pullam St, along drainage ditch, 4 Aug 1991, *Burkhalter 12791* (UWF image); between I-10 and Milton, weed on spoil banks bordering highway, 24 Jul 1974, *Godfrey 73767* (FSU image); off I-10 W of the Escambia River, borrow pit just next to the parking lot at the Stuckey's pit stop, 26 Jul 1989, *Godfrey 83391* (FSU image, TTRS image). Taylor Co.: St. Marks National Wildlife Refuge, by old cabin site

E of Mandalay Rd bordering Aucilla River bayou, loamy sand along edge of thicket, 10 Aug 2007, *Anderson 23415* (FSU image). Wakulla Co.: St. Marks National Wildlife Refuge (St. Marks Unit), between Picnic Pond and lighhouse road, 19 Dec 2014, *Anderson 28630* (FSU image); banks of marshes at St. Marks, 9 Aug 1965, *Godfrey 65905* (FSU image). Walton Co.: 10 mi E of De Funiak Springs, grassy roadsides, 6 Sep 1975, *Godfrey 74428* (FSU image). **Georgia**. Chatham Co.: Atlantic Coast Line Dock, 1.5 mi E of Savannah City Hall, open, well drained sandy soil, 9 Jun 1958, *Duncan 20868* (GA image); near Garden City Terminal, ditch in green space near Grange Road, 28 Aug 2015, *Lucardi et al. GPA CB9-14* (STAR image); Savannah-Ogeechee Canal Nature Center/Ogeechee River Nature Preserve, N side of Tow Path Trail at intersection with River Walk trail, on bricks of historic lock, 27 Jul 2012, *Zomlefer 2775* (GA image). Glynn Co.: Fort Frederica Natl. Monument, unmown border at marsh edge, 24 Jul 2003, *Schmidt s.n.* (GA image). Houston Co.: Oaky Woods WMA, roadside, loam over limestone, 456 ft, 20 Aug 2009, *Lynch 669* (ARIZ image, GA-2 images). Irwin Co.: Hwy 90, J. Robert's "Pigweed field," 12 Aug 2002, *Rausch 214* (GA image, VSC image). Liberty Co.: Ft. Stewart Military Reservation, Training Area A-17, 0.6 mi SW of jct Ga Hwy 144 and FS 48, roadside along Ga 144, sandy, 12 Aug 1992, *Carter 10344* (GA image); Ft. Stewart Military Reservation, sand pit S of Mill Creek, recently excavated and scraped with little vegetation, 13 Aug 1992, *Carter 10364* (GA-2 images, VDB); Ft. Stewart Military Reservation, Training Area D4, common along embankment of bridge over Taylor's Creek on Ga Hwy 119, between Ga Hwy 144 East and Ga 144 West, 4 Aug 1992, *Moore 1629* (GA image). Mitchell Co.: 3 mi S of jct of Ga Hwys 112 and 97, S of Camilla, sandy peat of drying edge of clay-base pond in cypress-pine flats, 17 Aug 2000, *Kral 90164* (VDB). **Louisiana**. Caldwell Par.: Riverton beside US Hwy 165 and RR tracks, 16 Oct 1983, *Thomas 86301* (NLU). Cameron Par.: W of Hackberry, ca. 2 mi N of Sabine Island, mixed woods beside the Sabine River, 6 Sep 1984, *Thomas 90808* (NLU-2 sheets). Franklin Par.: Winnsboro, along RR tracks beside La Hwy 15, unsprayed area, 11 Oct 1983, *Thomas 86183* (NLU). Orleans Par.: E of New Orleans, N of I-10 beside first exit E of La Hwy 47, 28 Jul 1974, *Thomas 40732* (NLU). Plaquemines Par.: Venice, common near Venice Inn along Hwy 23, 6 Nov 1979, *Montz 4918* (LSU image). St. Tammany Par.: Big Branch Marsh NWR, at intersection of Bayou Paquet Rd and Transmitter Rd, disturbed soils S of roadside, 5 Aug 2000, *Rosen 1277* (LSU image); S of Slidell, 1.6 mi E of North Shore and US Hwy 11, along fence N of restaurant at end of unmarked road, 17 Sep 1983, *Taylor 5789* (NLU); just S of St. Joe, woods beside US Hwy 11 and railroad, 21 Sep 1977, *Thomas 55330* (NLU). Washington Par.: W of La Hwy 438 near Hays Creek N of Hackley, pasture and woods edge, 17 Aug 1983, *Thomas 85410* (NLU); 0.5 mi E of Folsom, at La Hwy 40 bridge over Bogue Falaya River, woods and roadbank, 18 Aug 1983, *Thomas 85607* (NLU). **Mississippi**. George Co.: Gulfport, moist valley areas, 15 Aug 1953, *Demaree 33890A* (BRIT, SMU). Harrison Co.: Gulfport, near the coast, 11 Apr 1953, *Demaree 33231* (SMU, VDB); Gulfport, vacant lots, 26 Jul 1952, *Demaree 32293* (SMU, VDB-2 sheets). Jackson Co.: Horn Island, Gulf Islands Natl Seashore, extensive marsh system dominated by *Spartina patens* and *Panicum repens* near mid-island along West Cross Trail, 23 Aug 2005, *Gunn & Ferguson HI-94* (LSU image); Moss Point, roadside, 30 Mar 1969, *Rogers 2075-A* (VDB); Red Creek Mitigation Bank Property, E of Hwy 57, S of Red Creek, and N of Old River Rd, pine plantation uplands, 1 Aug 2006, *Sullivan 06-1439c* (MMNS image); ca 2 mi E of Pascagoula River along US Hwy 90, 18 Jul 1970, *Temple 12434* (MMNS image). Washington Co.: Ca. 3.5 air mi NNE of Leland, near jct of Napanee and L&H Road along edge of soybean field, clay soil, 7 Sep 2010, *Bryson 23632* (MMNS image); 5 mi NE of Lake Lee on sides of levee, 23 Sep-1 Oct 1976, *Gunn 12106* (MMNS image). **South Carolina**. Beaufort Co.: Lady's Island, intersect. of Cougar Drive and Hwy 21, 18 Sep 2005, *Payne 3794* (CLEMS image). Charleston Co.: Awendaw, Flat Farm Rd, 1.0 mi from intersect. with Moores Landing Road, 2.2 mi E of int. with US Hwy 17, 19 Sep 2001, *McMillan 5885* (CLEMS image). Georgetown Co.: Huntington Beach State Park, E side of Hwy 17, ca. 12 mi N of Georgetown, along path in maritime forest remnant, immediately W of host's campsite, 22 Aug 2003, *Nelson 24208* (USCH image); Huntington Beach State Park, E side of US Hwy 17 just S of Murrells Inlet, sandy ground at parking lot edge, 6 Sep 2006, *Nelson 26184* (USCH image). Jasper Co.: Pocotaligo, immediately E of I-95, N side of US Hwy 17, 30 Jul 2009, *Nelson 27799* (USCH image). Williamsburg Co.: 3.1 mi W of downtown Trio, Trio School, wet ground at edge of baseball field, 21 Aug 2016, *Nelson 36001* (USCH image). **Texas**. Chambers Co.: High Island, Boy Scout Woods (Louis B. Smith Bird Sanctuary Preserve), 0.2 mi E of jct Texas Hwy 124 and 5th Street, 2 Jan 2013, *Singhurst 19326* (BAYLU image).

The earliest collection of *Erigeron sumatrensis* in California was from San Diego in 1952; others from 1967 to 1983 were made in Butte, El Dorado, Sutter, Tulare, and Yuba counties. Those from coastal localities (except San Diego) have been more recently.

In contrast, *Erigeron bonariensis* was early collected in 1895 (San Diego Co.). Collections were made in Los Angeles Co. in 1905, 1906, and 1909 -- a collection from Pasadena in 1906 noted that it was a "street weed recently introduced" (7 Aug 1906, *Grant 7157*, CAS, JEPS). From 1905 to 1920, collections also were made in Alameda, Marin, Riverside, San Bernadino, San Francisco, and Santa Cruz counties. It was included in the accounts of Hall (1907) and Jepson (1925) (in both as *Erigeron linifolius* Willd.) -- by 1925 it had been documented as far north as Alameda Co. and by 1940 from other coastal and near-coastal localities (CCH 2018).

Erigeron floribunda is the most recently arrived in California and least widespread adventive among the conyzas. Early collections are from San Francisco (1956) and El Dorado Co. (1976). Others are from 1983 to 2003.

In the southeastern USA, early establishment of *Erigeron sumatrensis* along the Gulf Coast is documented by collections from Pensacola (1899) and areas around Gulfport (1952), St. Marks (1965), Mobile (1968), and New Orleans (1974). At least by 1983, it had reached inland localities in Louisiana (Caldwell and Franklin parishes) and a cluster of counties in Arkansas (Drew and Cleveland cos.) and adjacent Mississippi (Washington Co.); more recent inland collections are from Alabama (Calhoun and Marengo cos.) and Georgia (Houston and Irwin cos.). On the Atlantic coast, an early collection was from near Savannah (1958).

3. **Erigeron floribundus** (Kunth) Sch. Bip., Bull. Soc. Bot. France 12: 81. 1865. *Conyza floribunda* Kunth, Nov. Gen. Sp. (folio ed.) 4: 57. 1820 [1818]. *Erigeron bonariensis* var. *floribundus* (Kunth) Cuatrec., Trab. Mus. Nac. Ci. Nat., Ser. Bot. 33: 132. 1936. *Conyza sumatrensis* var. *floribunda* (Kunth) J.B. Marshall, Watsonia 10: 167. 1974. LECTOTYPE (Green 1994, p. 49): **ECUADOR**. Pichincha: juxta urbem Quito, Jul 1802, *Humboldt & Bonpland 3100* (P-HBK image! [ICD microfiche 6209. 95.III.7]). Protologue: "Crescit frequentissime locis frigidis et temperatis juxta urbem Quiti et pagum Guancabambae Peruvianorum, alt. 1330-1500 hex. Floret Julio-Augusto."

Conyza albida Willd. ex Spreng., Syst. Veg., ed. 16, 3: 514. 1826. *Erigeron albidus* (Willd. ex Spreng.) A. Gray, Proc. Amer. Acad. Arts 5: 319. 1862. TYPE: **BRAZIL**. Without specific locality, *Hoffmannsegg s.n.* (B-Willd. 15658 image!).

This sheet was annotated by G. Wagenitz in 1962 as the type of *Conyza albida* and identified by him as *C. bonariensis* var. *microcephala* (Cabr.) Cabr.; its identity is unambiguously *C. floribunda.*

Conyza bilbaoana Remy, Fl. Chil. 4: 75. 1849. *Erigeron bilbaoanus* (Remy) Cabr., Revista Mus. La Plata, Secc. Bot. 2: 254. 1939. LECTOTYPE (designated here): **CHILE**. Prov. Valdivia, *Mr. Cl. Gay 342* (P 00691985 image!; possible isolectotypes: NY-3 sheets images!).

Three sheets at P collected by Gay are labeled "TYPE." Two probably are duplicates -- both have stems with immature heads (but phyllaries diagnostic) and each has a printed "Herb. Mus. Paris" label with handwritten "Conyza bilbaoana" -- one has the apparently original handwritten label by Gay, identified as "Erigeron." The third sheet has mature heads and a label with handwritten "342" but there is a small "317" seemingly out of place at the top of the label -- this suggests that the sheet perhaps is a duplicate of three sheets at NY with mature stems and with "Herb. Mus. Paris labels" as *Gay 317*. The "317's" on the P and NY sheets are in a distinctive script and almost surely were written by the same hand. No specimens were cited in the original description, but Gay noted that "Se cria en la vecindad de Valdivia y la dedicamos al joven Bilbao, Chileno de grande provecho y mucho talento."

Erigeron bonariensis var. *leiothecus* Blake, Contr. Gray Herb. 52: 28. 1917. *Marsea bonariensis* var. *leiotheca* (Blake) Badillo, Bol. Soc. Venez. Ci. Nat. 10: 256. 1946. *Conyza bonariensis* var. *leiotheca* (Blake) Cuatrec., Phytologia 9: 5. 1963. *Conyza sumatrensis* var. *leiotheca* (Blake) Pruski & Sancho, Novon 16: 98. 2006. **TYPE**: **GUATEMALA**. [probably Dept. Guatemala]: San Rafael, 2135 m, 8 Jan 1915, *E.W.D. Holway 39* (holotype: GH image!).

Biological notes

Erigeron sumatrensis and *E. floribundus* have been treated as conspecific varieties (as *Conyza*, e.g., Sancho & Ariza Espinar 2003; Pruski & Sancho 2006), In South America, both species occur at least in Bolivia, Brazil, Colombia, Ecuador, Peru, and Venezuela; their sympatry extends northward through Central America into southern Mexico. Their sympatry in California apparently reflects independent introductions into that region.

Erigeron sumatrensis and *E. floribundus* may occur in close proximity but they are consistent in morphology, apparently with few obvious intermediates or intergrades. Occasional apparent intergrades between them have been encountered in this study among Mexican collections. *Kral 90164* from Mitchell Co., Georgia (see citations), perhaps is a hybrid between *E. sumatrensis* and *E. bonariensis* -- all cauline leaves are linear like those of *E. bonariensis* but it has small heads in broadly paniculate capitulescence and sumatrensis-like phyllaries.

Thebaud and Abbott (1995) found that naturalized *Erigeron floribundus* and *E. sumatrensis* are consistently distinct from each other in France (in nature and in a common garden in Montpellier) as well as from naturalized *E. bonariensis*. Spontaneous hybrids between *E. sumatrensis* and *E. blakei* Cabr. were formed in the common garden but were mostly sterile; no other morphological intermediates appeared in the garden where all four of these taxa were cultivated, suggesting to the authors that crossing barriers may exist.

Based on similarities in morphology and eletrophoretic data, two pairs were evident in the analysis by Thebaud and Abbott: *E. sumatrensis*/*bonariensis* and *E. floribundus*/*blakei*. Each of these four is hexaploid and observations of fixed heterozygosity at isozyme loci suggested that each is alloploid in origin. They hypothesized that the taxa are derived from "various combinations of different parental species."

Erigeron bonariensis and *E. sumatrensis* occur worldwide, from tropical to temperate zones. Pruski and Sancho (2006) noted that *E. floribundus* in the strict sense is restricted to the Neotropics, but its distribution needs to be reevaluated based on narrower species definitions -- Thebaud and Abbott (1995, and citing Rivière 1987) noted that it is spreading in western France and northeastern Spain, and it is documented here from California. *Erigeron blakei* apparently is naturalized only in England, France, Spain, and Italy (Jovet & de Vilmorin 1975; Guedes & Jovet 1975; Clement & Foster 1994; GCW 2018).

Conyza vs. Erigeron

Species identified as *Conyza* have arisen evolutionarily from within *Erigeron* at least twice independently (e.g., Noyes 2000; Brouillet et al. 2009). *Erigeron bonariensis*, *E. floribundus*, and *E. sumatrensis* are included in a clade with the type species of *Conyza* (*C. chilensis* Spreng.); *Erigeron. canadensis* L. arose within a separate clade (*Conyzella* Fabr. 1759, *Leptilon* Raf. 1818). North American/Mesoamerican species have formal names within *Erigeron* (completed in Nesom 2018) but in South America, where the greatest number of species occurs, the taxonomy and nomenclature are in need of revision.

Cronquist (1943) sought to clarify the distinction of *Conyza* from *Erigeron*, based on the presence or absence of ligules on the pistillate florets and, in part, the ratio of pistillate to staminate flowers, with the assumption that two genera indeed existed. *Conyza* as recognized since then includes species varying in habit, capitulescence form, head size, and biology (including chromosome number). Current evidence and current trends in nomenclature favor the identification of remaining American 'conyzoid' species within *Erigeron*.

ACKNOWLEDGEMENTS

Thanks to John Pruski and John Strother for helpful comments and to staff at BRIT (including SMU, NLU, and VDB), UC-JEPS, and CAS-DS. Specimen images from herbaria of the southeastern USA and from herbarium MEXU have been extremely helpful in determining geographic ranges.

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NEW SPECIES OF *BACCHARIS* (ASTERACEAE) FROM WESTERN MEXICO

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109
guynesom@sbcglobal.net

ABSTRACT

Four new species of *Baccharis* are described from western Mexico and one is raised in rank from variety. **Baccharis charucoensis** Nesom, **sp. nov.**, from the Rio Mayo region along Chihuahua-Sonora border, is similar in habit and related to *B. macrocephala* of eastern Mexico but differs in its linear leaves with stiffly ciliate margins. **Baccharis horizontalis** Nesom, **sp. nov.**, from western Durango and adjacent Sinaloa, is similar and closely related to the widespread *B. serrifolia* but differs in its sessile leaves and distant geographical location. **Baccharis supplex** Nesom, **sp. nov.**, from southeastern Durango (mpios. Mezquital and Súchil) differs from the sympatric *B. thesioides* in its rhizomatous habit with one or few stems from the base, broader leaves, and few-flowered capitulescence. **Baccharis praetermissia** Nesom, **sp. nov.**, from the Cape Region of Baja California Sur, is distinct in its erect habit, nearly glabrous stems, glabrous, elliptic leaves, dense capitulescence, and non-accrescent pappus, and disjunct geography within sect. *Aristidentes*. *Baccharis multiflora* var. *herbacea* McVaugh from western Michoacan is recognized here at specific rank: **Baccharis herbacea** (McVaugh) Nesom, **comb. et stat. nov.** Each of these five species apparently is rare.

In a review of *Baccharis* in CAS-DS, TEX-LL, and UC-JEPS, collections indicate that four distinct species are without names. They are formally described here, and another is recognized by raising its rank from variety to species.

1. **BACCHARIS CHARUCOENSIS** Nesom, **sp. nov.** TYPE: **MEXICO**. **Chihuahua**. [Mpio. Chínipas]. Sierra Charuco, Rancho Byerly, pine-oak forest, rocky igneous slopes, 5000-5800 ft, low woody perennial 4-8 dm tall, 17-25 Apr 1948, *H.S. Gentry 8025* (holotpe: TEX!, Fig. 2; isotypes: ARIZ image!, MEXU image!, UC!). Additional sheets at ARIZ and UC are labeled "Gentry 8025a."

Allied to species of *Baccharis* sect. *Glandulicarpae* Nesom in its large heads and achenes glandular over the whole surface. Most similar to *B. macrocephala* Sch. Bip. ex Greenm. (Fig. 0) in its large sessile to subsessile heads and its axillary clusters of small leaves, but the leaves of *B. charucoensis* are much smaller, quickly deciduous, neither punctate nor glutinous, and ciliate-margined and the phyllaries are without a wide, dark midregion. *Baccharis macrocephala* has heads axillary and subsessile or on short lateral branches and axillary clusters of small leaves; its leaves are 10–40 mm long, 3–5 mm wide, persistent, densely punctate and usually glutinous, with eciliate, pebbly-roughened tuberculate margins, and the phyllaries lack a dark midregion.

Shrubs 4–8 dm high, erect, dioecious (both collections include only pistillate branches). **Stems** woody, glabrous, few-branched, nodes with clusters of small leaves. **Leaves** (cauline) apparently quickly deciduous, linear, mostly 12–40 mm long, 1–4 mm wide, sessile, 1-nerved, fleshy, not punctate or glutinous, margins minutely serrulate with aristate teeth or merely aristate, 10–15 teeth or aristae per side; leaves of axillary clusters 3–15 mm long. **Heads** axillary, sessile or subsessile and solitary per node or 1–3 per node on pedicels up to 1.2 mm long, in a loose, spike-like capitulescence; pistillate involucres 8–10 mm wide; staminate heads not seen; phyllaries narrowly elliptic-lanceolate or elliptic-oblanceolate with hyaline margins and a dark green midregion, the inner 7–9 mm long. **Achenes** ca. 3 mm long, 5(–6)-nerved, with short viscid-glandular hairs over the whole surface; mature pappus accrescent, elongating to 10–12 mm, bristles in ca. 3–4 series. Figures 1, 2, 12.

Additional collection examined. MEXICO. Chihuahua. [Mpio. Chínipas]. Sierra Charuco, Arroyo Hondo, igneous rocky canyon slope in pine-oak forest, 4500-5500 ft, 16-30 Apr 1948, *Gentry 8097* (ARIZ, MEXU image! Fig. 1).

Sierra Charuco "is the name given by Gentry and still used by natives to mountains across the Sonora-Chihuahua border between Rancho Byerly, Chihuahua (27° 34.5' N, 108° 42' W, 1550 m), and El Charuco Ranch (27° 36' N, 108° 44.5' W, 800 m)" (see Martin et al. 1998, pp. 100 and 107).

Baccharis charucoensis is compared in the diagnosis with *B. macrocephala* because of their similarity in habit, not to suggest that they are most closely related to each other. The widespread *B. pteronioides* DC. (sect. *Glandulicarpae*) also has a similar habit, with short-pedicellate to subsessile, axillary heads from nodal clusters of small leaves. The only other species of sect. *Glandulicarpae* along the Pacific coast region are *B. occidentalis* Blake (few, small, long-pedunculate heads in a loosely corymboid cluster) and *B. squarrosa* Kunth (large, solitary heads at branch apices). *Baccharis occidentalis*, like *B. charucoensis,* has few-branched stems and few, widely separated, narrow leaves with aristate-toothed margins, and it seems a reasonable hypothesis that the two are closely related, especially in view of their geography. I had previously (in 1998) annotated some of the Sierra Charuca sheets as *Baccharis wrightii* A. Gray, also of sect. *Glandulicarpae*, but *B. wrightii* is a Chihuahuan Desert species with solitary heads.

Figure 1. *Baccharis charucoensis*. Details from *Gentry 8097* (MEXU).

HOLOTYPE OF
Baccharis charucoensis Nesom

10 280·3
PLANTS OF MEXICO
Sierra Madre Occidental, Chihuahua
ALLAN HANCOCK FOUNDATION EXPEDITION

Baccharis ramulosa (DC.) Gray

Determined by ~~Gentry~~ Blake
Locality: Rancho Byerly, Sierra Charuco. April 17-25, 1948.
Habitat: Rocky igneous slopes; Pine-Oak Forest. 5000 5800 feet elev.
Low woody perennial 4-8 dm tall.

Collected by Howard Scott Gentry No. 8025

Figure 2. *Baccharis charucoensis.* Holotype, *Gentry 8025* (TEX). Arrow points to enlargement.

Figure 3. *Baccharis horizontalis.* Holotype, *Vizcarra 179* (TEX).

Figure 4. *Baccharis horizontalis.* Details from holotype, *Vizcarra 179* (TEX).

Figure 5. *Baccharis horizontalis*. *Vega A. 9770* (MEXU) from Mpio. Concordia, Sinaloa.

Figure 6. *Baccharis supplex.* Holotype (MEXU).

Figure 7. *Baccharis supplex*. *Breedlove 59107* (MEXU), from Mpio. Mezquital.

Figure 8. *Baccharis* aff. *bigelovii* from Mpio. Urique, Chihuahua. Unusual in its long leaves and low, rhizomatous habit. The venation contrasts with typical *B. supplex* (compare Fig. 7).

Figure 9. *Baccharis praetermissa*, holotype (UC). Staminate branch.

Figure 10. *Baccharis praetermissa*, isotype (87179––2 branches, staminate and pistillate) and paratype (87178––staminate branch). The similarity between the holotype and *Brandegee 297* suggests that labels on the sheet above may have been switched in error.

Figure 11. *Baccharis praetermissa.* Details, leaves and capitulescence.

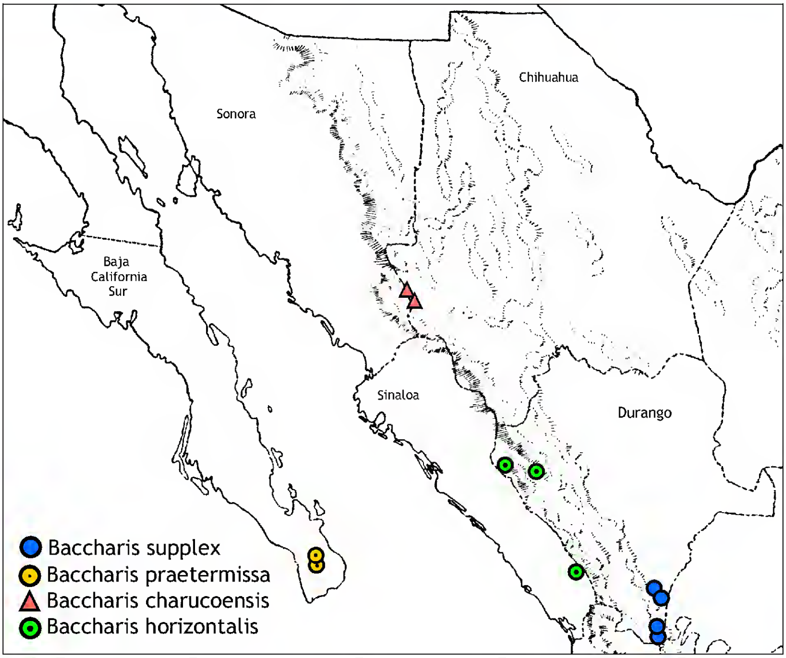

Figure 12. Distribution of *Baccharis supplex, B. praetermissa, B. charucoensis,* and *B. horizontalis.*

2. BACCHARIS HORIZONTALIS Nesom, **sp. nov.** **TYPE**: **MEXICO**. **Durango**. [Mpio. Canelas]. 20 km al S de Canelas, potrero en ladera con encino blanco, hierba de 1.5 m, flor blanca, muy abundante, 11 Jan 1986, *M. Vizcarra 179* (holotype: TEX!, Fig. 2; isotypes: CIIDIR, UNAM image!).

Similar to *Baccharis serrifolia* DC. (sect. *Aristidentes* Nesom) in habit (spreading branches, climbing-clambering), leaf shape, size, and vestiture, and its small, few-flowered heads, but distinct in its sessile leaves with rounded to truncate base (*B. serrifolia* has petioles consistently 2–7 mm long, base obtuse to attenuate), leaf surfaces without evident punctations (vs. punctate), and lanceolate phyllaries with acute apex and hyaline, little dissected margins (vs. oblong phyllaries with rounded to blunt apex and hyaline margins highly dissected distally into fimbriae).

Shrubs 1.5 m high, subscandent (climbing or clambering), dioecious (the type specimen has only a staminate branch). **Stems** greenish with white ridges, branching at nearly right angles, densely pubescent with crinkly, orange-viscid, multicellular hairs not obscuring the stem surface. **Leaves** oblong to oblong-lanceolate or broadly lanceolate, mostly 15–80 mm long, 6–35 mm wide, pinnate-veined, veins whitish and raised on both surfaces, essentially sessile or petiole of 0.5 mm, base rounded to truncate, apex obtuse, adaxial surface slightly glossy, dull beneath, both surfaces sparsely and minutely pubescent with tiny, orange-viscid hairs, not evidently punctate, margins shallowly serrulate with apiculate-aristate teeth, 7–27 teeth per margin. **Heads** in loose, rounded to pyramidal panicles at the ends of lateral branches and terminally, ultimate pedicels 1–3 mm long; staminate involucres 3–4 mm wide, 3–3.5 mm long; 14–15 flower per head. **Mature achenes** not seen; pappus bristles (staminate) in 2–3 series, slightly but distinctly dilated at the apex. Figures 3, 4, 5, 12.

Additional collection examined. **MEXICO**. **Durango**. [Mpio. Tamazula]: Chacala, 5 Mar 1899, *Goldman 352* (DS). **Sinaloa**. Mpio. de Concordia: La Petaca a 5 km al S rumbo a el Cuatantal, bosque de *Pinus* con *Quercus*, 1600 m, 16 Feb 1999, *Vega A. 9770* (MEXU image!, Fig. 5).

The strong similarity between *Baccharis horizontalis* and *B. serrifolia* supports a reasonable hypothesis that they are sister species, either as vicariants or more likely with *B. horizontalis* established through dispersal from the wide range of *B. serrifolia* in southeastern Mexico and subsequently differentiated in geographic isolation. The three collections show the same distinct morphology (Figs. 3, 5, and 6, *Goldman 352* not shown).

3. BACCHARIS SUPPLEX Nesom, **sp. nov.** **TYPE**: **MEXICO**. **Durango**. Mpio. Súchil: Reserva de La Michilía, potrero San Juan de Michis, bosque de encino-pino, terreno plano, 2 Oct 1985, *J. Alvarado 141* (MEXU, Fig. 6; isotype: TEX!).

Similar to *Baccharis bigelovii* A. Gray (sect. *Aristidentes*) in its relatively low stature, few-flowered capitulescence, leaf shape and size. Different in its rhizomatous habit with one or few stems from the base (vs. woody-rooted and a multi-stemmed shrub), more densely serrate leaf margins (15–29 teeth per side evenly distributed vs. 6–11 teeth on the distal 1/2–2/3), and leaf teeth with thread-like aristate extensions (vs. teeth acute to sharply acute). The southern extremity of the range of *B. bigelovii* is in Chihuahua.

Similar to *Baccharis thesioides* Kunth (sect. *Aristidentes*) in its finely toothed leaf margins. Different in its rhizomatous habit with one or few stems from the base (vs. woody-rooted and a multi-stemmed shrub), herbaceous stems (vs. woody), broader leaves (3–15 mm wide vs. 3–7 mm), and few-flowered capitulescence (vs. relatively densely flowered, corymboid capitulescence).

Herbaceous perennials, rhizomatous, dioecious. **Stems** erect to erect-ascending, 30–50 cm tall, simple or few-branched until the capitulescence, green, glabrous, multi-ridged, inconspicuously glandular with minute, orange-glandular or glutinous hairs. **Leaves** elliptic to elliptic-ovate or elliptic-obovate, mostly 10–50 mm long, 3–15 mm wide, largest proximally or at midstem, venation brochidodromous, apex acute to obtuse, base attenuate, often narrowed and subpetiolate, margins shallowly serrate with sharp teeth (5–17 per cm, 15–29 per side), each tooth with a thread-like aristate extension, both surfaces punctate, each punctation with an extruded papilla, surfaces sometimes becoming glutinous. **Heads** few and essentially solitary in a loose, paniculate cluster, ultimate pedicels 1–9 mm long; pistillate heads: 22–27-flowered, involucres 3 mm long; staminate heads: ca. 8-flowered, involucres 2 mm long. **Achenes** oblong-terete, 1.5–2 mm long, 5–6-nerved, deciduous-glandular near the base, otherwise glabrous; pappus bristles in 1(–2) series, 3–3.5 mm long at maturity, not accrescent, often becoming purplish. Figures 6, 7, 12.

Additional collections examined. Durango. Mpio. Súchil: Ejido San Juan de Michis, creek descending from Sierra Urica Potrero Raymundo, W-facing ravine, beside creek bank in semishade of *Quercus rugosa*, 18 Oct 1987, *Jamieson 703* (TEX). Mpio. Mezquital: 48 km WNW of Huejuquilla El Alto, Jalisco, on road to Canoas, Durango, crest of ridge with steep slopes to N and S, forest of *Pinus*, *Arbutus*, and *Quercus*, 2530 m, 31 Oct 1983, *Breedlove 59107* (CAS, MEXU, TEX); 14 km ENE de Canoas, bosque de pino-encino, 2300 m, 31 Oct 1982, *Gonzalez & Rzedowski 2262* (TEX).

Baccharis supplex is a member of sect. *Aristidentes* Nesom (Nesom 1990), with *B. bigelovii*, B. *thesioides*, and others. I previously have identified the Durango plants as *B. bigelovii* (e.g., Nesom 1998) primarily because of their relatively broad leaves, but the two are significantly different in morphology (see diagnosis above) as well as geographically disjunct. *Baccharis supplex* is sympatric with *B. thesioides* as well as with *B. heterophylla*, *B. palmeri*, *B. pteronioides*, *B. salicifolia*, *B. salicina*, and *B. squarrosa*.

Plants of *Baccharis supplex* are similar in habit to those from western Michoacan described as *B. multiflora* var. *herbacea* McVaugh (McVaugh 1972, 1984), a herb with rhizomes ("creeping rootstocks" fide McVaugh) (Fig. 8). Those of *B. supplex* differ in their glabrous or minutely glandular vestiture (vs. sparsely pilose, eglandular), generally smaller leaves (10–50 mm long vs. 25–70 mm), smaller heads (pistillate involucres 3 mm long vs. 4.5–5 mm), and shorter mature pistillate pappus.

A collection from southern Chihuahua (Fig. 8: Mpio Urique, *Camou G. 166*, MEXU), at the southern extremity of *Baccharis bigelovii*, is similar to *B. supplex* but the leaves are distinctly 3-nerved like *B. bigelovii*. The Urique collection may represent a distinctive evolutionary entity.

4. **BACCHARIS PRAETERMISSA** Nesom, **sp. nov.** **TYPE**: **MEXICO**. **Baja California Sur**. [Mpio. Los Cabos]: Cape Region mountains, 25 Mar 1892, *T.S. Brandegee s.n.* (holotype: UC 87180, Fig. 8; isotype: UC 87179, Fig. 9).

Similar and related to species of sect. *Aristidentes* Nesom in its stem vestiture of glutinous-viscid hairs, leaves with aristate-serrate margins and surface punctations with extruding papillae, pedicellate heads, and glabrous, 5–6-nerved achenes. Different from *B. bigelovii* in its taller, woody habit, elliptic leaves with finely serrulate margins and distinct petiolar base, and its dense capitulescence. Different from *B. serrifolia* in its erect habit, glabrous leaves and nearly glabrous stems, and more compact and corymboid capitulescence. Similar to *B. multiflora* in habit but different in its glabrous stems and leaves, densely sunken-punctate leaves with acute apices, smaller involucres, and non-accrescent pappus. Geographically disjunct from all possible close relatives.

Woody shrubs. **Stems** erect, early growth stongly multi-ridged, very sparsely puberulent with tiny orange-viscid hairs, becoming woody after the first year. **Leaves** mostly elliptic to broadly elliptic-lanceolate, 3–5.5 cm x 5–20 mm, reduced in size in the capitulescence, pinnate veined, sometimes weakly 3-veined, veins not raised, margins sharply serrate, 12–20 teeth per side, each tooth sometimes with a short hair-like arista, both surfaces densely punctate (each punctation sunken with an extruded papilla), glabrous, slightly glutinous when young, apex acute, base cuneate or abruptly attenuate to a petiole 1–3 mm long. **Heads** in loose to dense corymboid clusters, ultimate pedicels 6–23 mm long; pistillate involucres 3–4 mm wide, 2.5–3 mm long; staminate involucres mostly 3 mm wide, 4 mm long; phyllaries lanceolate to triangular, minutely and sparsely glandular with tiny viscid hairs of 1 or few cells, margins narrow, hyaline, minutely lacerate. **Achenes** oblong, mature size not seen, 5–6-nerved, glabrous, nerves orange; pappus apparently not accrescent. Figures 9, 10, 11, 12.

Additional collections. **MEXICO. Baja California Sur**. [Mpio. Los Cabos]: San Francisquito Mts., 18 Oct 1890, *Brandegee 297* (UC! Fig. 10); Sierra La Laguna, Valle La Laguna, 27 Apr 2000, *Domínguez L. 2774* (HCIB not seen); Sierra La Laguna, Cañón de La Zorra Campamento de Palo Extraño, 16 Feb 2001, *Domínguez L. 3002* (HCIB not seen). HCIB collections, fide Jon Rebman, pers. comm.

Baccharis praetermissa is known by two collections made almost 130 years ago and two recent ones. On Brandegee's two explorations in the Cape Region Mountains, he accompanied ornithologist W.E. Bryant, who provided an account of the trips and geography (Bryant 1891; also see Moran 1952). The trips were two years apart but the collections apparently were made in close proximity. In 1890, they travelled north from San José del Cabo to La Paz mostly along the eastern flank of the mountains. From Agua Caliente (23° 26' 35" N, 109° 46' 28" W) they went inland (west) into the Sierra de San Francisquito, then returned to Agua Caliente a week later. In 1892, according to Moran (1952), they again traveled north from San José del Cabo --Brandegeee collected on 25 March at Chuparosa in the Sierra de la Laguna and the next day was in the Sierra de San Francisquito. Maximum elevations in this area range from about 4000 to 6200 feet (fide Google Earth).

The only other species of *Baccharis* beside *B. praetermissa* collected from the Cape Region (and from all of Baja California Sur) are *B. salicifolia*, *B. sarothroides*, and *B. sergiloides* (Flora of Baja California 2018).

5. **BACCHARIS HERBACEA** (McVaugh) Nesom, **comb. et stat. nov.** *Baccharis multiflora* var. *herbacea* McVaugh, Contr. Univ. Michigan Herb. 9: 364. 1972. TYPE: **MEXICO. Michoacan**. Mpio. Coalcomán: near summits ca. 25 km SW of Aserradero Dos Aguas, nearly W of Aguililla, pine-fir forests on limestone, 2400-2500 m, 6 Mar 1965, *R. McVaugh 22846* (holotype: MICH image!; isotypes: DS! Fig. 13, DUKE image!, ENCB image! Fig. 15, LL!, NY image! Fig. 14).

Subshrubs, erect, rhizomatous. **Stems** up to 1 m tall, simple or few-branched until the capitulescence, sparsely pilose-puberulent with brownish, viscid hairs, eglandular. **Leaves** elliptic, 25–70 mm long, 10–20 mm wide, 2–4 times longer than wide, with a raised reticulum of veins, sparsely pilose-puberulent with brownish, viscid hairs, eglandular. **Heads** few in a loose, paniculate cluster, ultimate pedicels 3–11 mm long; pistillate heads with ca. 22 flowers, involucres 4.5–5 mm long, mature pistillate pappus slightly accrescent, 6–7 mm long; staminate heads with ca. 16 flowers, involucres 3.5–4 mm long, pappus bristles apically subclavate. Figures 13, 14, 15, 17.

McVaugh emphasized the similarities between typical *Baccharis multiflora* (sect. *Aristidentes*) and the entities he recognized as *B. multiflora* var. *brevipappa* McVaugh (= *B. brevipappa* (McVaugh) Nesom) and *B. multiflora* var. *herbacea*. I recognized *B. brevipappa* at specific rank (Nesom 1998), noting its distinctions in subscandent habit, relatively diffuse capitulescence, longer leaves, and smaller heads and its separate geographic range (Figs. 16, 17).

I also noted (Nesom 1998) that var. *herbacea* warranted recognition at specific rank, pending corroboration of its distinction by further collections. No other collections apparently have been made but McVaugh (as collector) obviously saw the entity as distinct and made numerous duplicates (isotype citations above). It is morphologically distinct and geographically disjunct from typical *Baccharis multiflora*. It occurs at the range periphery of *B. brevipappa* (Fig. 15) but is distinct from it particularly in its rhizomatous, single-stemmed habit (vs. woody root, multi-stemmed in *B. brevipappa*) and its much smaller leaves (vs. (40–)75–130 mm long, 3.5–6(–8) times longer than wide in *B. brevipappa*).

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Contr. Univ. Mich. Herb. 9:364. 1972.

PLANTS OF MICHOACAN

COLLECTED FOR THE HERBARIUM OF THE UNIVERSITY OF MICHIGAN BY ROGERS McVAUGH, M. F. BAAD, W. R. ANDERSON AND C. W. LASKOWSKI

Baccharis multiflora var. herbacea McVaugh
ISOTYPE

Pine-fir forests on limestone, near summits ca. 25 km. southwest of Aserradero Dos Aguas, and nearly west of Aguililla; elevation 2400–2500 m.

Abundant.

Herb with creeping rootstocks; flowers white.

ROGERS McVAUGH, NO. 22846 6 MARCH 1965

Figure 13. *Baccharis herbacea.* Isotype (DS).

Figure 14. *Baccharis herbacea.* Isotype (NY).

ISOTIPO

Baccharis multiflora var. herbacea McVaugh

PLANTS OF MICHOACAN

COLLECTED FOR THE HERBARIUM OF THE UNIVERSITY OF MICHIGAN BY ROGERS McVAUGH, M F. BAAD, W. R. ANDERSON AND C. W. LASKOWSKI

Pine-fir forests on limestone, near summits ca. 25 km southwest of Aserradero Dos Aguas, and nearly west of Aguililla; elevation 2400–2500 m.

Abundant.

Herb with creeping rootstocks; flowers white.

ROGERS McVAUGH, NO. 22846 6 MARCH 1965

Isotipo
Baccharis multiflora Kunth var. **herbacea** McVaugh
Contr. Univ. Michigan Herb 9(4): 364. 1972.

ISOTIPO de Baccharis multiflora HBK. var., herbacea Mc Vaugh
Descripción: Contr.Univ.Mich.Herb. 9: 364. 1972
Revisó: J.R.

Figure 15. *Baccharis herbacea.* Isotype (ENCB).

Figure 16. *Baccharis brevipappa*. Paratype, *McVaugh 10096* (MEXU) from Jalisco.

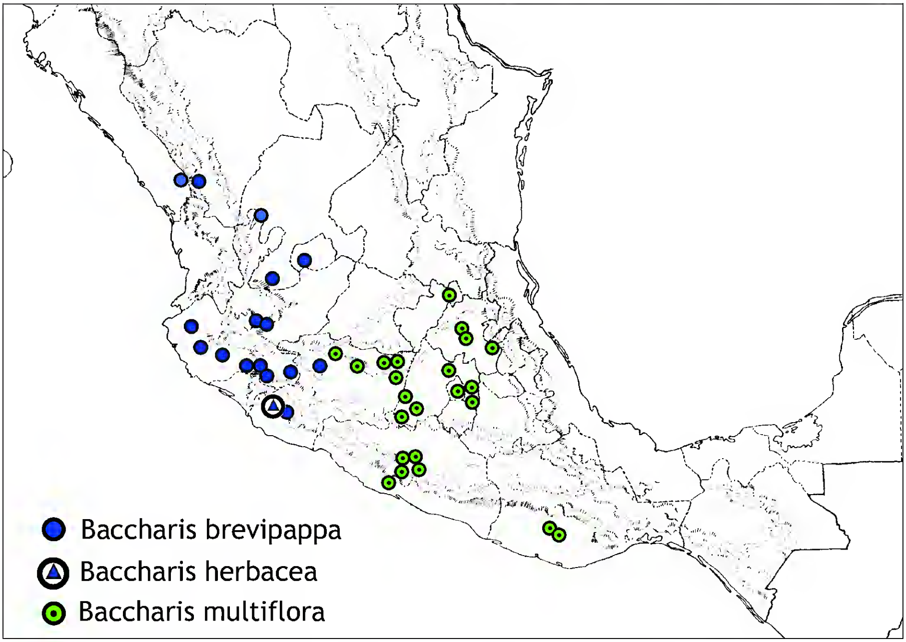

Figure 17. Distribution of *Baccharis brevipappa*, *B. herbacea*, and *B. multiflora*.

ACKNOWLEDGEMENTS

Thanks to the staff at CAS, TEX-LL (especially Amalia Díaz for providing images of TEX specimens), and UC for their hospitality, to George Ferguson (ARIZ) for information on ARIZ collections, and to Jon Rebman (San Diego Museum of Natural History) for information on recent collections of *Baccharis praetermissa*. John Strother suggested the epithet for *B. praetermissa*. Access to digital photographs of specimens JSTOR Global Plants, Seinet, and the Portal de Datos Abiertos UNAM – Colleciones Biologicas) has been inexpressably helpful.

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IPOMOPSIS RUBRA (POLEMONIACEAE): DISTRIBUTION AND HABITAT

BRUCE A. SORRIE AND ALAN S. WEAKLEY
UNC Herbarium (NCU), North Carolina Botanical Garden
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina 27599-3280

KEITH A. BRADLEY
A. C. Moore Herbarium, Department of Biological Sciences
University of South Carolina
Columbia, South Carolina 29208

ABSTRACT

Over most of its range, *Ipomopsis rubra* has a patchy or irregular distribution, which has led to questions regarding its native status in a number of states. The species has long been in cultivation and escapes have provided additional distribution records. Habitat analysis demonstrates fidelity to several community types, but roadsides comprise the bulk of records. We document native distribution from North Carolina to Florida west to Oklahoma and Texas, in natural habitats ranging from maritime dunes to inland sandhills, river scour zones, and rocky slopes.

Ipomopsis is a genus of about 30 herbaceous species, found primarily in the southwestern USA and northwestern Mexico. One species occurs from Texas eastward, *I. rubra* (L.) Wherry, a hummingbird-pollinated biennial. Our interest in this species stems from a desire to clarify its native distribution. As Shinners (1963) indicated, this species is peculiar in having been first described from the Southeast, yet it is most abundant further west. A very showy species (Fig. 1), it was early brought into cultivation and spread locally in a number of midwestern and eastern states, whether originally native or not. For example, Darby (1860) wrote of the species that "on the Congaree, near Columbia, S.C. ... One of the most beautiful of our native plants, which has become extensively introduced into our gardens." Bartram (1791, p. 374-375) wrote that "In the loose rich soils verging round this rock [apparently a granitic flatrock near Camak, Warren Co., Georgia, fide F. Harper], grew several curious herbaceous plants, particularly one of singular elegance and beauty ... It grows erect, three feet high, with a strong stem, which is decorated with plumed or pinnatifid linear leaves ... these [branches] terminate with large tubular or funnel-formed flowers ... of a perfect rose color, elegantly besprinkled on the inside of their petals with crimson specks ... I saw a species of this plant, if not the very same, growing on the sea coast islands near St. Augustine [Florida]."

The Linnaean (1753) type of *Polemonium rubrum* L. was collected from "habitat in Carolinae citerioris arenosis." Wherry (1936) stated that Catesby sent seeds to England, "... where it was studied and described by Dillenius in 1732." Linnaeus cited the plate of this plant published by Dillenius (1732).

Wherry (1936) considered and mapped the native range of *Ipomopsis rubra* as being from southern North Carolina to central Florida, west to central Texas and southern Oklahoma. It can be surprisingly difficult to determine the native distributions of southeastern United States species, as the period of significant documentation of plant distributions via collecting followed two centuries after the European settlement of at least the regions of the Atlantic and Gulf coasts. There was thus substantial opportunity for plants to be moved around deliberately by horticultural use, or for them to adventively colonize agricultural and other disturbed ground with increased and more intensive land use following European colonization. We wished to reassess the native distribution based on the habitats and years of collection of *I. rubra* to make the best determination possible at this time of the native distribution and habitats of this interesting species.

Methods

We searched online databases and journal sources for records of *Ipomopsis rubra*. The SERNEC Portal (sernecportal.org) provided access to a large number of specimens from over 20 herbaria, while texts of state and regional manuals and floras were especially useful in determining native status. The PLANTS database was searched for additional states of occurrence. Label data were analyzed for similarities among habitats and then mapped to see how habitats sorted out geographically.

Figure 1. *Ipomopsis rubra,* Richmond Co., North Carolina.

Results

Our updated map of the distribution of *Ipomopsis rubra* is shown in Figure 2. There has been a great increase in specimen records since Wherry (1936), yet the overall range remains the same. As validation, we here assess the status of *I. rubra* in several states that border, or are contained within, the native range.

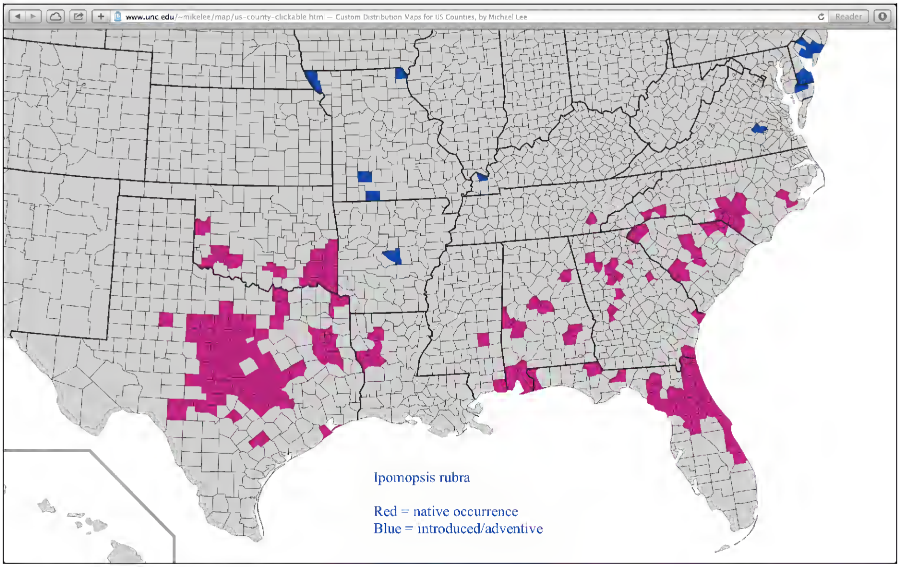

Figure 2. Range map of *Ipomopsis rubra*. Red = presumed native occurrence; blue = presumed introduced /adventive.

Arkansas. Wherry (1936) stated that *Ipomopsis rubra* was "Seen by Nuttall in the southeastern prairies." Gentry et al. (2013) mapped it only in Pulaski County and considered it non-native. Under *Cantua coronopifolia* Willd. (an old synonym), Nuttall (1835) stated "Hab. On the elevated prairies of Red river, where the flowers are of a bright scarlet, and spotted with a deeper tinge of colour." Nuttall's travel to the Arkansas Territory took place in 1819 (Nuttall 1821), when the prairies were still mostly wilderness, and occurrences of *I. rubra* there would have been undoubtedly natural. However, Theo Witsell (pers. com.) informs us that most of the prairies along the Red River occur in what are now Oklahoma and Texas, with a short portion in Little River and Miller counties, Arkansas. Based on these data, we cannot be sure that *I. rubra* is native in Arkansas, but it should be sought in the southwestern corner of the state.

Louisiana. Wherry did not map any occurrences in this state. No Louisiana specimens are found at the LSU herbarium. Thomas and Allen (1998) mapped it as a native species in Bienville, Natchitoches, and Sabine parishes in the northwestern quarter of the state. Given the proximity to numerous east Texas collections, it is likely that *Ipomopsis rubra* is native in Louisiana. A Sabine Parish collection (at GA) is from "sandy oak and pine woods."

Mississippi. The only inland record known to us is from a roadside in Jasper County ["along rte. 15, dry sandy and clay hillside", *Ray, Jr. 6657* (NCU)]. Since this falls within the Jackson Prairie region, it may have been part of a native population. However, native status is assured in Jackson County, where several collections were taken from vegetated dunes on Horn Island (LSU, MISS, NCU, USMS).

North Carolina. Wherry (1936) stated that "Specimens preserved from Craven County probably represent a native colony." However, Croom (1837) did not list this species in his flora of New Bern and vicinity. New Bern was founded in 1710, served as the state's first capital, and long has been a cultural center. We question the native status of *Ipomopsis rubra* there, as it is far disjunct from other North Carolina populations. The Sandhills region of North and South Carolina supports specimens of *I. rubra* from thirteen counties (7 NC, 6 SC). Habitats vary from "sandhills" to "pine woods," "sandy pine-oak woods border," "margins of sandy oak woods," "roadsides," and "river slope." While the natural habitat(s) of *I. rubra* seems elusive in the Sandhills region, we feel that the number of records, and the long time frame involved point towards native status. Finally, there are records from the upper piedmont (Rutherford County) and mountains (Henderson County) of North Carolina. At the former, it was collected from "Sandy floodplain of Broad River, 31/4 mi SW of Harris, natural colony, not an escape," 17 Jul 1956, *Freeman 56470* (UNCA, NCU). The Henderson County specimen (NCU) merely says "Hendersonville" without date.

South Carolina. Evidence of populations in the state extend back two centuries, but it has apparently remained a rare species throughout this time. Elliott (1821) wrote that it "Grows in in the upper districts of Carolina and Georgia. Sent me from Columbia, by Mr. Herbemont." Nicholas Herbemont, a viticulturist in Columbia, Richland County, probably sent plants from nearby. Similarly, Darby (1860) reported it along the Congaree River near Columbia. Chapman (1897) also included it for the state. In contrast, the species was not collected by William Henry Ravenel (1814-1887) or mentioned in his correspondence, nor was it mentioned prior to Elliott by Thomas Walter (1788). Only scattered occurrences are known since 1900, including the bank of the Congaree River (Richland County), a montane granitic dome (Pickens County), a creek bank (Greenville County, upper piedmont), and sandy roadsides (Barnwell and Chesterfield counties, Sandhills region).

Tennessee. Wherry stated that *Ipomopsis rubra* was "Recorded in McMinn County" and treated it as native. This represents the only record of *I. rubra* from the Valley and Ridge Province. The Tennessee Flora Committee (2015) did not include *Ipomopsis*, nor did Chester, Wofford, and Kral (1997). However, Chester et al. (2009) cited Gattinger (1901): "perhaps strayed from cultivation, Red Knobs. McMinn County, E Tenn." Therefore, we treat *I. rubra* as adventive or introduced to Tennessee.

Virginia. The sole record for the state was collected in Chesterfield County in the lower piedmont. Weakley, Ludwig, and Townsend (2012, p. 1369) have treated it as a waif.

Our analysis corroborates the native distribution as mapped by Wherry (1936), with the exception of Arkansas and Tennessee, where available evidence suggests alien status. Records from states and provinces to the north are considered to be adventive or introduced: Delaware, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Jersey, New York, Ohio, Wisconsin, and Ontario. Our map of the native distribution (Fig. 2) shows concentrations of records in central Texas, east coast and north peninsula of Florida, piedmont of north-central Georgia, and the Sandhills region of the Carolinas and Georgia.

Habitat Analysis

Figures 3 and 4 show the distribution of *Ipomopsis rubra* by habitat type, based on herbarium specimens. The large number of roadside records suggests that during the era of most botanical collecting (20th century), *I. rubra* has survived on open roadsides following alteration and/or conversion of natural habitats. In the Sandhills of the Carolinas and Georgia, one might suspect firesuppression in the longleaf pine ecosystem, particularly during the twentieth century (Frost 1998), as a causal factor in relegating *I. rubra* to roadsides. However, since the initiation of fire management in the 1970s-80s, this species has shown no evidence of moving into longleaf pine-wiregrass communities. Some other factor of its natural history than fire seems to play a role in successful germination and growth of plants.

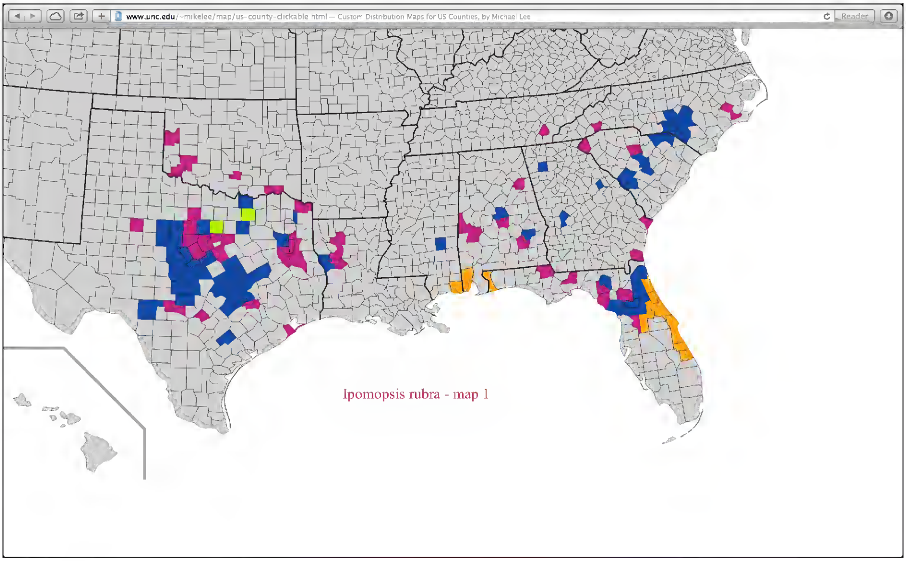

Figure 3. Habitat types of *Ipomopsis rubra*, map 1. Blue = roadsides; orange = dunes; pale green = prairies; red = unknown.

There is a distinct cluster of records from maritime dunes on the east coast of Florida and from dunes on barrier islands of the mid Gulf Coast. These collections are all from natural communities, not heavily disturbed by humans, and undoubtedly represent natural occurrences, beginning with a probable observation by Bartram in 1775 (Bartram 1791). A recent collection from St. Johns County reads "Fort Matanzas National Monument ... shrub/herb backdune with *Gaillardia pulchella, Helianthus debilis, Ilex vomitoria, Myrica cerifera, Opuntia stricta,* and *Serenoa repens,*" 2003, *Giannasi & Zomlefer 432* (GA). From Mobile Co., Alabama, a collection label reads "Little Dauphin Island, low sand dunes interspersed with shell deposits," *Lelong 5618* (NCU). We have seen no specimens of Gulf Coast *Ipomopsis rubra* from the adjacent mainland.

A single record was taken inland from an "old dune" in Lake County, Florida (*Houck s.n.* USCH), while a second from the same county was from "high pine land, sandy soil near Eustis," (*Nash s.n.* GH, PH). These both likely refer to sand pine or longleaf pine uplands on the Lake Wales Ridge –– a likely native habitat.

The greatest concentration of *Ipomopsis rubra* records is from central and eastern Texas, extending north to southern Oklahoma. We know from a very early account (Nuttall 1821) that this species was found "On the elevated prairies of Red river"; yet not a single modern specimen was taken from a prairie near that river! Have all former prairies there been converted? We have seen only two specimens specifically from prairies: Collin and Parker counties, Texas, well away from the

Red River. The Collin specimen reads "relict blackland prairie," *Baucum 7* (LL), while the Parker label reads "Utley Prairie," *Swadek 357* (TEX).

The great majority of specimens from central Texas and southern Oklahoma are from roadsides or do not provide habitat. It is tempting to think of them as modern roadside refugees of former prairies or of rolling oak-juniper-grass habitats of the Edwards Plateau, but without exhaustive research into historical records, such as land surveys, we cannot be definitive. A similar argument may be made regarding records from the Blackland Prairie region of Alabama and the Jackson Prairie region of Mississippi.

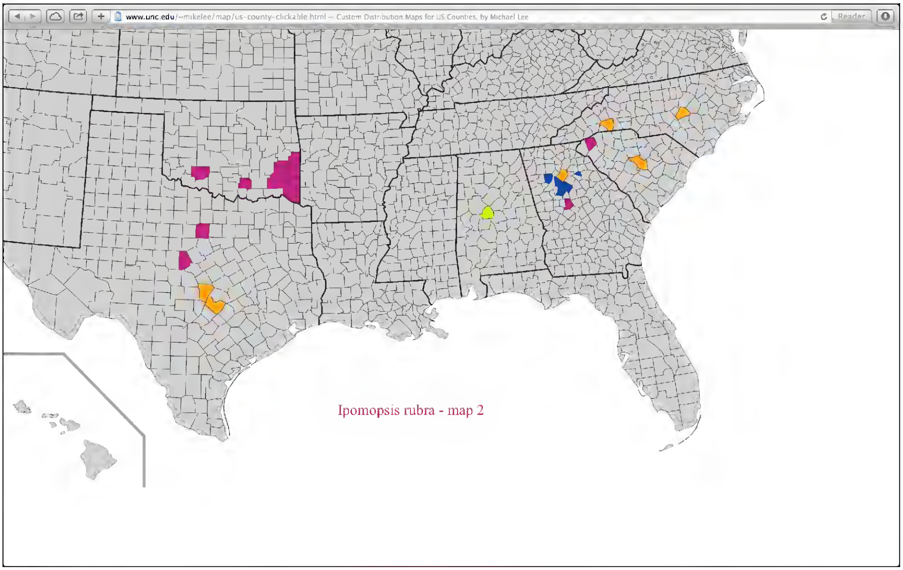

Figure 4. Habitat types of *Ipomopsis rubra,* map 2. Orange = river scour zones; blue = granitic flatrocks; pale green = limestone river bluffs; red = rocky slopes.

Figure 4 maps the distribution of a second set of habitats. A Johnston Co., Oklahoma, specimen indicated "limestone outcrop," but the other maroon records gave no specifics. At the least, it would be valuable to know the substrate rock types at the various rocky slope occurrences. One Bibb Co., Alabama, record was collected in 1977 from limestone bluffs by the Cahaba River (GA); a second record was collected there or nearby in 1884 (*Mohr s.n.* NCU). There is a distinct cluster of records (dark blue) from granitic flatrock habitats in north-central Georgia; curiously, *Ipomopsis rubra* has been recorded from only one other flatrock in the Southeast, in Pickens Co., South Carolina. River shores and scour zones are noted for a number of interesting native plant species but also attract a wide variety of adventive or escaped species. Assessing native status of plants in these habitats is not straightforward. However, river edge records go back at least to 1860 (Darby 1860, reports from Georgia and South Carolina); and a specimen from Rutherford Co., North Carolina, also points towards native status: "Natural colony, not an escape, sandy floodplain of Broad River, 3 1/4 mi SW of Harris," 17 Jul 1956, *Freeman 56470* (NCU, UNCA).

Discussion

From our analysis of specimen records we conclude that *Ipomopsis rubra* occurs naturally in a relatively broad range of habitat and substrate types. Records from some of these habitat types are concentrated geographically - for example, granite flatrocks and maritime dunes - but seemingly identical habitats elsewhere lack any records. In the case of the Sandhills of the Carolinas and Georgia, virtually all specimens were collected from roadsides which pass through longleaf pine uplands, mostly at the northern end of this physiographic region. However, despite the suggestion that some subset of the longleaf pine ecosystem may have been an original habitat for *I. rubra*, that cannot be confirmed at this time. Similarly, roadside records through what formerly were prairies in Alabama, Mississippi, Oklahoma, and Texas are also suggestive and supported by Nuttall's early observations (Nuttall 1821). However, we have little idea today of whether *I. rubra* was a regular component of prairie ecosystems.

In summary, the native range of *Ipomopsis rubra* has not changed significantly in the past 80 years, despite the wealth of accumulated specimen records. Within and at the periphery of this native range some populations are clearly introductions, but others are ambiguous. While early records on riverbanks (e.g., Darby 1860) may appear to be native because of the habitat and "early" date, even these could represent escapes from cultivation from nearby cities. However, the earliest observations, particularly by Bartram in 1775 both on the coast at Saint Augustine, Florida, and a flatrock in Georgia, indicate a broad native range in appropriate ecosystems at an early date. These occurrences could not as easily be explained by use as an ornamental.

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DOS ESPECIES NUEVAS DE *AGERATINA* (COMPOSITAE, EUPATORIEAE) DEL CENTRO-ESTE DE MÉXICO

JERZY RZEDOWSKI
Instituto de Ecología, A.C.
Centro Regional del Bajío
Apartado postal 386
61600 Pátzcuaro, Michoacán, México
jerzedowski@gmail.com

RESUMEN

Se describen como nuevas e ilustran dos especies mexicanas de *Ageratina*, ambas de limitada distribución geográfica. **Ageratina eleazari** Rzed., **sp. nov.**, procede del noreste del estado de Querétaro y se vincula estrechamente con *A. spooneri* B.L. Turner. **Ageratina crassimonticola** Rzed., **sp. nov.**, solo se conoce de una localidad ubicada en la Sierra Gorda en el noreste del estado de Guanajuato. En virtud de la presencia de abundantes y brillantes glóbulos resinosos en gran parte de su superficie, se le compara con *A. petiolaris* (DC.) R.M. King & H. Rob.

ABSTRACT

Two Mexican species of *Ageratna* of limited geographical distribution are described as new and illustrated. **Ageratina eleazari** Rzed., **sp. nov.**, was collected in northeastern Querétaro and is closely related to *A. spooneri* B.L. Turner. **Ageratina crassimonticola** Rzed., **sp. nov.**, is only known from one locality in the Sierra Gorda in northeastern Guanajuato. Because of the abundance of shining resinous globules on much of its surface, it is compared with *A. petiolaris* (DC.) R.M. King & H. Rob.

La revisión de materiales de herbario no identificados, algunos de hace bastante tiempo, arrojó la existencia de dos especies de *Ageratina* todavía desconocidas, mismas que se describen a continuación.

AGERATINA ELEAZARI Rzed., **sp. nov.** TIPO: **MÉXICO**. **Querétaro**. Mpio. de Jalpan: "El Chijol," 4-5 km al NW de Rancho Nuevo, ladera de cerro con vegetación de bosque de encino, alt. 800 m, arbusto de 1.5-2 mm de alto, más o menos abundante, flores blanco-rosadas, 24 Oct 1992, *E. Carranza 4441* (holotipo: IEB; isotipos por distribuirse).

Frutex 1–3 m altus, ramis teretibus minutissime puberulis; folia opposita, petiolis 2–4 cm longis, laminis ovatis ad fere deltatis, 8–12.5 cm longis, apice longe acuminatis, base rotundatis vel admodum truncatis, margine crenatis vel denticulatis, supra minutissime puberulis, subtus glabris et minute atropunctatis, trinervatis; panicula terminalis laxe foliosa ad 18 cm longa et lata, axibus minute puberulis, pedicellis 10 mm longis vel saepe brevioribus; involucra anguste campanulata ca. 3.5 mm longa, phylariis ca. 10 fere aequalibus biseriatis anguste oblongis vel anguste lanceolatis apice acutis, extus viridibus et minute puberulis, scariosis, receptaculo minute puberulo; flores per capitulum ca. 18; corollae fere tubulosae 2–2.5 mm longae, albae, albidae vel subroseae, segmentis minutis et minute puberulis; achaenia fere cylindrica ca. 1 mm longa nigrescentia glabra, pappo ca. 20 setis albis ca. 2 mm longis.

Arbusto o a veces planta herbácea de 1 a 3 m de alto; ramas rollizas, grisáceas, pubérulas con pelillos casi microscópicos; hojas opuestas, peciolos de 2 a 4 cm de largo, delgados, casi filiformes,

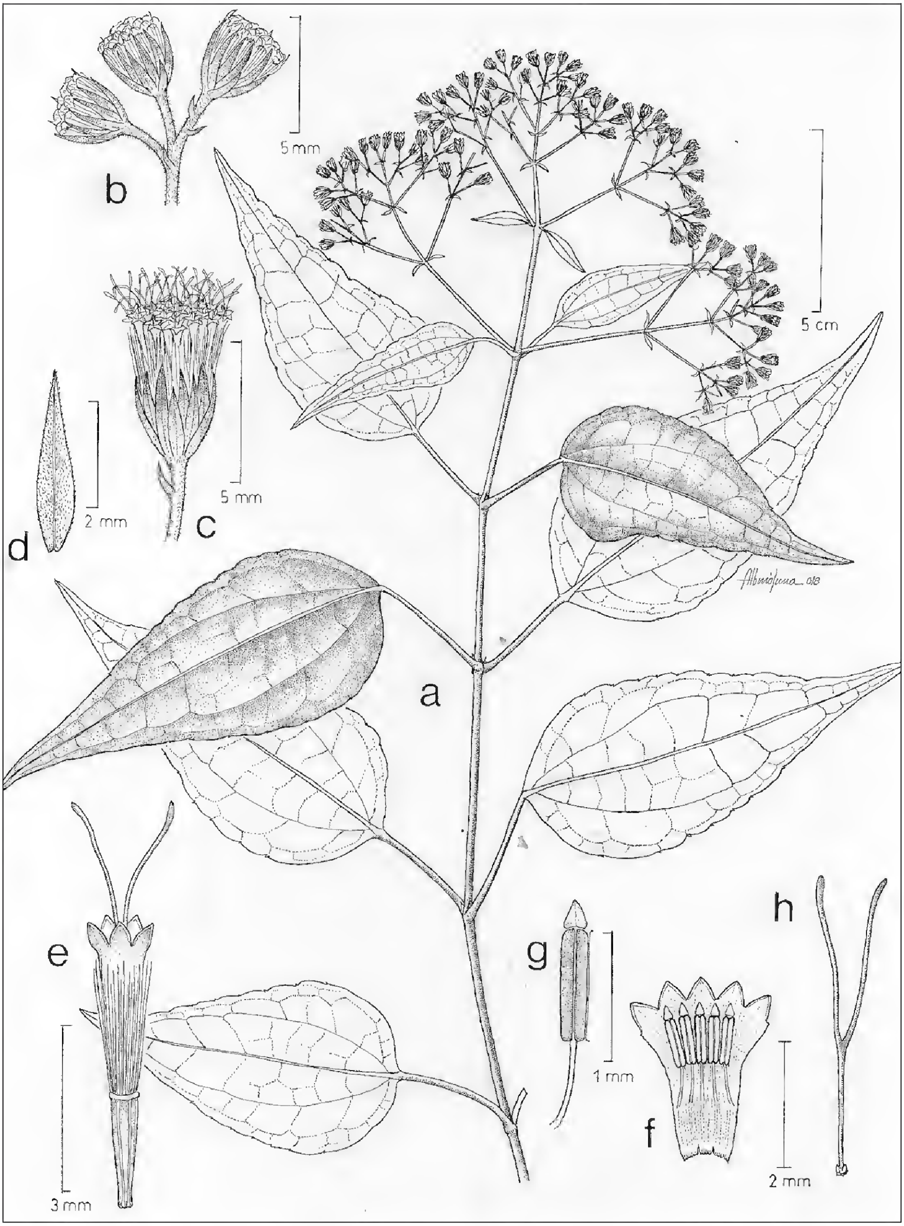

Figura 1. *Ageratina eleazari*. a. Rama con hojas e inflorescencia. b. Conjunto de cabezuelas. c. Cabezuela. d. Bráctea involucral. e. Flor. f. Corola disecada. g. Estambre. h. Estilo. Ilustrado por Albino Luna.

láminas ovadas a casi deltoides, de 8 a 12.5 cm de largo, de 4 a 6 cm de ancho, largamente acuminadas en el ápice, ampliamente redondeadas a prácticamente truncadas en la base, crenadas a denticuladas en el margen, muy finamente pubérulas con pelos de menos de 0.1 mm de largo en el haz, glabras y con numerosos finos puntos oscuros en el envés, trinervadas, de textura membranácea; inflorescencia en forma de panícula terminal laxa, hasta de 18 cm de largo y de diámetro, redondeada en el ápice, provista de hojas de tamaño reducido y finalmente de brácteas lineares hasta de 7 mm de largo, sus ejes filiformes, muy finamente pubérulos, pedicelos hasta de 10 mm de diámetro pero por lo general mucho más cortos; involucros estrechamente campanulados, de ca. 3.5 mm de alto, sus brácteas 8 a 10, dispuestas en 2 series de casi igual longitud, angostamente oblongas a angostamente lanceoladas, agudas en el ápice, uninervadas, verdes y finamente pubérulas por fuera, plateadas, lustrosas y glabras por dentro, escariosas, receptáculo casi plano, finamente pubérulo; flores por cabezuela ca. 18; corolas casi cilíndricas, muy levemente ensanchadas en la garganta, blancas, blanquecinas a rosáceas, de 2 a 2.5 mm de largo, los segmentos del limbo diminutos, finamente pubérulos por fuera; anteras con apéndices triangulares; aquenios casi cilíndricos, de ca. 1 mm de largo, glabros, negruzcos, vilano de ca. 20 cerdas firmes, blancas, de ca. 2 mm de largo.

Material adicional examinado: **MÉXICO**. **Querétaro**. Mpio. de Jalpan: 4-5 km al norte y oriente de La Parada, ladera de cerro con vegetación de bosque de pino-encino, alt. 1300 m, arbusto erecto de 2 a 3 m de alto, flores blancas, 19 Oct 1990, *Servín 591* (IEB, duplicados por distribuirse); 3-4 km al oriente de La Parada, ladera de cerro con vegetación de bosque de pino-encino, alt. 1200-1250 m, arbusto erecto de 1 a 2 m de alto, flores blanquizcas, abundante, 30 Oct 1990, *Servín 607* (IEB, duplicados por distribuirse); 4 km al SW de La Parada, bosque de *Pinus greggii, Juniperus flaccida* y *Quercus* spp. sobre laderas calizas, alt. 1200 m, planta herbácea, flores blancas, 22 Oct 1994, *Zamudio* y *Pérez 9450* (IEB, duplicados por distribuirse). Mpio. de Landa: 11 km al S de Madroño, cañada húmeda con *Juglans* y *Quercus* entre el matorral submontano, alt. 1515 m, planta herbácea, flores blanquecinas, abundante, 5 Nov 1987, *Zamudio 5902* (IEB, duplicados por distribuirse).

Planta conocida únicamente del sector del estado de Querétaro correspondiente a la Sierra Madre Oriental. Muy probablemente represente un endemismo estrecho.

En la forma de la hojas y en varios rasgos de la inflorescencia y de la flor *Ageratina eleazari* está cercanamente relacionada con *A. spooneri* B.L. Turner, conocida del estado de Veracruz (Turner 2008). En el cuadro 1 se resumen las principales características que separan estas dos especies.

CARACTERES	**Ageratina eleazari**	**Ageratina spooneri**
Porte	planta comúnmente arbustiva, de 1.5 a 2 m de alto	planta herbácea, hasta de 1 m de alto
Hojas, indumento	finamente pubérulas en el haz, glabras en el envés	pubescentes en ambas superficies
Inflorescencias		
largo y ancho	hasta de 18 cm	5 a 8 cm
pedicelos, largo	10 mm o menos	10 a 20 mm
Aquenios	glabros	pubescentes
Vilano	firme	frágil

Cuadro 1. Principales características distintivas entre *Ageratina eleazari* y *A. spooneri*.

El nombre de la especie nueva está dedicado en calidad de particular reconocimiento a la obra de Eleazar Carranza González, colector de su ejemplar tipo. El proyecto "Flora del Bajío y de regiones adyacentes" está en profunda deuda con este trascendente colaborador suyo, quien le dedicó gran parte de su vida. El Dr. Carranza González es autor o algunas veces coautor de 29 fascículos de la Flora, además de uno que tiene en preparación. Dedicó asimismo 5 años (1987-1992) de esfuerzo a la organización y eficiente administración de una red de colectores locales en el noreste del estado de Querétaro, cuya labor global sumó cerca de 10,000 números, o sea alrededor de 50,000 ejemplares de herbario. De este material se han descrito hasta la fecha un género y más de 40 especies nuevas y al menos otro tanto está por publicarse con base en la cuantiosa parte remanente que no se ha estudiado bien todavía.

AGERATINA CRASSIMONTICOLA Rzed., **sp. nov.** TIPO: **MÉXICO**. **Guanajuato**. Mpio. de Victoria: aprox. 30 km al W de Xichú, sobre el camino a San Luis de la Paz, ladera andesítica con vegetación de encinar, alt. ca. 2300 m, arbusto de 1 m de alto, 14 Jun 1957, *J. Rzedowski 9084* (holotipo: IEB; isotipo por distribuirse). Figura 2.

Frutex ca. 1 m altus; rami minute puberuli; folia opposita, petiolis 0.8–2 cm longis, laminis deltatis vel fere cordiformibus, 4–6 cm longis, apice acuminatis, base truncatis vel leviter cordatis, margine serrulatis vel serratis, utrinque puberulis, subtus minute maculatis et multos globulos resinosos nitidos ferentibus; panicula terminalis, saepe cum 2 vel 4 paniculis axillaribus junctis, conjuncte paniculam foliosam hemisphaericam amplam facientibus, axibus dense puberulis, pedicellis 3-10 mm longis; involucra campanulata vel fere cylindrica, phylariis ca. 12, 4–6 mm longis, oblongis vel lanceolatis subaequilongis, extus puberulis et globulis resinosis nitidis tectis, receptaculo glabro; flores per capitulum ca. 18; corollae angustissime infundibuliformes ca. 4.5 mm longae, albidae ad leviter brunneo-rubellae, segmentis extus puberulis et globulis resinosis nitidis tectis; styli rami ca. 2 mm longi; achaenia prismatica ca. 3 mm longa, nigricantia, ad costas hispidula, pappo ca. 25 setis albis ca. 3.5 mm longis.

Arbusto de ca. 1 m de alto; ramas rojizas, finamente pubérulas; hojas opuestas, peciolos de 0.8 a 2 cm de largo, láminas deltoides a casi cordiformes, de 4 a 6 cm de largo, de 2.5 a 4.5 cm de ancho, acuminadas en el ápice, truncadas o a veces ligeramente cordadas en la base, serruladas a serradas en el margen, pubérulas en ambas superficies, en el envés provistas de numerosas diminutas máculas oscuras de forma irregular y también de muchos glóbulos resinosos brillantes, trinervadas, de textura membranácea; inflorescencia dispuesta en panícula terminal de contorno redondeado con mucha frecuencia acompañada de dos o cuatro panículas axilares, conformando en conjunto una amplia panícula foliosa hemisférica hasta de 18 cm de alto y de diámetro, con ca. 100 o menos cabezuelas, sus ejes densamente pubérulos, pedicelos de 3 a 10 mm de largo; involucros campanulados a casi cilíndricos, de 4 a 6 mm de largo, sus brácteas ca. 12, dispuestas en 2 a 3 series de largo casi igual, a veces algunas de las exteriores más cortas, oblongas a lanceoladas, de ápice agudo, uninervadas, verdes, pubérulas y a menudo con glóbulos resinosos brillantes por fuera, pajizas y glabras por dentro, escariosas, receptáculo plano, glabro; flores por cabezuela ca. 18; corolas muy estrechamente infundibuliformes, de ca. 4.5 mm de largo, el tubo café-rojizo, de poco menos de 2 mm mm de largo, el resto de la corola inicialmente blanquecino, tornándose blanco-rojizo o café-rojizo claro con la edad, los segmentos triangulares, de ca. 0.4 mm de largo, pubérulos y con glóbulos resinosos brillantes por fuera; anteras con apéndices triangulares; ramas del estilo de ca. 2 mm de largo, café-rojizas; aquenios prismáticos pero estrechados cerca de la base, de ca. 3 mm de largo, negruzcos, con 5 costillas hispidulas, vilano de ca. 25 cerdas blancas del ca. 3.5 mm de largo.

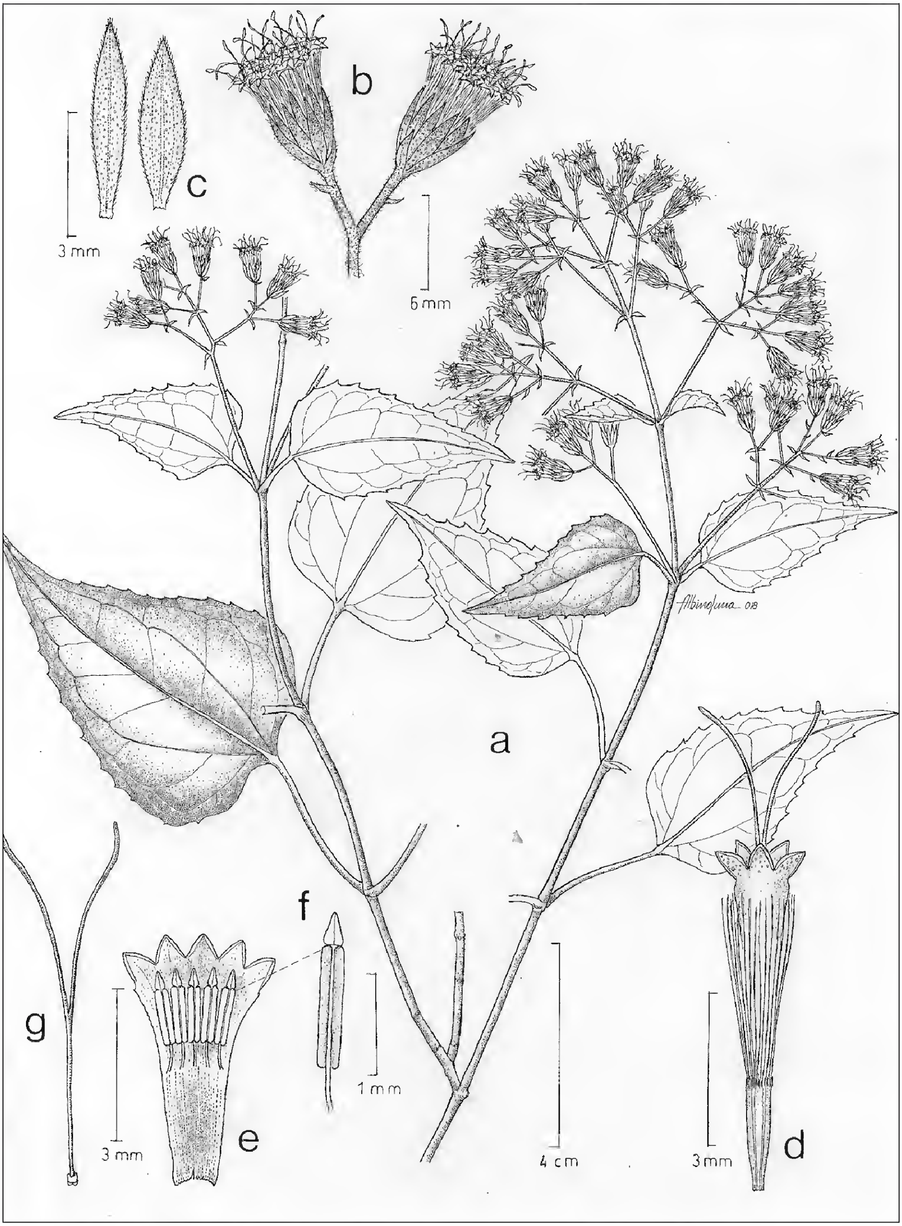

Figura 2. *Ageratina crassimonticola.* a. Rama con hojas. b. Conjunto de cabezuelas. c. Brácteas involucrales. d. Flor. e. Corola disecada. f. Estambre. g. Estilo. Ilustrado por Albino Luna.

Ageratina crassimonticola es planta rara y debe ser estrechamente endémica, pues no se ha vuelto a encontrar desde hace más de 60 años a partir de su registro inicial, a pesar del hecho de que posteriormente la región ha sido bastante explorada por varios botánicos y colectores de plantas.

En su porte arbustivo, en la forma de las hojas y de las inflorescencias, y sobre todo en la presencia de glóbulos brillantes resinosos entremezclados con la pubescencia, *Ageratina crassimonticola* converge con *A. petiolaris* (DC.) R.M. King & H. Rob., elemento de amplia distribución en México, incluyendo el estado de Guanajuato. Sin embargo, las dos especies discrepan en varios caracteres importantes, como puede observarse en el Cuadro 2.

CARACTERES	**Ageratina crassimonticola**	**Ageratina petiolaris**
Peciolo, largo	hasta de 2 cm	hasta de 10 cm
Lámina foliar		
ápice	acuminado	obtuso a agudo
margen	serrulado a serrado	crenado
textura	membranácea	cartácea
Brácteas involucrales, número	ca. 12	ca. 20
Flores por cabezuela	ca. 18	35 a 72
Segmentos de la corola	por fuera pubérulos	por lo general glabros
Época de floración conocida	junio	enero a abril

Cuadro 2. Principales características diferenciales entre *Ageratina crassimonticola* y *A. petiolaris*.

El nombre de la especie alude a la circunstancia de que la localidad del ejemplar tipo se encuentra ubicada en la región localmente conocida como 'Sierra Gorda' en el noreste del estado de Guanajuato.

AGRADECIMIENTOS

Se agradece al Maestro Albino Luna la atinada y oportuna preparación de las ilustraciones. Martha Rzedowski y Ernestina Rzedowski auxiliaron en la composición tipográfica del trabajo.

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VALIDATION OF *PRATOCHLOA* (POACEAE: ARUNDINOIDEAE) AND A NEW COMBINATION, *PRATOCHLOA WALTERI*, BASED ON *ERAGROSTIS WALTERI*

LAURENT HARDION
Laboratoire Image Ville Environnement (LIVE)
University of Strasbourg, CNRS
Institut de Botanique
28 rue Goethe
67000 Strasbourg, France
hardion@unistra.fr

PAUL M. PETERSON and ROBERT J. SORENG
Department of Botany
National Museum of Natural History
Smithsonian Institution
Washington, DC 20013-7012
peterson@si.edu; sorengr@si.edu

ABSTRACT

The new genus **Pratochloa** Hardion is validated and the new combination **Pratochloa walteri** (Pilg.) Hardion is made for *Eragrostis walteri.*

The Arundinoideae Kunth ex Beilschm. includes 40 species in 14 genera (Soreng et al. 2017). Hardion et al. (2017) presented a new phylogeny and classification of the Arundinoideae and found *Eragrostis walteri* to be sister to two species of *Elytrophorus* P. Beauv. However, for lack of a genus diagnosis or description, the proposed new genus *Pratochloa* and species transfer were not effectively published (Art. 38.5 ICN; McNeill et al. 2012). Descriptio generico-specifica did not apply, as there was only a reference to an earlier species description. We validate the new genus below and make a new combination.

PRATOCHLOA Hardion, **gen. nov.** TYPE: *Pratochloa walteri* (Pilg.) Hardion (≡ *Eragrostis walteri* Pilg.).

Pratochloa differs from *Elytrophorus* in having hairy ligules, open, ovate panicles with the primary branches bearing spikelets almost near the base, 7–15-flowered spikelets with 3-veined glumes, lemmas with glabrous margins, and caryopses with an adherent pericarp.

This new genus is named in tribute to Henri Prat (1902–1981), professor at the Universities of Marseille (France) and Montreal (Quebec, Canada).

Pratochloa occurs in the Nama-Karoo and Desert Biomes of Namibia (Gibbs Russell et al. 1990; Clayton et al. 2006; Ingram et al. 2011). The single species is found in damp, sandy and brackish soils around seepage areas, stagnant pools, or along creeks often associated with calcium carbonate (Gibbs Russell et al. 1990). The type, three additional specimens to exhibit individual variation within *P. walteri,* and a close up of the florets are shown in Figure 1.

PRATOCHLOA WALTERI (Pilg.) Hardion, **comb. nov.** *Eragrostis walteri* Pilg., Notizbl. Bot. Gart. Berlin-Dahlem 15: 452. 1940. TYPE: **NAMIBIA**. Kleiner Naukluftrivier, 29 Oct 1937, *H. & E. Walter 458* (holotype: B [image B100272776!]; isotype: B [image B100272777!]).

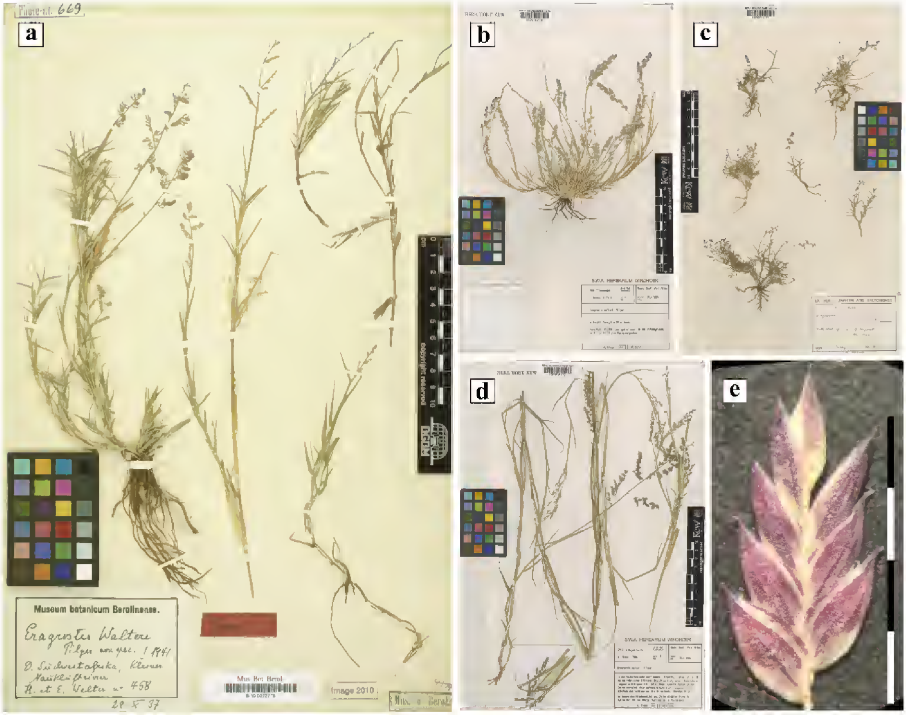

Figure 1. *Pratochloa walteri*. A. Image of the holotype (B100272776). B. *Geiss 8104a* (K000795176). C. *Strey 6* (K00079573). D. *Geiss 7995* (K000795172). E. Florets taken from *Geiss 7995* (K000795172), scale = 4 mm.

ACKNOWLEDGEMENTS

We thank Neil Snow for reviewing an earlier draft of the manuscript and Guy Nesom for editing the final version.

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FESTUCA FLORIBUNDA, A NEW COMBINATION FOR *DIELSIOCHLOA* (POACEAE: POOIDEAE: POEAE: LOLIODINAE: LOLIINAE)

PAUL M. PETERSON, ROBERT J. SORENG, AND KONSTANTIN ROMASCHENKO
Department of Botany
National Museum of Natural History
Smithsonian Institution
Washington, DC 20013-7012
peterson@si.edu; sorengr@si.edu; romashchenkok@si.edu

ABSTRACT

Based on morphological and molecular evidence, *Trisetum floribundum* [syn. *Dielsiochloa floribunda* (Pilg.) Pilg.] is transferred to *Festuca* as **Festuca floribunda** (Pilg.) P.M. Peterson, Soreng & Romasch., **comb. nov.** Specimens examined (Argentina, Bolivia, Chile, Peru) are included.

Pilger (1906) described *Trisetum floribundum* based on two syntypes collected by A. Weberbauer [nos. 1028 & 2811] from Peru. Hitchcock (1927) effectively chose *Weberbauer 1028* as a lectotype in his treatment of the Grasses of Ecuador, Peru, and Bolivia but did not cite a herbarium. Thirty-seven years later Pilger (1943) erected the new genus *Dielsiochloa* Pilg., with a single species [*D. floribunda*] and three varieties. He also stated that *Weberbauer 1028* was "Typus der Art." Pilger (1943, p. 100) mentioned that *Deilsiochloa* was roughly similar to species in *Bromus* sect. *Stenobromus* Griseb. (= *Bromus* sect. *Genea* Dumort., including *B. sterilis* L. and *B. madritensis* L.; see Soreng et al. 2018), in which the upper florets within a spikelet are sterile with an irregularly disarticulating rachilla, and he concluded that the genus belonged in tribe Aveneae s. l. near *Trisetum.*

Most systematists have followed this phylogenetic assessment of the species (Nicora 1975; Clayton & Renvoize 1986; Nicora & Rúgolo de Agrasar 1987; Tovar 1993; Chiapella 2012). *Dielsiochloa floribunda* is characterized in having 6–10-flowered spikelets (only the lower 2 or 3 fertile, upper sterile and diminished), 1-veined glumes shorter than the spikelet, 5-veined lemmas bearing a single erect awn (5–10 mm long) arising dorsally below a bifid apex (notch 1–3.2 mm deep with aristate, hyaline teeth), glabrous ovaries, and a dorsally compressed caryopses with an adherent pericarp (Clayton et al. 2006).

Currently, the United States National Herbarium is being rearranged in a new classification following Soreng et al. (2017) and we came to *Dielsiochloa*, a taxon we have known was embedded within *Festuca* L. for over 10 years (Quintanar et al. 2007; Döring 2009; Refulio et al. 2012; Saarela et al. unpubl. (sequences in GenBank); Romaschenko et al. unpubl. (sequences in GenBank)). In a molecular DNA study using *trnTL-trnLF* and ITS markers, Minaya (2017) found *D. floribunda* deeply embedded in a derived clade of northern South American festucas and sister to *Festuca cuzcoensis* Stančík & P.M. Peterson, a species known only from the higher elevations (3200–3850 m) of Bolivia and Peru (Stančík & Peterson 2002). We believe the species belongs in *Festuca* and make the new combination below.

FESTUCA FLORIBUNDA (Pilg.) P.M. Peterson, Soreng, & Romasch., **comb. nov.** *Trisetum floribundum* Pilg., Bot. Jahrb. Syst. 37: 505. 1906. *Dielsiochloa floribunda* (Pilg.) Pilg., Bot. Jahrb. Syst. 73: 99. 1943. LECTOTYPE (designated by Hitchcock in Contr. U.S. Natl. Herb. 24: 359. 1927): **Peru.** Prov. Sandia: unterhalb Ananea, auf sehr durftig bewachsenem, steinigen Boden, 4800 m, 15 May 1902, *A. Weberbauer 1028* (B, image B100250163!; isolectotypes: S image S-R-6247!, SGO image SGO000000770!).

The species is found in the Cordillera de los Andes of northwestern Argentina, Bolivia, northern Chile, and Peru at 4000–5100 m. It grows on steep, rocky, gravelly slopes, talus slopes, rock outcrops, wet meadows, and lake shores associated with *Festuca*, *Poa*, *Cinnagrostis* (syn. *Calamagrostis* Adans., *Deyeuxia* Clarion ex P. Beauv.), *Anatherostipa*, *Jarava*, *Pappostipa*, *Azorella*, *Lepidophyllum*, *Polylepis*, and *Pycnophyllum*.

Festuca floribunda shares with other members of the genus lemmas with a rounded back, a glabrous callus that is blunt and annulated, and a dorsoventrally compressed rachilla (Watson & Dallwitz 1992; Clayton et al. 2006). *Festuca casapaltensis* Ball, a Peruvian endemic, is morphologically similar to *F. floribunda* in having short tufted culms, lemmas with long slender awns, and glumes longer than the lower floret with attenuate apices (Tovar 1972, 1993).

Specimens examined: **ARGENTINA. Jujuy.** Dpto. Famatina. Sierra de Famatina, *Krapovickas 6241* (BAA); Dpto. Humahuaca: 150 m below cumbre del Aguilar, *Ruthsatz 493* (BAA). **BOLIVIA. La Paz**. Prov. Murillo, La Paz, hacia la Cumbre, 10 Jul 2004, *Beck & Beck 31058* (LPB, US); Prov. Murillo, Nevado Chacaltalya al norte de La Paz, 6 Feb 1989, *Beck 14695* (LPB, US); Prov. Murillo, Mina Milluni, 15 May 1985, *Beck 11197* (LPB, US); Prov. Murillo, the dam at Lago Zongo, 17 Apr 1985, *Solomon 13367* (MO, US); Prov. Murillo, 6.6 km N of the road to Valle del Zongo, on the road to Chacaltaya, 15 Mar 1984, *Solomon 11784, Stein & Uehlong* (MO, US). **Potosí**. Prov. Sud Chichas, 20 mi E of Atocha and 1.5 mi above Santa Barbara on the southwest face of Nevada Choroloque, 15 Mar 1993, *Peterson 12939, Annable, Soreng, Laegaard & Rojas-Ponce* (LPB, US); Sud Lipez, 2 mi N of San Antonio de Lepiz, 20 Mar 1993, *Peterson 13024, Soreng & Laegaard* (LPB, US); Sud Lipez, 27 mi SW of San Antonio de Lipez and 22 mi NE of Quentena Chico, 21 Mar 1993, *Peterson 13053, Soreng & Laegaard* (LPB, US). **CHILE. Region I.** 26 km E of Zapahuira on top of Cerro Chapiquiña, 18°20'7.1"S, 69°30'3.6"W, 1 Apr 2001, *Peterson 15721 & Soreng* (CONC, US); 92 km NE of Huara on road towards Colchane, 19°37'55.3"S, 69°4'11.5"W, 26 Mar 2001, *Peterson 15636 & Soreng* (CONC, US); 106 km NE of Huara on road towards Colchane, 19°34'53.2"S, 68°58'1.1"W, 26 Mar 2001, *Peterson 15653 & Soreng* (CONC, US). **Region II.** km 45 on road from San Pedro to Paso Jama, 22°55'30'S, 67°45'41"W, 16 Mar 2001, *Peterson 15526, Soreng & Judziewicz* (CONC, US). **PERU.** Between Culini and Obrajillo, Wilkes Expedition (US-868484); 21 km E of Pachacofo on road towards Hullanca, 9°52'59.0"S, 77°12'4.5"W, 21 Mar 2004, *Peterson 17912, Refulio Rodriguez, Cano, LaTorre & Salinas* (US, USM). **Ancash.** Bolognesi Prov., Paso Chonta, 29 Apr 1956, *Tovar 2663* (USM, US); Bolognesi Prov., Abra Yanashallas, W of Huallanca and 55 km E of Conococha, 9°51'36.1"S, 77°4'41.6"W, 24 Mar 2004, *Peterson 17947 & Refullio Rodriguez* (US, USM); Bolognesi Prov., 5 km NW of Abra Yanashalash on road towards Antimina, 9°50'3.5"S, 77°6'57.6"W, 25 Mar 2004, *Peterson 17963 & Refulio Rodriguez* (US, USM); Recuay Prov., Huascarán National Park, Quebrada Quenua Ragra, 10 May 1985, *Smith 10652, Valencia & Gonzales* (MO, US); Yungay Prov., Cordillera Negra, Cerro Chonta, at head of Quebrada Teclio, 9°17'50.3"S, 77°48'30.4"W, 14 Mar 2008, *Peterson 21668, Soreng, LaTorre & Rojas Fox* (US, USM); Yungay Prov., Cordillera Blanca, on road to pass E of Lago Llanganuco and Yanama, 9°2'39.9"S, 77°35'47.3"W, 16 Mar 2008, *Peterson 21761, Soreng, LaTorre & Rojas Fox* (US, USM). **Arequipa.** Nevado de Chachani, 14 Apr 1925, *Pennell 13313* (US); Arequipa Prov., 11 km NE of Patahuasi on road towards Chivay, 15°57'59.1"S, 71°22'45.9"W, 11 Apr 2004, *Peterson 18258 & Refulio Rodriguez* (US, USM); Caylloma Prov., 15 km SE of Callalli on road towards Condoroma, 15°28'14"S, 71°22'26.9"W, 12 Apr 2004, *Peterson 18274 & Refulio Rodriguez* (US, USM); Caylloma Prov., 10 km SE of Callalli on road towards Condoroma, 15°29'26"S, 71°23'5.9"W, 12 Apr 2004, *Peterson 18261 & Refulio Rodriguez* (US, USM); Caylloma Prov., Bosque de Rocas, S of Imata, 12 km on road to Pati, 75 air km NE of Arequipa, 15°54'37.4"S, 71°2'38"W, 1 Apr 2007, *Peterson 20758, Soreng, Romaschenko & Gonzalez Elizondo* (US, USM); Caylloma Prov., S of Imata, 17 km on road to Pati, 6 km S of Bosque de Rocas, 73 air km NE of Arequipa, 15°57'40"S, 71°2'14.4"W, 1 Apr 2007, *Peterson 20769, Soreng, Romaschenko & Gonzalez Elizondo* (US, USM). **Ayacucho.** Cangallo Prov., just S of Abra Apacheta, 84 km W of Ayacucho on road to Pisco, 13°21'28.9"S, 74°43'57.1"W, 22 Mar 2002, *Peterson 16661 & Refulio Rodriguez* (US, USM); Cangallo Prov., 0.5 km E of Abra Apacheta on road towards Ayacucho, 13°21'28.8"S, 74°43'57.2"W, 5 Apr 2004, *Peterson 18165 & Refulio Rodriguez* (US, USM); Lucanas Prov., 51 km SE of Puquio and 24 km NW of Chavina, 14°52'2.2"S, 73°55'40.2"W, 27 Feb 2002, *Peterson 16313, La Torre, Ramirez & Susanibar Cruz* (US, USM); Lucanas Prov., 55 km E of Puquio on road towards Cuzco, 14°38'15.5"S, 73°49'51.3"W, 12 Mar 2002, *Peterson 16464 & Refulio Rodriguez* (US, USM); Lucanas Prov., 4 km N of Pedregal and 49 km S of Putajasa, 14°24'30.4"S, 74°24'23.5"W, 23 Feb 2002, *Peterson 16197, Cano, LaTorre, Ramirez & Susanibar Cruz* (US, USM); 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ACKNOWLEDGEMENTS

We thank the Smithsonian Institution's Restricted Endowment Fund, the Scholarly Studies Program, Research Opportunities, Atherton Seidell Foundation, Biodiversity Surveys and Inventories Program, Small Grants; the National Geographic Society for Research and Exploration (Grants No. 8848-10, 8087-06), Neil Snow for reviewing an earlier draft of the manuscript, and Guy Nesom for editing the final version.

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LOMATIUM FILICINUM (APIACEAE): A NEW COMBINATION EPITYPIFIED WITH *LOMATIUM BASALTICUM*

DONALD H. MANSFIELD
Department of Biology
Harold M. Tucker Herbarium
The College of Idaho
Caldwell, Idaho 83605
dmansfield@collegeofidaho.edu

BARBARA L. WILSON
Carex Working Group
2250 NW 13th Street
Corvallis, Oregon
cwg@peak.org

JAMES F. SMITH
Department of Biological Sciences
1910 University Drive
Boise State University
Boise, Idaho 83725
jfsmith@boisestate.edu

MARK DARRACH
Burke Museum of Natural History and Culture
University of Washington
Seattle, Washington 98195
corydalis.mark@gmail.com

ABSTRACT

Lomatium basalticum Mansfield & McK. Stevens was described recently without knowledge of the type specimens of *Leptotaenia filicina* M.E. Jones described in 1902. Here we argue that these represent the same species and provide the combination **Lomatium filicinum** (M.E. Jones) Mansfield & McK. Stevens, **comb. nov.**, to accomodate the earlier name. An epitype is designated for *Leptotaenia filicina.*

When publishing the narrowly endemic biscuitroot *Lomatium basalticum* Mansfield & McK. Stevens (Mansfield et al. 2016), the authors were unaware of the type specimens of *Leptotaenia filicina* M.E. Jones, a name that had been ignored since its publication (Jones 1902). Dr. Jason Alexander brought to our attention the *Leptotaenia filicina* holotype specimen at RSA (Figure 1; herbarium acronyms from Theirs continuously updated). An isotype was located at UTC and viewed on-line (http://intermountainbiota.org/portal/collections/individual/index.php?occid=3074559&clid=0). Both types had been annotated as "= *Lomatium grayi* var. *filicinum* (Jones) n. comb. ined." in 1939 by Mathias and Constance. Apparently, that name was never published.

The *Leptotaenia filicina* type specimens have long, narrow mature fruits, like those of *Lomatium basalticum* and *L. brunsfeldianum.* The leaves were largely senescent at the time of collection and are in poor condition. The few remaining ultimate leaf segments appear filiform, consistent with the identification of *L. basalticum* and *L. brunsfeldianum.*

The type specimens were collected in 1899 in the Seven Devils Mountains of Idaho. This area was variously recognized as either Idaho County or Washington County during the second half of the 19th century. In 1911, part of this area was separated to form Adams County. The Seven Devils

Mountains straddle what is now the western Adams Co./Idaho Co. border. This location falls within the range of *Lomatium basalticum,* which is known from Adams Co., Idaho, and Wallowa and Baker cos., Oregon. However, *Lomatium brunsfeldianum* grows on rocky cliffs along streams in the northern Rocky Mountains, as nearby as eastern Idaho County, so range considerations alone do not allow for a confident discrimination between these two species.

Figure 1. Holotype of *Leptotaenia filicina,* RSA

In attempts to determine the identity of the *Leptotaenia filicina* type specimens relative to these recently described species, measurements of fruit length and width were taken from photographs of the type specimens. Additionally, Dr. Mare Nazaire, RSA Collections Manager, weighed the available fruits in a fragments packet on the type specimen there.

The filiform leaves might suggest that the types are *Lomatium grayi*. However, the form of *L. grayi* found in the area [*L. papilioniferum* J.A. Alexander and W. Whaley, in review] has proportionately shorter fruits, with length/width ratios 1.5–2.2 (Mansfield et al. 2016) versus 3.5–5.1 for the types (Table 1). It also has shorter and notably papillose ultimate leaf segments that attach more distantly from the rachis. Though leaves of the type specimen are badly broken, a few of the remaining ultimate leaf segments appear too long and are attached too proximally to comport with *L. grayi*/*papilioniferum*.

Fruit measurements of *Lomatium basalticum* and *L. brunsfeldianum* overlap greatly (Mansfield et al. 2016). Nonetheless, those of the type specimens seem to match *L. basalticum* better than *L. brunsfeldianum*. Fruit weights are considered the best trait for distinguishing fruits of the two species (Mansfield et al. 2016). Weights of fruits in the fragment packet on the RSA specimen are intermediate between those of the two species. However, these weighed fruits average smaller than those attached to the type specimen sheet (Nazaire, pers. comm.), and they have had approximately 100 years longer to lose mass than any fruits evaluated for the publication of *L. basalticum*.

Table 1. Traits of the *Leptotaenia filicina* type specimens and of *Lomatium basalticum* and *Lomatium brunsfeldianum*.

Trait	*L. filicina* type (RSA)	*L. basalticum*	*L. brunsfeldianum*
Mericarp length	15-21 mm	12-21 mm	9.8-17 mm
Mericarp width	3.5-5 mm	3--4.8 mm	2-3.8 mm
Mericarp L/W ratio	3.5-5.1	3.3-5.6	3.3-5.5
Mericarp mass	14.0 +/- 9.4 g	34.3 +/- 14.5 g	4.8 +/- 0.1 g
Habitat	not known	gravelly slopes, hillsides	river banks
Range, Idaho	Seven Devils Mts. (NW Adams Co. and SW Idaho Co.)	Adams and Washington cos.	Benewah, eastern Idaho, Kootenai, Nez Perce, and Shoshone cos.
Range, Oregon		Baker and Wallowa cos.	
Range, Montana			Sanders Co.

We conclude that the *Leptotaenia filicina* type specimens belong to the same species that was later named *Lomatium basalticum* by Mansfield et al. (2016). In light of this new information, two actions are necessary.

First, the name *Leptotaenia filicina* must be epitypified to stabilize its meaning. The Jones type specimens lack some of the important characteristics, such as plant bases, for properly identifying this taxon. Numerous new nomenclatural combinations and modifications to taxonomic understanding are occurring in this group of plants (e.g., Feist et al. 2017), and more changes will likely occur as a result of ongoing analysis of phylogenetic relationships in Apiaceae subfamily Apioideae (George et al. 2014; Smith et al. 2018). Besides this general flux, disagreement exists regarding how best to classify *Lomatium basalticum* in relation to *L. brunsfeldianum* and the remainder of the *L. grayi* complex (J.A. Alexander, pers. comm.). In this regard, we epitypify *Leptotaenia filicina* with the more complete specimen that is the type of *Lomatium basalticum*.

Second, as has been the case with all other members of the genus *Leptotaenia,* the name *L. filicina* must also be assigned to *Lomatium* (Mathias & Constance 1942). Phylogenetic analyses (George et al. 2014; Mansfield 2016) have placed *L. basalticum* and *L. brunsfeldianum* within the same large subclade of *Lomatium* that includes all the other species (we sampled 9) originally placed in *Leptotaenia* but transferred by Mathias and Constance (1942) to *Lomatium.*

Lomatium filicinum (M.E. Jones) Mansfield & McK. Stevens, **comb. nov.** *Leptotaenia filicina* M.E. Jones, Contr. W. Bot. 10: 56. 1902. TYPE: **USA**. **Idaho**. Washington Co.: Seven Devils Mountains, 5 Aug 1902, *M.E. Jones s.n.* (holotype RSA!; isotype UTC! [photos of both seen online], Fig. 1). **Epitype** (here designated): **Oregon**. Wallowa Co.: Hells Canyon National Recreation Area, 1.26 km SE of McGraw Lookout, 370 m due E of Forest Service Road 110, 45.1672124° N -116.7681258° W, sparse *Pseudoroegneria spicata* grassland/forbland, common on silty loam derived from weathered entablature basalt, southerly aspect, with *Pseudoroegneria spicata, Poa secunda, Bromus carinatus, Sedum stenopetalum, Astragalus reventus, Artemisia rigida,* elev. 1804 m (5920 ft), 5 Jul 2015, *M. Darrach* 1115 (holotype: CIC!; isotypes: NY!, OSC!, RM!, WTU!, ID!).

Lomatium basalticum Mansfield & McK. Stevens, Phytoneuron 2016-74: 2. TYPE: **USA**. **Oregon**. Wallowa Co.: Same collection (*Darrach 1115*) and distribution as for *Lomatium filicinum.*

ACKNOWLEDGEMENTS

Dr. Jason A. Alexander informed us about the *Leptotaenia filicina* type specimens, Dr. Mare Nazaire at RSA weighed holotype seeds for us, and Dr. Kanchi Gandhi gave us advice about how to proceed with the discovery that *L. filicina* is an earlier name for *Lomatium basalticum.*

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FIRST REPORT OF *SAGINA APETALA* (CARYOPHYLLACEAE) FOR NEW YORK

DANIEL ATHA
Center for Conservation Strategy
New York Botanical Garden
Bronx, New York 10458
datha@nybg.org

REGINA V. ALVAREZ
Dominican College
470 Western Highway
Orangeburg, New York 10962

KEN CHAYA
Ken Chaya
245 West 107th Street, Apt. 14A
New York, New York 10025

ABSTRACT

Sagina apetala is documented from New York State for the first time. It was found in Central Park, New York Co., New York. The occurrence is documented with herbarium specimens and a DNA sample. A key to the *Sagina* species of New York State is provided.

Sagina apetala Ard. is native to Europe and has been documented in North America from British Columbia, California, Oregon, Washington, Kansas, Illinois, Louisiana, Maryland and New Jersey (Crow 1978, 2005). The *Sagina* species of New York State were revised by Mitchell and Tucker (1991). They did not report *Sagina apetala*. The species is not reported in the Catalogue of the Vascular Plants of New York State (Werier 2017) or the USDA Plants database for New York (USDA, NRCS 2018).

Voucher specimens, *Sagina apetala*. USA. New York. New York Co.: New York City. Central Park, Bethesda Terrace, between 72nd and 73rd Streets and between 5th and 6th Avenues, 40.774505N, 73.970649W (WGS84, ±25m), ca 17 m elev, 26 Apr 2017, *Atha 15923* (NHA, NY).

Sagina specimens from Central Park were collected while conducting a botanical inventory of the Park in collaboration with the Central Park Conservancy and the New York City Department of Parks and Recreation. We also collected *Sagina japonica* and *Sagina procumbens* in Central Park. These two, non-indigenous species are common in full sun in hard packed soils in the joints of paving stones and around the foundations of walls and buildings. *Sagina decumbens* is endangered in New York state and is only known from Queens and Suffolk counties (Werier 2017).

Key to *Sagina* species of New York State

1. Flowers principally 4-merous; sepals 4, divergent in fruit; petals 4 or absent; stamens 4(–8).

    2. Leaf base margins long-ciliate; pedicels glandular-pubescent; petals absent or minute **Sagina apetala**
    2. Leaf base margins glabrous or with minute glandular cilia; pedicels always glabrous; petals equal to or shorter than the sepals .... **Sagina procumbens**

1. Flowers principally 5-merous; sepals 5, erect in fruit; petals 5; stamens 5 or 10.

    3. Plants often purple-tinged; pedicels and sepals glabrous or sparsely glandular-pubescent, sepal-tips often purple; capsule sutures ≥ 1/2 capsule length; seeds with dorsal groove .... **Sagina decumbens**
    3. Plants green; pedicels densely glandular-pubescent, the sepal tips green or white; capsule sutures 1/4 capsule length; seeds without dorsal groove.. **Sagina japonica**

ACKNOWLEDGEMENTS

We are grateful to Meryl Rubin for processing the herbarium specimens and to Guy Nesom for his helpful suggestions on the manuscript. We thank the Central Park Conservancy for their collaboration on the Central Park Flora Project, the New York City Department of Parks and Recreation for their collaboration and permission to collect specimens on city park land. In 2017, Amy Chang and Carrie Seltzer queried the first author about an iNaturalist observation from Union Station, Washington, DC that turned out to be *Sagina decumbens*. Their inquiry prompted him to look more closely at all *Sagina* plants. Susan Hewitt, Zihao Wang, and Erik Danielsen have observed unusual *Sagina* plants in New York City; these also posted to iNaturalist. Their observations helped inform the present paper and may result in additional new records.

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ON *SOLIDAGO MACVAUGHII* (ASTERACEAE: ASTEREAE), A RARE MEXICAN ENDEMIC OF THE *TORTIFOLIAE* GROUP OF *SOLIDAGO.* SUBSECT. *TRIPLINERVIAE*

JOHN C. SEMPLE
Department of Biology, University of Waterloo
Waterloo, Ontario Canada N2L 3G1
jcsemple@uwaterloo.ca

ABSTRACT

Nesom (1989) described *Solidago macvaughii* based on two collections from Aguascalientes, Mexico, in his paper on *S. velutina* in *Solidago* subsect. *Nemorales.* Based on triple-nerved leaves and lower stem leaves that are wilted, twisted, and persistent, *S. macvaughii* is placed in the informal Tortifoliae group of subsect. *Triplinerviae*, which includes *S. pringlei* and *S. durangensis*, also both endemic to Mexico. Detailed illustrations of the species are presented.

Nesom (1989) described *Solidago macvaughii* Nesom but did not illustrate the new species. He noted that it was similar to *S. velutina* DC. (subsect. *Nemorales* (Mackenzie) Nesom), following McVaugh's identification of it (1984) as that species (by the synonym *S. scabrida* DC.). The holotype of *S. macvaughii* (cited below) was examined as part of a multivariate study of subsect. *Nemorales.* However, close examination of the type indicated it is likely a member of subsect. *Triplinerviae*, based on senesced lower stem leaf traits, which are similar to those of *S. tortifolia* Ell. (Fig. 4; Semple & Cook 2006; Semple 2018, frequently updated). The type includes a ca 98 cm tall shoot with inflorescence and a much smaller vegetative shoot glued underneath the large shoot. The stem of the larger shoot is glabrate near the base, possibly due to hair loss with age (Fig 2A), but becomes densely short-woolly distally (Fig. 2B) in the region bearing multiple senesced lower stem leaves that are brown, pendent, and twisted (Fig. 2E-F). The lower mid to upper stem leaves of the type are similar to those of other species in the *Tortifoliae* group of subsect. *Triplinerviae* and have up to 8–15 small serrations on the lower mid stem leaves (Fig. 2G-J) and 0–1 on the distal stem leaves (Fig. 2K). All leaves have two prominent lateral veins that are visible on even the upper stem leaves, the triple-nerved condition of sect. *Triplinerviae.*

The informal *Tortifoliae* group includes *Solidago altiplanities* C.&J. Taylor, *S. chilensis* Meyen, *S. durangensis* Nesom, *S. juliae* Nesom, *S. leavenworthii* Torr. & A. Gray, *S. microglossa* DC., *S. pringlei*, and *S. tortifolia* (Semple 2018 frequently updated); some collections of nearly all of these species have similar persistent, wilted, twisted, brown to black, lower stem leaves. Such leaves are not characteristic of other species of *Solidago.* There is no specimen of *S. durangensis* with lower stems and leaves. The inner phyllaries of the *S. macvaughii* type are generally narrowly oblong with broad, hyaline, fimbriate margins distally; *S. pringlei* can have similar phyllaries.

Nesom (1989) noted that *Solidago macvaughii* grows in wetter habitats than *S. velutina*, to which he compared it. *Solidago durangensis* also may be native to wetter habitats, or was once, if it is now extinct. Such habitats in Aquascalientes, Durango, and western Zacatecas should be searched to locate more collections of both very rare species.

Nomenclature

Solidago macvaughii Nesom, Phytologia 67: 301. 1989. **TYPE: MEXICO. Aguascalientes.** [Mpio. Rincón de Romos]: 2 km S and 2 km E of Rincón de Romos; low ungrazed meadow with some permanent wet places, elev. 2000 m, local in patches near road, 4 Sep 1967, *R. McVaugh 23663* (holotype: MICH; Figs 1-3).

HOLOTYPE: ***Solidago macvaughii*** Nesom, Phytologia 67(4) 301 1989 TYPE. MEXICO. AGUASCALIENTIES. [Mpio. Rincón de Romos] 2 km S and 2 km E of Rincón de Romos, low ungrazed meadow with some permanent wet places, elev. 2000 m., local in patches near road, 4 Sep 1967, *R McVaugh 23663* (HT MICH), illustrated under the name *S scabrida* DC in McVaugh (1984, p 855)

- *Solidago macvaughii* Nesom

John C Semple, WAT 2 May 2018

TYPE · COLLECTION of
Solidago macvaughii Nesom

Reference: Phytologia 67: 301. 1989.

Verified by: R. Nacz Date: Sept. 1991

Remarks. Holotype

HOLOTYPE OF Solidago macvaughii Nesom

PLANTS OF MEXICO

COLLECTED FOR THE HERBARIUM OF THE UNIVERSITY OF MICHIGAN BY ROGERS McVAUGH AND RUTH B. McVAUGH

Solidago scabrida DC.

ESTADO DE AGUASCALIENTES: 2 km south and 2 km east of Rincón de Romos; low ungrazed meadow with some permanent wet places, elev. 2000 m.; local, in patches near the road.

Flowers yellow.

ROGERS McVAUGH. NO. 23663 4 SEPTEMBER 1967

Figure 1. Holotype of *Solidago macvaughii* from Aguascalientes, Mexico.

Figure 2. Details of holotype of *Solidago macvaughii*: stems and leaves. **A.** Lower stem near base. **B.** Lower stem with leaves still attached. **C.** Mid stem. **D.** Upper stem. **E-F.** Withered and twisted lower stem leaves. **G-H.** Lower stem leaf of vegetative shoot. **I.** Distal lower stem leaf of large shoot. **J.** Lower mid stem leaf abaxial surface detail. **K.** Upper stem leaf. Scale bar = 1 cm in E-G, I, and K; = 1 mm in A-D, H, and J.

Figure 3. Details of holotype of *Solidago macvaughii*: floral traits. **A.** Inflorescence of 98 cm tall shoot. **B.** Peduncles and bracts. **C.** Heads. Scale bar = 1 cm in A; = 1 mm in B and C.

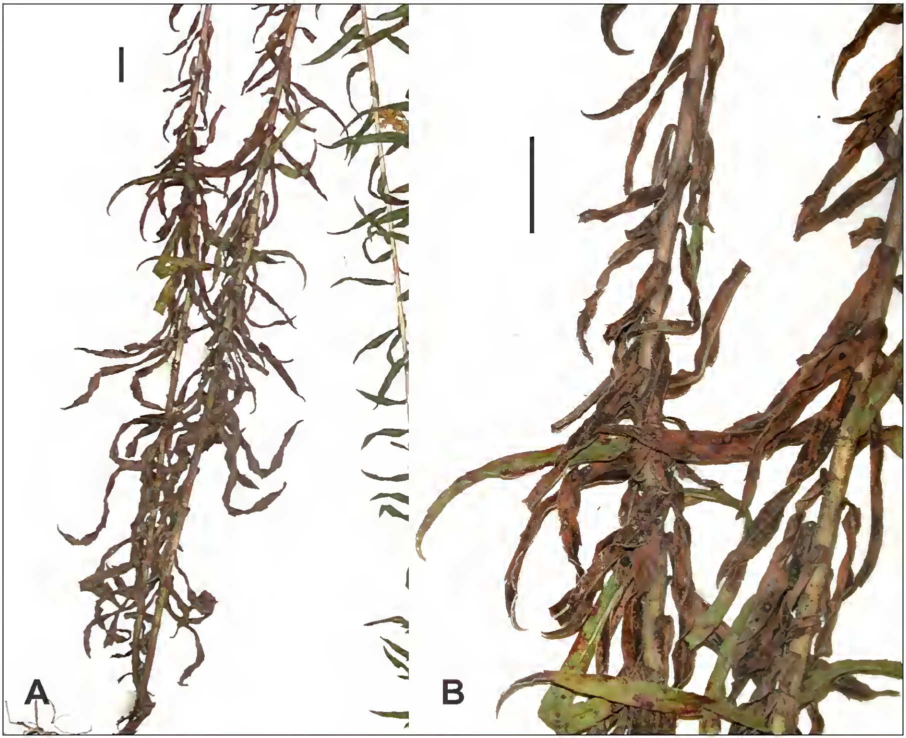

Figure 4. Wilted and twisted lower stem leaves of *Solidago tortifolia*, *Godfrey 67409* (MO) from Thomas Co., Georgia. **A.** Two lower stems with wilted brown leaves and a portion of a mid stem with green leaves. **B.** Distal lower stem leaves. Scale bars = 1 cm.

Additional collection: **MEXICO**. **Aguascalientes**. Mpio. Asientos, near Cienega Grande, grassy pastured flats along a watercourse, locally abundant, 2000 m, 8 Sep 1967, *McVaugh 23784* (MICH), as cited by Nesom (1989).

ACKNOWLEDGEMENTS

This work was supported by a Natural Sciences and Engineering Research Council of Canada Operating and Discovery Grants to the JCS. Joan Venn is thanked for her curatorial assistance with loans. The following herbaria are thanked for loaning specimens and giving permission to dissect heads of selected specimens: MICH, MO, TEX.

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Nesom, G.L. 2018. *Baccharis palmeri* (Asteraceae) lectotypified. Phytoneuron 2018-36: 1. Published 30 May 2018. ISSN 2153 733X

BACCHARIS PALMERI (ASTERACEAE) LECTOTYPIFIED

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109
guynesom@sbcglobal.net

In his collections of a *Baccharis* species from the vicinity of Cd. Durango, Edward Palmer separated the staminate and pistillate plants and gave them each a separate number -- 801 and 802, respectively. Greenman (1906) described the species as *B. palmeri* and cited both collection numbers as type material. The pistillate collection is chosen here as the lectotype, as the mature achenes and pappus more fully characterize the species. While it may be argued that a formal choice among syntypes of this nature hardly justifies formal publication (e.g., Turland 2013), it does call more pointed attention to the existence and value of these specimens.

Baccharis palmeri Greenm., Proc. Amer. Acad. Arts 41: 259. 1906. LECTOTYPE (designated here): **MEXICO**. **Durango**. City of Durango and vicinity, Apr-Nov 1896, *E. Palmer 802* (GH image!; isolectotypes: B, K image!, MICH image!, MO!, NY image!, S image!, UC!, US image!). Duplicates of Palmer 801 (GH, MO, NY, US -- images!).

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BATHYSANTHUS SINFOROSA (ASTERACEAE, ASTEREAE), A NEW GENUS AND SPECIES FROM SOUTHERN CHIHUAHUA

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109
guynesom@sbcglobal.net

ABSTRACT

Bathysanthus sinforosa Nesom, **gen. et sp. nov.** (tribe Astereae), is known only from the type collection from along the Rio Verde at the bottom of Barranca de Sinforosa, part of the Barrancas del Cobre system in southern Chihuahua. It is a low, lignescent herb with eglandular, epunctate stems and leaves, linear-lanceolate leaves with entire margins, paniculate-corymboid clusters of small heads each with 8–12 hermaphroditic flowers and no ray flowers, oblong-obovate, 2(-4)-nerved achenes, and a 1-seriate pappus without a short outer series. Its evolutionary relationships are not clear but the most indicative similarities are to *Solidago* (involucre, disc corolla morphology, pappus). Habit and details of the new species are illustrated by photos.

Study at CAS-DS has brought to light a collection of tribe Astereae from southern Chihuahua that does match any known species and does not fit within any known genus from North America (Nesom 2000; Strother & Brouillet 2006; Nesom, in prep.) or Central America (Pruski 2018). Nor is there a match from South America, where all genera of the tribe are accounted for (Nesom & Robinson 2007; Brouillet et al. 2009) except for one (Robinson & Funk 2014). It is recognized here as a previously undescribed species and genus.

Bathysanthus sinforosa Nesom, **gen. et sp. nov.** TYPE: **MEXICO**. **Chihuahua**. [Mpio. Morelos]: Sierra Madre Occidental, Barranca de Sinforosa, S side of Rio Verde at vado [ford] approx. 1 km downstream from base of burro trail from Rancho San Rafael and 6-7 km upstream (E) from confluence with Rio de Los Loera, 26° 38' N, 107° 11' W, 900 m, occasional herb to 1 m tall, in upper sandy areas of floodwash zone, 7 Jan 1996, *G.F. Hrusa 12595* with W. Dougherty (holotype: CAS, Fig. 1). On Google Earth, this locality is at ca. 26° 45' N, 107° 38' W, at an elevation of ca. 1450 feet.

Distinct as a genus in its combination of eglandular, epunctate stems and leaves, sparsely puberulent with minute (<0.1 mm), white hairs usually sharply bent at the apex, linear-lanceolate leaves with entire margins, heads each with 8–12 fertile hermaphroditic flowers, on filiform ultimate pedicels in corymboid clusters, involucres tiny (1.5–2 mm wide, 2.5–3.5 mm high), ray flowers absent, achenes oblong-obovate, flattened, 2–4-nerved, short-strigose and eglandular, and pappus 1-seriate without a short outer series.

Herbs (as characterized by the collector; basal parts not seen, presumably perennial). **Stems** erect, to 1 m tall, lignescent, minutely puberulent with tiny (lens) white hairs <0.1 mm long and bent near the apex. **Leaves** 1–5 cm long, 1.5–5 mm wide, blades narrowly oblanceolate to narrowly elliptic, basally attenuate to a petiolar region 2–7 mm long, margins entire, flat, apex acute, venation brochidodromous, sometimes with 1–2 pairs of slightly more prominent secondary veins arching from the midvein, surfaces and margins eglandular, not punctate or resinous, minutely and sparsely puberulent with tiny (lens) white hairs <0.1 mm long and bent near the apex, hairs slightly longer along the abaxial midvein. **Heads** in loose, terminal, paniculate-corymboid clusters, ultimate pedicels filiform, 2–7 mm long, each pedicel usually with 1–2 minute bracts, each head with 8–12 hermaphroditic flowers; involucres 1.5–2 mm wide, 2.5–3.5 mm long; phyllaries in 2–3 graduate series, oblong to oblong-lanceolate, glabrous, apex rounded, margins hyaline, sometimes slightly fimbriate, midzone green, gradually broadening distally but not to a distinct apical patch, midvein orange. **Corollas** glabrous, ca. 2 mm long, narrowly infundibular, tube 1 mm, limb 1 mm, cream? or white?, maturing purplish, abruptly broadened above the tube, lobe sinuses cut ca. 2/3 the length of the limb and of equal depth, lobes narrowly triangular, reflexing-coiling; style branches linear, ca. 0.5 mm long, collecting appendages ca. 1/2 the branch length, papillate, slightly widening distally but not clavate. **Achenes** ca. 1 mm long (immature), oblong-obovate, apparently flattened, 2(-4)-nerved, short-strigose, eglandular; pappus of ca. 20–25 fragile, terete bristles in 1 series about 4/5 the length of the floret, without a short outer series, bristle apex not dilated. Figures 1-6. Known only from the type collection.

The Sinforosa collection has rayless heads and the superficial aspect of a staminate plant of *Baccharis* or *Archibaccharis*, but the flowers have fertile ovaries (no dioecy), the achenes are flattened, and the pappus is of few and fragile bristles. It has the general habit of *Euthamia*, but *Euthamia* leaves are 3-nerved, punctate, and glabrous, the heads are radiate, phyllaries with a prominent green apical patch, achenes subterete, and the corolla lobes shorter. It is superficially similar to *Chrysothamnus* in its corymboid capitulescence, but *Chrysothamnus* leaves are punctate, involucres larger with indurate phyllaries, corolla lobe sinuses shallower, and pappus bristles in 2–3 series.

The flattened, 2-nerved achenes and 1-seriate pappus of the Sinforosa plant are similar to those of subtribe Conyzinae (Nesom 2006), but bracteate ultimate pedicels, phyllary morphology, and deeply cut corollas eliminate it from consideration there. It would be out of place in *Erigeron* sensu lato.

Within American Astereae, the combination in the Sinforosa plant of involucral morphology, corollas with deeply cut lobes, and 1-seriate pappus seems most suggestive of *Solidago*, but species there are characterized by leaf venation of small, angular-orthogonal areoles, radiate heads, non-purpling disc corollas, and subterete achenes. Even if the heads were radiate, it would not find a convincing fit within *Solidago* (Nesom 1993; Semple & Cook 2006; Semple 2017, 2018). The closely related, monotypic *Brintonia* E. Greene, of the southeastern USA, is eradiate, but morphological and molecular evidence place it outside of *Solidago* sensu stricto (Semple 2006).

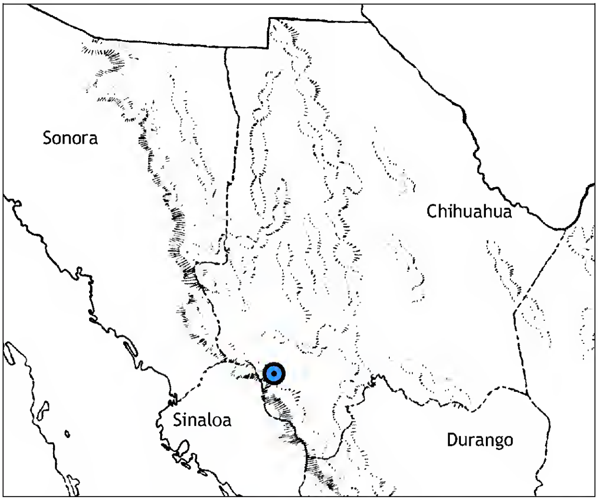

Figure 1. Distribution of *Bathysanthus sinforosa*.

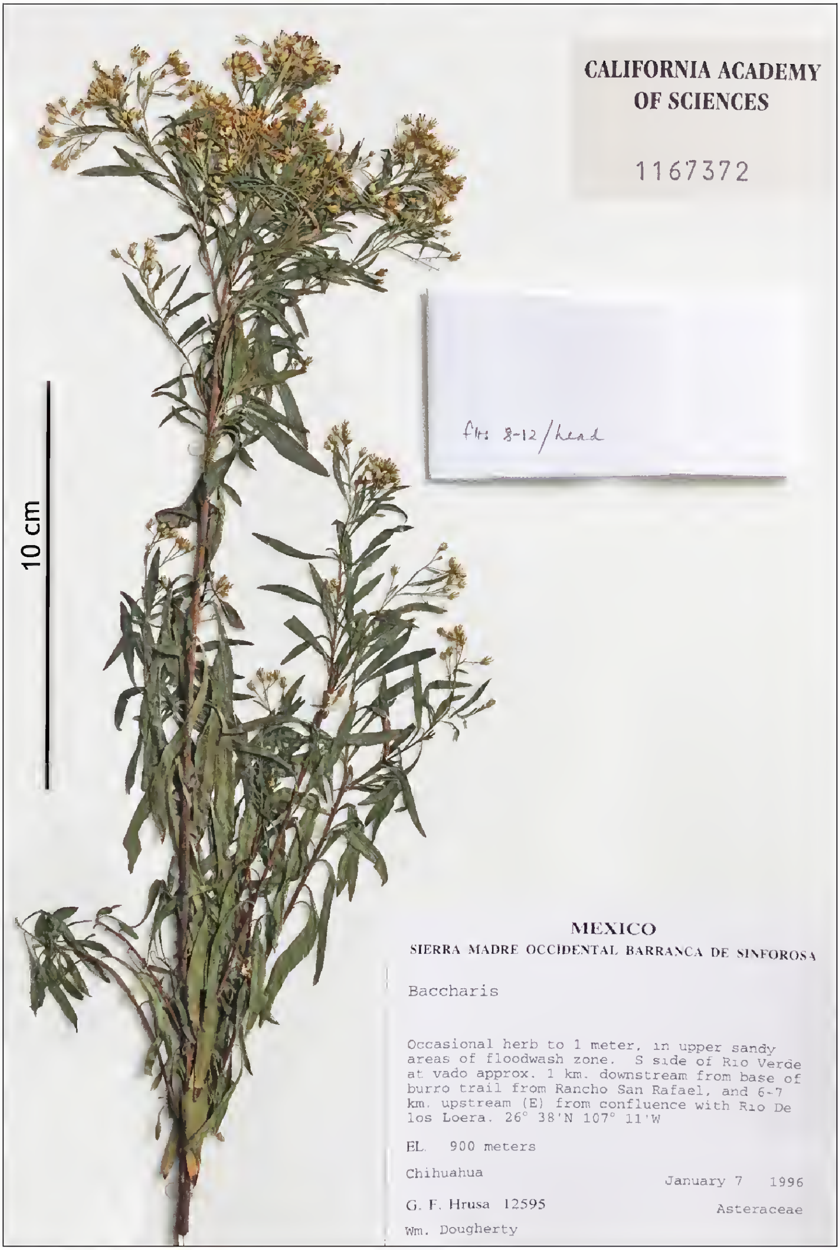

Figure 1. *Bathysanthus sinforosa,* holotype. Labels rearranged but to the same scale as the specimen as on the herbarium sheet.

Figure 2. *Bathysanthus sinforosa*, leaves slightly thickened, neither punctate nor resinous. The distinctive arching-downturned petioles perhaps reflect a partial wilt before pressing, but this feature shows most strongly only on the proximal leaves.

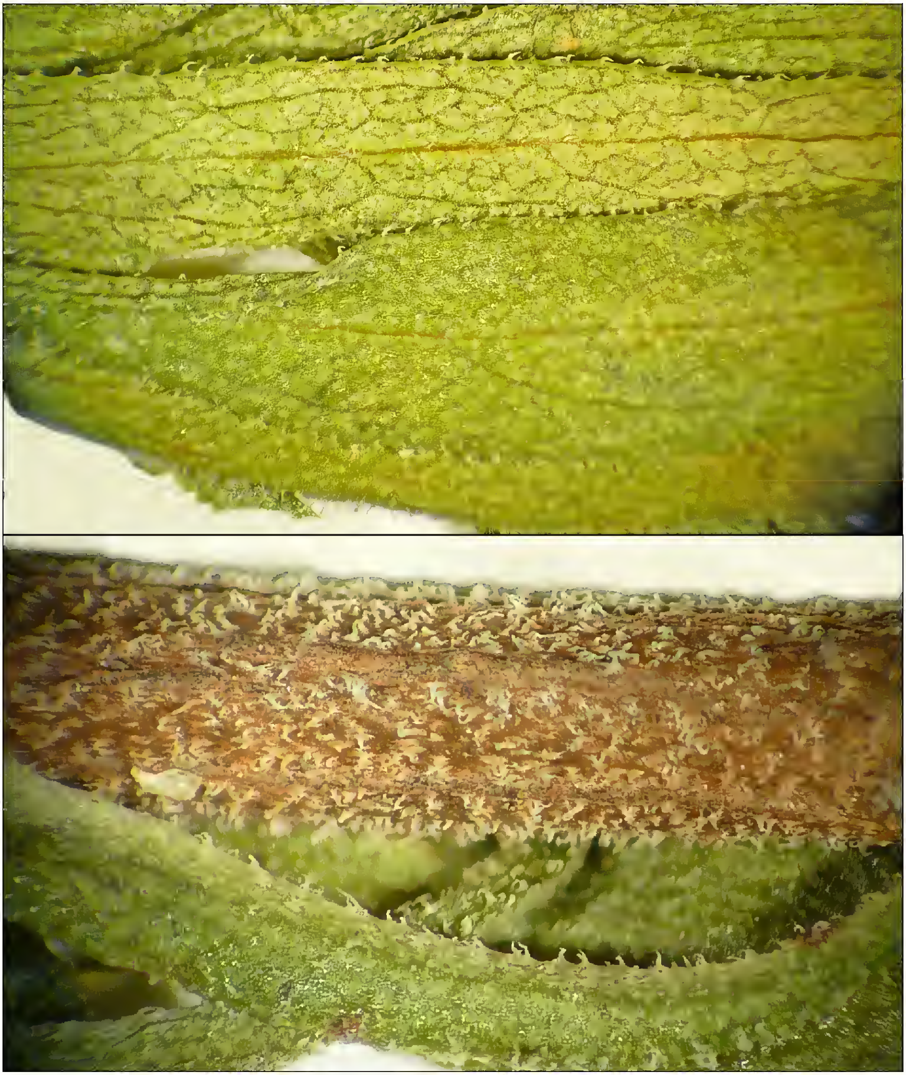

Figure 3. *Bathysanthus sinforosa*, detail of stems and leaves. Top: abaxial and adaxial surfaces with marginal cilia; brochidodromous venation evident, without typical *Solidago* areolation. Bottom: Stem vestiture.

Figure 4. *Bathysanthus sinforosa*, close views of capitulescence. The portion pointed to by the arrow also is shown in Fig. 5. Involucres are 2.5–3.5 mm long.

Figure 5. *Bathysanthus sinforosa*, close view of portion of capitulescence (see Fig. 4).

Figure 6. *Bathysanthus sinforosa*. Top: florets, maturing achenes. Bottom: involucres and florets. Florets become purplish with maturity, the fresh color not certain. Each head has 8–12 flowers; some buds do not open or else they may open progressively. Involucres are 2.5–3.5 mm long.

Barranca de Sinforosa is one of six distinct canyons along the western side of the Sierra Tarahumara that comprise the Barrancas del Cobre (Copper Canyon) system. At the site where the new species was collected, high points on the north and sides of Rio Verde are between 2900 and 4400 feet elevation. Videos and many photos of Barranca de Sinforosa can be found online.

The genus name is derived from Greek *bathys* (deep) and *anthus* (flower), alluding to its canyon bottom habitat. Saint Symphorosa (Italian and Spanish "Sinforosa") is a saint of the Catholic Church -- the name used here in apposition in reference to the collection locality.

ACKNOWLEDGEMENTS

Thanks to the staff at CAS-DS for their hospitality, to John Strother (UC) for comments on the generic placement of this collection, and John Semple for comments on the manuscript.

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Published 19 June 2018. ISSN 2153 733X

TAXONOMIC REVIEW
OF THE *SYMPHYOTRICHUM MORANENSE* GROUP (ASTERACEAE)

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109
guynesom@sbcglobal.net

ABSTRACT

Six species are recognized in the *Symphyotrichum moranense* group: *S. moranense* (Kunth) Nesom, *S. hintonii* (Nesom) Nesom, **Symphyotrichum turneri** (Sundberg & Jones) Nesom, **comb. nov.**, **Symphyotrichum purpurascens** (Sch. Bip. in Seem.) Nesom, **comb. nov.**, **Symphyotrichum chihuahuense** Nesom, **sp. nov.**, and **Symphyotrichum bimater** (Standl. & Steyerm.) Nesom, **comb. nov.** Each is endemic to Mexico, except for *S. bimater*, which occurs in Mexico and Guatemala. A key, brief descriptions, and distribution maps are provided. Lectotypes are designated for *Aster ehrenbergii, A. purpurascens*, and *A. trilineatus*.

Aster moranensis and its closest relatives are mostly restricted to Mexico –– *Aster bimater* was described as a species of Chiapas and Guatemala, extending the group into Central America. The plants are perennials with short, oblong, sessile leaves, solitary heads, graduate phyllaries, each with a distinctly demarcated, apical green patch and white-indurate base and a chromosome number based on x=5. As a previously unrecognized feature, the achenial Zwillingshaare of each of these species are minutely bifurcate at the apex. Variation patterns and nomenclature in the group have not been previously considered in detail in the context of the whole group. Six species are recognized in the treatment here.

Key to species

1. Plants arising from a small woody corm, without rhizomes; stems with bracteate peduncles 3–10 cm long; stems (distally) and/or phyllaries often minutely stipitate-glandular; leaf bases often subclasping.

  2. Stems strigose to short-villous with crinkly, thin-based hairs .... **Symphyotrichum purpurascens**
  2. Stems hispidulous to hirsute with stiff, thick-based hairs.

    3. Leaves hispid to hispid-hirsute on both surfaces; phyllaries minutely glandular, without other hairs; achenes short-strigose, if glandular then only at the base .... **Symphyotrichum bimater**
    3. Leaves densely hispidulous (abaxial), sparsely so to glabrate (adaxial); phyllaries densely hispidulous at least on the green portion; achenes glandular over the whole surface, without other hairs .... **Symphyotrichum chihuahuense**

1. Plants arising from rhizomes, without a corm; stems usually uniformly leafy up to the heads; stems and phyllaries eglandular; leaf bases not subclasping.

  4. Stems, leaf surfaces, and phyllaries completely glabrous; rays consistently blue to purple .... **Symphyotrichum turneri**
  4. Stems, leaf surfaces, and phyllaries hairy, rays usually white, rarely light blue to lavender.

    5. Stems and phyllaries densely villous with hairs 0.3–1 mm long .... **Symphyotrichum hintonii**
    5. Stems and phyllaries strigose with closely appressed hairs 0.1–0.5 mm long .... **Symphyotrichum moranense**

1. SYMPHYOTRICHUM MORANENSE (Kunth) Nesom, Phytologia 77: 286. 1994. *Aster moranensis* Kunth, Nov. Gen. Sp. (folio ed.) 4: 73. 1820 [1818]. *Diplostephium moranensis* (Kunth) Nees, Gen. Sp. Aster., 198. 1832. *Virgulus moranensis* (Kunth) Reveal & Keener, Taxon 30: 650. 1981. TYPE: **MEXICO**. [**Hidalgo**.] May-Jun 1803, *Humboldt and Bonpland s.n.*

(holotype: P-HBK image!, Fig. 3; Jones also cited a duplicate sheet at B). Protologue: "Crescit rarissime in montibus Mexicanorum inter Cerro Ventoso et fodinam Moran." The P sheet was cited by Jones (1984) as "lectotype;" it has a red "TYPE" printed label.

Aster lima Lindl. in DC., Prodr. 5: 230. 1836. *Virgulus lima* (Lindl. in DC.) Reveal & Keener, Taxon 30: 650. 1981. **TYPE**: **MEXICO**. The only collection data: "Mexico, *Mr. Graham*" --"Bentham" also is on the handwritten label (holotype: CGE photo!). Protologue: "29. A. LIMA (Lindl. adn. mss), caule scabro ... foliis scaberrimis ... ♃ in Mexico ex herb. Bentham."

Almut Jones studied the CGE specimen and obtained a photo (copy at TEX!); she noted (1984, p. 374) that "The taxon is conspecific with and the name goes in synonymy under [*Aster moranensis* Kunth]. The photo is small and the image dark, but the aspect, especially the evenly distributed, non-clasping cauline leaves, indicates that the plant belongs with *A. moranensis* sensu stricto. There is no specimen at BM or K (fide JSTOR Global Plants) that appears to be original material of *Aster lima* and no reference to it, apart from the protologue, apparently has been made in previous literature.

The collector, presumably George John Graham (1803-1878), is known to have collected in 1827-1829 around Mexico City, the mining districts of Tlalpujahua (northwestern Michoacan), and the Real del Monte (near Pachuca in Hidalgo) (Britten 1905).

Aster lindenii Sch. Bip. in Seem., Bot. Voy. Herald, 302. 1856. **TYPE**: **MEXICO**. **Veracruz**. Mirador, Feb 1839, *J.J. Linden 1170* (holotype: P image!; isotypes: G-2 sheets images!, GENT image!, K image!). The K specimen is mounted on a sheet with *Galeotti 2303*, collected in Veracruz in 1840. The P sheet was cited by Jones (1984) as lectotype.

Aster ehrenbergii Sch. Bip. in Seem., Bot. Voy. Herald, 302. 1856. **LECTOTYPE** (designated by Jones 1984, p. 375): **MEXICO**. **[Edo. Mexico?]**. "Mexico, pr. Regle," *C.A. Ehrenberg 791b* (P image!; isolectotype: CGE as cited by Jones 1984). Protologue: "Mexico, C. Ehrenberg! n. 791 et 947 in Herb. Reg. Berol." 791b (P) is mounted on a single sheet with *Ehrenberg 791a* (fragments) and *947* -- each of the three has a printed P label: 791a-SYNTYPE, 791b-ISOTYPE, and 947-SYNTYPE. In 1981 A.G. Jones annotated 791b as "isolectotype;" she (Jones 1984) later referred to "791" as the lectotype, without specifying 'a' or 'b' but surely she meant either the whole plant (b) rather than the fragments or else saw the fragments as part of a single 791 mounted on one sheet. *Aster ehrenbergii* is not included in the account by Jones and Hiepko (1981).

Perennial, producing scale-leaved rhizomes, sometimes with a thickened caudex but without a distinct corm. **Stems** to 9 dm tall, branching in distal half, moderately strigose with thin, short, antrorsely appressed to appressed-ascending hairs, eglandular. **Leaves** narrowly oblong-oblanceolate, entire, often clearly 3-nerved but sometimes weakly so or not at all, ascending, sessile, not clasping, the largest 1–2(–4) cm long, 2–3 mm wide, relatively even-sized or distinctly reduced in size distally but still closely and evenly spaced, surfaces glabrous to sparsely strigose, margins short-ciliate with hairs sharply bent upward. **Heads** solitary on equably leafy stems; involucres 10–14 mm wide; phyllaries strongly graduate and uneven in length, tightly appressed-erect and not spreading or reflexing, spinulose-apiculate, sparsely strigose, eglandular. **Ray florets** 18–25, usually white, coiling. **Achenes** densely strigose, eglandular. **Chromosome numbers** 2n=18? (Michoacan, *Venable & West 1884*, LL--"n=9II BLT 1976"; 2n=20 (Oaxaca, *Cowan 5000*, TEX--"n=10II clearly"). Figures 3 and 4.

Chihuahua, Durango, Sinaloa, Nayarit, Jalisco, Zacatecas, Aguascalientes, Guanajuato, Querétero, Michoacan, Guerrero, Mexico, Distrito Federal, Morelos, Tlaxcala, Hidalgo, Puebla, San Luis Potosí, Veracruz, Oaxaca; grassland, oak, pine, and open pine-oak woodlands, 1000–2750 m; Oct–Apr. Distribution in Fig. 2.

Outlying collections. **Chihuahua**. [Mpio. Chínipas]: Sierra Charuco, Rancho Byerly, rocky igneous slopes, pine-oak forest, 5000-5800 ft, 17-25 Apr 1948, *Gentry 8104* (UC). Mpio. de Urique: on the Batopilas to La Cieneguita road, 1.5 km S of jct to Urique, 7.8 air km E of Guapalayna, 14.9 air km

NE of Batopilas, open woodland with pines and oak, white igneous soil, 2045 m, 8 Mar 2017, *Spellenberg 15346* et al. (UNM image!, Fig. 4). **Durango**. Mpio. Mezquital: 32 km al W de Los Charcos por el camino a La Guajolota, bosque de pino-encino, 2040 m, 15 Mar 1985, *Gonzalez et al. 1649* (NY image, TEX). **Sinaloa**. [Mpio. Badiraguato]: Puerto a Tamiapa, steep clay slopes, oak forest, 4500 ft, 5 Mar 1940, *Gentry 5817* (ARIZ, NY image!).

Distinguished by its production of rhizomes, consistently strigose, eglandular vestiture, equably leafy stems, and strongly graduate phyllaries tightly appressed without a spreading or reflexing apex.

2. SYMPHYOTRICHUM HINTONII (Nesom) Nesom, Phytologia 77: 283. 1994. *Aster hintonii* Nesom, Phytologia 67: 342. 1989. **TYPE**: **MEXICO**. **Guerrero**. Distr. Mina: Aguazarca Filo, oak forest, 21 Dec 1937, *G.B. Hinton et al. 11316* (holotype: LL!; isotypes: NY image!, UC!).

Presumably perennial, base not seen. **Stems** 4–8 dm tall, densely hispid-pilose to villous with irregularly spreading to slightly retrorse, thin-walled hairs 0.3–1 mm long, eglandular. **Leaves** oblong-obovate to oblong, 12–32 mm long, 5–11 mm wide, slightly reduced upward, equably distributed to immediately beneath the heads, without a subclasping base. **Heads** solitary; involucres 10–14 mm wide; phyllaries short-villous to hirsute, eglandular, uneven in length and strongly graduate, the green apices often spreading to reflexing. **Rays** 25–30, white, coiling. **Achenes** hairy, eglandular (only immature achenes observed). Figure 5.

Guerrero; oak and oak-pine woods; 1400–2200 m; Nov–Jan. Distribution in Figure 1.

Additional collections examined. Guerrero. Mpio. Coyuca de Catalán: El Cundán, aprox. 101 km al SO de Cd. Altamirano a 9 km al NE de El Bálsamo (Puerto del Bálsamo o Filo Mayor), carr. Cd. Altamirano-Zihuatenejo, *Pinus-Quercus* perturbado, ladera de cerro de pendiente pronunciada, 1404 m, 27 Nov 2012, *Soto N. 20391* (MEXU image). Distr. Galeana: Teotepec, pine and oak forest, 2200 m, 26 Dec 1937, *Hinton et al. 11148* (LL, NY, UC). [Mpio. San Miguel Totolapan]: 81.5 km NE of Mex Hwy 200 jct in La Salitrera on the way (Mex 134) to Cd. Altamirano, edge of pine and dwarf oaks, 1530 m, 6 Dec 2003, *Yahara T. et al. 2972* (MEXU image, TEX).

Distinct in its equably leafy, densely hispid-pilose to villous stems, lack of glands, and strongly graduate, appressed phyllaries. It is similar to *Symphyotrichum moranense* in aspect and apparently sympatric with it, but the distinct vestiture and geographical coherence of *S. hintonii* support its recognition.

3. SYMPHYOTRICHUM TURNERI (Sundberg & Jones) Nesom, **comb. nov.** *Aster moranensis* var. *turneri* Sundberg & Jones, Bull. Torrey Bot. Club 113: 176. 1986. *Symphyotrichum moranense* var. *turneri* (Sundberg & Jones) Nesom, Phytologia 77: 287. 1994. **TYPE**: **MEXICO**. **Durango**. Mpio. Mezquital: W de Sta. Ma. de Ocotán, a lo largo de margenes de arroyo, vegetacion riparia enmedio de bosque de pino-encino, 16 Oct 1984, *M. Gonzalez 1518 con S. Acevedo* (holotype: TEX!, Fig. 5).

Perennial, rhizomatous, without a corm. **Stems** glabrous or occasionally with a few, appressed trichomes, leaf surfaces and phyllaries glabrous and not resinous. **Leaves** linear-oblong to linear-lanceolate, 1–3 mm wide, bases not at all subclasping, apices sharp-apiculate, margins evenly ciliate from base to tip with short, stiff, spreading (slightly antrorse-oriented) hairs. **Heads** solitary on equably leaf stems or bracteate peduncles 1.5–5 cm long; involucres 9–15 mm wide; phyllaries strongly unequal in length and imbricate, tightly appressed or sometimes more loosely so and spreading, inner with narrowly lanceolate apices, margins of outer ciliate with short, stiff, spreading hairs. **Rays** 20–27, blue to purple, coiling. **Achenes** strigose, eglandular. Figure 6.

Durango; oak and pine-oak woods, llanos, wet pastures, commonly along waterways, 2050–2750 m; Oct–Mar. Distribution in Figure 2.

Additional collections examined. **Durango**. Mpio. Durango: Arroyo "El Salto," al NW de El Salto, pino-encino, 2490 m, 16 Oct 1982, *Tenorio 2135* (MEXU image!). Mpio. Mezquital: 32 mi S of Durango on road to La Flor, small creek bed and N-facing slope, 7200 ft, 25 Dec 1984, *Ayers 521* (TEX); 74 km WNW of Huejuquilla El Alto, Jalisco, near Canoas, Durango, meadows with *Pinus* and *Quercus* on surrounding hills, 2720 m, 22 Oct 1983, *Breedlove 59195* (CAS, NY image, TEX); 2 km al N de La Guajolota, pastizal inundable, 2050 m, 8 Oct 1983, *Fernández N. 1877* (NY image); 22 km al NE de Los Charcos, bosque de encino-pino, 2750 m, 1 Nov 1982, *Gonzalez & Rzedowski 2338* (TEX); 6 km al N de La Guajolota, bosque de encino-pino, llano, 21 Oct 1985, *Solís 491* (TEX); ca. 8 km de San Francisco de Ocotán, Cueva de Violin, cercanias, llano, bosque de encino-pino, 17 Oct 1988, *Solís 1099* (TEX); 39 km al SW de Mezquital, encino-pino, 2520 m, 6 Mar 1985, *Tenorio 8073* (NY image); Mpio. Súchil: Reserva de Michilía, Arroyo El Temascal, bosque de encino-pino, 5 Oct 1985, *Alvarado 178* (TEX); Rancho Temazcal, potrero las Alazanas, ladera bosque de encino-pino, 12 Oct 1985, *Alvarado 329* (TEX); San Juan de Michis, potrero Labores, área sobrepastoreada, con *Acacia*, 16 Oct 1985, *Alvarado 346* (NY image); Rancho la Peña, Arroyo El Taray, bosque de encino-pino, 25 Nov 1985, *Alvarado 643* (TEX); Rancho La Peña (El Bebedero), bosque de *Quercus*, 7 Oct 1982, *Gonzalez E. 1130* (TEX).

Symphyotrichum turneri is tightly coherent in geography -- all collections are from southeastern Durango. Typical *S. moranense* grows in the same area (see citation, Mpio. Mezquital). As in *S. moranense*, plants of *S. turneri* are rhizomatous, without a corm, and the phyllaries are strongly unequal in length. The latter is distinct in its consistently blue ligules, narrower and mostly more loosely appressed phyllaries, glabrous stems and leaf surfaces, and spreading-ciliate leaf margins.

4. **SYMPHYOTRICHUM PURPURASCENS** (Sch. Bip. in Seem.) Nesom, **comb. nov.** *Aster purpurascens* Sch. Bip. in Seem., Bot. Voy. Herald, 303. 1856. **LECTOTYPE** (designated here): **MEXICO**. **Hidalgo**. Prov. Real del Monte, *C.A. Ehrenberg 474* (P image!, Figs. 7 and 8). Protologue: "C. Ehrenberg! n. 474 in Herb. Reg. Berol." A handwritten label on the P sheet by J.H. Beaman in 1963 notes that "This probably should be designated as the lectotype, since the holotype in Berlin was almost certainly destroyed." Annotated by A.G. Jones in 1983 as "? ISOTYPE or LECTOTYPE, as designated by Beaman of *Aster purpurascens* ... = *A. moranensis* ... ," but the choice apparently was never effected by publication. *Aster purpurascens* is not included in the account by Jones and Hiepko (1981).

Aster trilineatus Sch. Bip. ex Klatt, Leopoldina 20: 91. 1884. *Symphyotrichum trilineatum* (Sch. Bip. ex Klatt) Nesom, Phytologia 77: 293. 1994. **LECTOTYPE** (designated here): **MEXICO**. **Oaxaca**. [Distr. Ixtlán, Mpio. Santiago Laxopa]: Lachopa, Jun 1842, *F.M. Liebmann 519*/11004 (C 10006960 image!, Fig. 9; isolectotypes: C 10006961 image!, P image!). Protologue: "leg. Liebmann Nr. 519. Herb. Hort. Bot. Hafn." without specifying which sheet. C 10006960 was labeled by Scott Sundberg in 1986 as "lectotype," C 10006961 as "isolectotype," but the choice apparently was never effected by publication.

Perennial, without scale-leaved rhizomes. **Stems** sparsely strigose with thin hairs to short-villous, commonly sparsely to densely stipitate-glandular distally. **Leaves** narrowly oblong to oblong-lanceolate, the largest 8–30 mm long, 1–3 mm wide, mostly even-sized up to the peduncles, 1- or 3-nerved, sessile, base often subclasping, surfaces glabrous to strigose or sparsely to short-villous, sometimes (uncommonly) stipitate-glandular, margins entire, ciliate with thin, sharply upward-bent hairs. **Heads** on bracteate peduncles 3–12 cm long, solitary or in a loose, corymboid capitulescence; involucres (8–)10–14 mm wide; phyllaries weakly imbricate, weakly unequal in length, strigose-hirsute to strigose, often glandular, distal half (green patch) usually spreading or reflexing. **Rays** white, 20–25, coiling. **Achenes** sparsely strigose, glandular or eglandular. **Chromosome number** 2n=10 (Guatemala, *King 3423*, as cited below). Figures 7–10.

Nuevo León, Tamaulipas, San Luis Potosí, Guanajuato, Hidalgo, Tlaxcala, Puebla, Distrito Federal, Mexico, Guerrero, Oaxaca, Chiapas, Guatemala (Dept. Huehuetenango); open woods with various mixtures of pine and oak, rarely grassy flats, 1500–2850 m; all year. Distribution in Figure 1.

At least some populations of *Symphyotrichum purpurascens* in the area of Picacho San Onofre (Sierra Peña Nevada), Nuevo León, include plants with typically strigose stems and leaves as well as plants with short-villous to hirsute vestiture similar to that of *S. bimater* (e.g., *Villarreal 4896*, TEX; *Wells & Nesom 411*, TEX). Two stems collected from a single plant (*Nesom 7103*, TEX; Fig. 10) have hirsute stems and leaves. From around La Encantada just north of Picacho San Onofre, *Patterson 5853* (TEX) and *Patterson 5860* (TEX) have strigose vestiture, while *Patterson 5890* (TEX) has hirsute vestiture.

One plant of *Symphyotrichum purpurascens* from a San Luis Potosí collection has achenes densely stipitate-glandular without other hairs; another plant on the same sheet has achenes sparsely strigose and stipitate-glandular (NW of Guadalcazar, just SE of Realjo, *Breedlove 63349*, TEX).

A few plants from Edo. Mexico on the north and east sides of Distrito Federal are rhizomatous but otherwise show morphology of *Symphyotrichum purpurascens*. These seem likely to be hybrids with *S. moranense*: Mpio. Texcoco, *Ventura 841* and *1316* (MEXU images); Mpio. Tepotzotlán, *Rzedowski 31448* (ASU image); Mpio. Ixtapaluca, *Rzedowski 34805* (MEXU image).

Outlying collections. **GUATEMALA**. **Dept. Huehuetenango**. Ca. 6 mi S of Huehuetenango, hills along Natl. Rte 9N, 18 Jul 1960, *King 3423*, voucher for chromosome count of n=5 (TEX, UC); Salcaja, near Quezaltenango, 7500 ft, 1 Jul 1963, *Nickerson s.n.* (TEX).

5. **SYMPHYOTRICHUM CHIHUAHUENSE** Nesom, **sp. nov.** **TYPE**: **MEXICO**. **Chihuahua**. [Mpio. Namiquipa]: Culebra Mts., 18 Aug 1936, *H. LeSueur 981* (holotype: TEX!, Fig. 11; isotypes: GH!, TEX!).

Similar to *Symphyotrichum purpurascens* in its cormose, non-rhizomatous base, cauline leaves with subclasping base, white rays, glandular stems and achenes, and long-caudate inner phyllaries but distinct in its few-bracteate peduncles 3–6(–8) cm long, evenly hispidulous stems, leaves (abaxially; glabrous adaxially), and phyllaries, and achenes with no vestiture except short viscid hairs.

Perennial, arising from a woody corm, without rhizomes. **Stems** 20–35 cm tall, sparsely to moderately and evenly hispidulous to hirsute with spreading to antrorse, sharp-pointed hairs, stipitate-glandular distally. **Leaves** oblong-lanceolate to lanceolate or narrowly elliptic, mostly 10–20 mm long, 1–4 mm wide, densely hispidulous abaxially, sparsely so to glabrate adaxially, base subclasping, apex sharp-apiculate, margins regularly ciliate with stiff, sharp-pointed, antrorse-ascending hairs. **Heads** on bracteate peduncles 3–8 cm long; involucres 7–12 mm wide, inner phyllaries 5–8 mm long; phyllaries slightly uneven in length, weakly imbricate, at least the green portion densely hispidulous, eglandular or minutely stipitate-glandular, distal half (green patch) usually spreading or reflexing. **Rays** 18–24, white, coiling. **Achenes** with short viscid hairs over all the surface, without other hairs except near the apex, mature size not seen. Figure 11.

Chihuahua, Durango; grassland, oak-pine woods; ca. 1800–2500 m; Jun–Sep. Distribution in Figure 1.

Additional collections examined. **Chihuahua**. [Mpio. Chihuahua]: Plains at the base of the Sierra Madre, Sep 1887, *Pringle 1538* (GH). Mpio. Guerrero: Distr. Guerrero, Arroyo Ancho, dry plateau above the Arroyo, 4 Jun 1929, *Mexia 2588* (UC). [Mpio. Ignacio Zaragoza]: Culebra Mts, 18 Aug 1936, *LeSueur 981* (GH, LL, TEX). [Mpio. Madera]: Chuchuichupa, 16 Jun 1891, *Hartman 702* (GH, US). **Durango**. [Mpio. Durango]: 6 km N of Hwy 40 at El Soldado along side road to Otinapa, flat ridge with *Pinus*, *Quercus*, *Juniperus*, and *Arctostaphylos*, 2130 m, 25 Aug 1986, *Breedlove 63148* (MEXU image, TEX).

There is a apparent geographic disjunction between the Chihuahua and Durango populations, but the Durango plants are a close match for those in Chihuahua.

6. SYMPHYOTRICHUM BIMATER (Standl. & Steyerm.) Nesom, **comb. nov.** *Aster bimater* Standl. & Steyerm., Publ. Field Mus. Nat. Hist., Bot. Ser. 23(3): 141. 1944. *Virgulus bimater* (Standl. & Steyerm.) Reveal & Keener, Taxon 30: 650. 1981. **TYPE**: **MEXICO**. **Chiapas**. [Mpio. Cintalpa]: Hillsides near Hacienda Monserrate, May 1927, *C.A. Purpus 12091* (holotype: F image!).

Perennial, arising from fibrous-rooted corms, without rhizomes. **Stems** erect 12–18 inches tall, branches ascending at least from midstem, stems sparsely to moderately hirsute to hirsute-villous to hispid or hispid-hirsute with spreading to slightly deflexed hairs, sparsely but evenly stipitate-glandular. **Leaves** narrowly oblong to linear-lanceolate, 1- or 3-nerved, proximal mostly 15–30 mm x 2–4 mm, abruptly becoming much smaller or mixed with much smaller, 3–7 mm x 1–2 mm, sessile, base sometimes subclasping, both surfaces eglandular or sparsely stipitate-glandular, densely and evenly hispid to hispid-hirsute with thick-based, sharp-pointed hairs, margins entire, spreading-ciliate with thick-based hairs. **Heads** on few-bracteate peduncles 3–7 cm long, essentially solitary in a loose cluster; involucres 8–10 mm wide 5–6 mm high; phyllaries weakly imbricate, weakly unequal in length, minutely stipitate-glandular, without other hairs. distal half (green patch) usually spreading or reflexing. **Rays** 16–25, white, coiling. **Achenes** oblong-fusiform, 2.5–3 mm long, 6–8-nerved, sparsely short-strigose, minutely stipitate-glandular basally.

Oaxaca, Chiapas, and Guatemala (Huehuetenango: see Standley & Steyermark 1944, Pruski 2018); pine-oak woods, sometimes mixed with *Liquidambar*, *Nyssa*, *Acacia*, *Arbutus*, and others, ravines, steep slopes, grassy openings; 1000–2150 m; May–Dec. Distribution in Figure 1.

Symphyotrichum bimater is similar in habit and general aspect to *S. purpurascens* (without rhizomes, glandular, long peduncles, subclasping leaf bases, phyllaries weakly graduate and loose) but consistently distinct in its densely hispid to hispid-hirsute adaxial and abaxial leaf surfaces. Typical *S. purpurascens* in Chiapas occurs only in a single area (Fig. 2) of six essentially contiguous municipios (Amatenango del Valle, Comitán de Dominguez, Las Rosas, San Cristobal Las Casas, San Juan Chamula, Tenejapa, Teopisca) in a tight cluster and within the wider distribution of *S. bimater*.

Evidence at hand suggests that *Symphyotrichum purpurascens* and *S. bimater* are sympatric in Guatemala and at least in part of Chiapas, and there appears to be little morphological intergradation between them. One collection from Mpio. San Miguel Chimalapa in Oaxaca, from a locality near two of typical *S. bimater* (see citations), is identified here as *S. bimater* although it has only a few spreading hairs on leaf surfaces, perhaps reflecting gene exchange with *S. purpurascens*: Rio Escondido (Arroyo Baúl), 1 Jul 1986, *Maya J. 3501* (TEX); a duplicate (MEXU image) is prominently hispid-hirsute. In a small area of Nuevo León, vestiture variation in *S. purpurascens* includes plants that might be identified as *S. bimater* in a typological system (see comments above) –– in contrast, two evolutionary entities appear to be present in the Chiapas region.

Additional collections examined. **GUATEMALA**. **Dept. Huehuetenango**. Aguacatán road, 10-15 km E of Huehuetenango, ca. 1900 m, Jan 1941, *Standley 81931, 82065* (F, as cited by Standley and Steyermark 1944). **MEXICO**. **Chiapas**. Mpio. Cintalapa: Hacienda Monserrate, Sep 1923, *Purpus 9071* (NY image, UC); Hacienda Monserrate, Sep 1923, *Purpus 9304* (DS, UC); ravines and hillsides near Monserrate, rare, Jun 1930, *Purpus 10059* (UC; a NY sheet [image] of 10059 gives "open pine and oak forest, near Fenix" as the locality). Mpio. Jitotol: 6-8 km W of Jitotol, adjacent to large double waterfall, steep slopes with *Pinus, Quercus,* 1450 m, 16 Dec 1971, *Breedlove 23287* (DS); 5 km SE of Jitotol along road to Bochil, open forest with *Pinus, Quercus, Nyssa, Liquidambar,* and *Brunellia,* 1600 m, 11 Jul 1972, *Breedlove 26149* (DS), *Breedlove 26150* (NY image!); 5 mi S of Pueblo Nuevo Solistahuacán along road to Jitotol, slope with *Quercus, Pinus,* and tree legumes, grassy openings, 5300 ft, Sep 1971, *Thorne & Lathrop 41389* (DS). Mpio. La Independencia: 6-10 km NNE of La Soledad along logging road from Las Margaritas to Campo Alegre, slope with pine and oak, 1600 m, 1 Jul 1981, *Breedlove 51280* (CAS); above and SW of La Soledad on road to Las Margaritas, rocky slope with *Pinus*, *Acacia*, and *Quercus*, 1525 m, 29 Sep 1981, *Breedlove 52113* (CAS). Mpio. La Trinitaria: Near Colonia Carmen Xhan and the ruins of Chinkultik, pine-oak forest, 1525 m, 9 Aug 1981, *Breedlove 52013* (CAS). Mpio. San Juan Cancuc: 4 km from La Gloria, pine-oak woodland, 3900 ft, 6 Jul 1990, *Brett 70* (CAS); 5 km N of Cancuc, pine-oak woodland, 3200 ft, 1 Aug 1990, *Brett 152* (CAS); Saka Te'el, 2 km abajo del pueblo de Cancuc, 3800 ft, 12 Sep 1987, *Sántiz C. 299* (CAS); Sakil Tontik, 6 km al NE del poblado, 3500 ft, 7 May 1988, *Sántiz C. 660* (CAS, LL, NY image). Mpio. Teopisca: 5 km WSW of Teopisca on small dirt road, slopes with *Pinus*, *Quercus*, *Arbutus*, 1750 m, 27 Nov 1976, *Breedlove 41867* (DS, LL). Mpio. Totolapa: 6-8 km W of Teopisca on the side of Cerro Chenek'ultik, slopes with *Pinus* and *Quercus*, 2150 m, 16 Aug 1972, *Breedlove 27059* (DS). Mpio. Venustiano Carranza: 3 mi S of Aguacatenango along road to Pinola Las Rosas, steep slope with *Quercus* and *Pinus*, 5600 ft, 25 Jun 1965, *Breedlove 10549* (DS, LL, NY image); 5 mi S of Aguacatenango along road to Pinola Las Rosas, steep slope with *Quercus* and *Pinus*, 1725 m, 17 Oct 1980, *Breedlove 46402* (CAS). **Oaxaca**. Mpio. San Miguel Chimalapa: Cerrito al N de El Trebol, ca. 1.5 km al NE de Benito Juárez, ca. 39 km en línea recta al N de San Pedro Tapanatepec, 1000 m, bosque de encino con pino, pendiente fuerte arenosa, 1 Jul 1985, *Maya J. 1838* (MEXU image, TEX); cañada al N de Cerro de la Leona (cerro al NE de Cerro Quetzal y ca. 7-9 km al N de Cerro Guayabitos), ca. 46 km in línea recta al N de San Pedro Tapanatepec, 1300 m, laderas arenosas en bosque de pino-encino, 13-14 Jul 1986, *Maya J. 3599* (MEXU image, TEX).

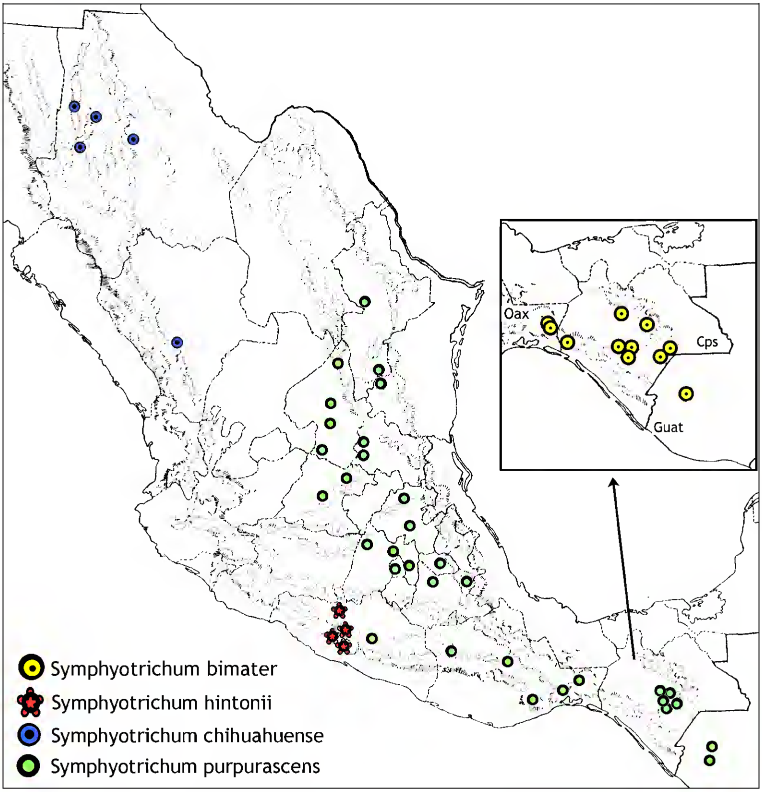

Figure 1. Distribution of *Symphyotrichum purpurascens*, *S. chihuahuense*, *S. hintonii*, and *S. bimater*. Municipios for the tight cluster of *S. purpurascens* populations in Chiapas are cited in the text.

Generic placement

Jones (1980, as noted above) placed *Aster moranensis* with other *x*=5 taxa of *Aster*. Reveal and Keener (1981) also included it (along with *A. bimater* and *A. lima*) among the virguloid asters, although Semple and Brouillet (1980a, 1980b) did not. Sundberg and Jones (1986) placed *A. moranensis* in subg. *Virgulus*, and in 1989, I reckoned (Nesom 1989) that it was closely related to *A. oblongifolius* Nutt. of subg. *Virgulus* (also *x*=5).

Molecular data of Morgan and Holland (2012) place *Aster moranensis* with either the "Almutaster-Psilactus-Virgulus clade" (the APV clade; based on ITS + ETS data) or the "Symphyotrichum clade" (based on 5S data) of subtribe Symphyotrichinae. The chromosome number and morphology of *A. moranensis* align with the subg. *Virgulus* species. Morgan and Holland (p. 828) concluded that "The ITS + ETS, cytological, and morphological evidence indicate that the ancestry of *S. moranense* and *S. trilineatum* is from subg. *Virgulus* and other members of the APV clade; the conflicting 5S results might then be explained by introgression."

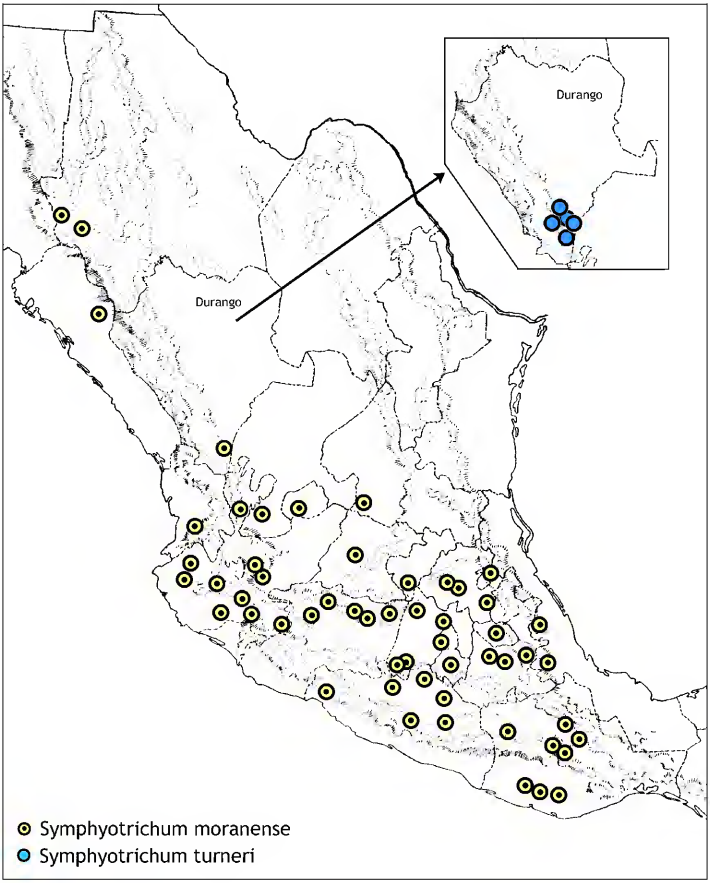

Figure 2. Distribution of *Symphyotrichum moranense* and *S. turneri*.

Figure 3. *Symphyotrichum moranense*, holotype.

Asteraceae

15346
Coll: R. Spellenberg, T. Lowrey, W. Anderson
8 Mar 2017

Mexico, Chihuahua, Mpio. de Urique., on the Batopilas to La Cieneguita road 1.5 km S of the junction to Urique, 7.8 air km E of Guapalayna, 14.9 air km NE of Batopilas, 27°09'818" N, 107°49'064" W,

Elev. 2045 m

Gently sloping bench on generally W-facing steep slope on white igneous soil, in open woodland with pines, *Quercus viminea, Q. tarahumara.*

Plants to 90 cm tall, with wand-like stems, rays white. disks yellow. Not common, scattered here, not noted elsewhere.

REMOVE THIS NOTE Collection consists of six duplicates Please send identification to Rich at *spelly@zianet com* whenever you have it One duplicate is held at NMC

Figure 4. *Symphyotrichum moranense*. Southeastern Chihuahua, *Spellenberg et al. 15346* (UNM). Note presence of rhizomes.

Figure 5. *Symphyotrichum hintonii,* isotype (NY). None of the collections of *S. hintonii* includes the base, but its similarity to *S. moranense* and *M. turneri* in other features suggests that it is rhizomatous.

Figure 6. *Symphyotrichum turneri,* holotype. Note presence of rhizomes.

Figure 7. *Symphyotrichum purpurascens* (*Aster purpurascens*, from the lectotype).

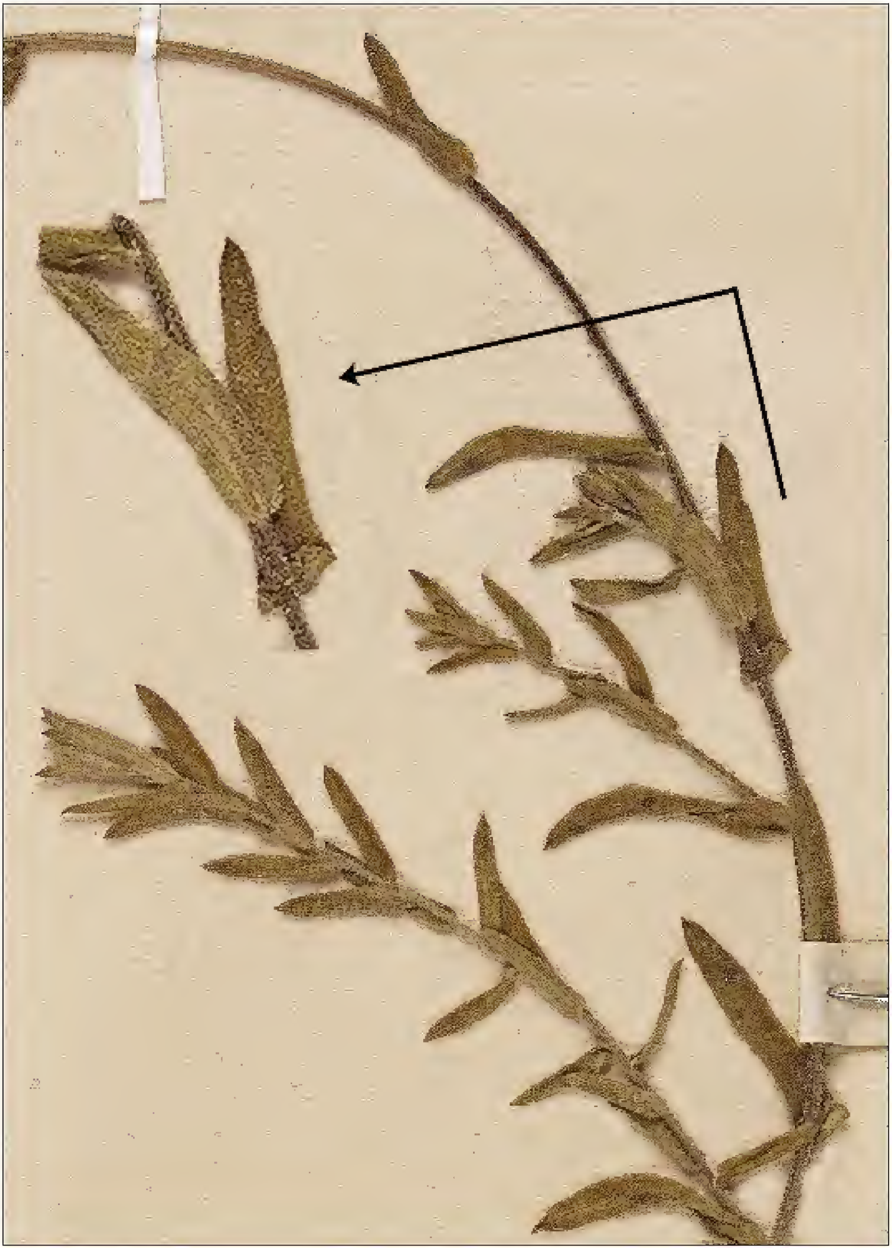

Figure 8. *Symphyotrichum purpurascens* (from the lectotype of *Aster purpurascens*). Subclasping leaf bases.

Figure 9. *Symphyotrichum purpurascens* (lectotype of *Aster trilineatus*). As noted by Sundberg's annotation, a line drawing of the left stem, from the F.W. Klatt herbarium, is filed at NY (copy at TEX!).

PLANTS OF MEXICO
ASTERACEAE

Aster trilineatus Schultz-Bip. ex Klatt
det. G Nesom, 1989

Nuevo Leon. Mpio. Zaragoza.
Road NW from "Puerto Pinos" on N side of
Pena Nevada toward Joya de San Diego.
Ca. 1 mi NW of Puerto Pinos. NE-facing
slope, area of pine-oak-madrono with
dense, low shrubs (abundant Ceanothus).

2840 m; 24 49'N, 99 52'W
Sprawling herbs in brush, to 0.5 m tall.
Rays white.

23 Aug 1989
Guy Nesom 7103
with John Norris

UNIVERSITY OF TEXAS HERBARIUM (TEX-LL)

Figure 10. *Symphyotrichum purpurascens.* Nuevo León, *Nesom 7103* (NY).

Figure 11. *Symphyotrichum chihuahuense*, holotype. Cormoid base, without rhizomes.

585307

California Academy of Sciences

DUDLEY HERBARIUM

Nº 656722

STANFORD UNIVERSITY

PLANTS OF CHIAPAS, MEXICO

Aster moranensis HBK.

Flowers white.
Slopes with Pinus and Quercus 6 - 8 km
west of Teopisca on the side of Cerro
Chenek'ultik. Municipio of Totolapa.

Elevation 2150 m

D. E. Breedlove 27059 16 August 1972

Herbarium, University of Waterloo

Virgulus moranensis (H.B.K.) Reveal & Keener
(syn. *Aster moranensis* H.B.K.)
Det.: John. C. Semple 1987

Figure 12. *Symphyotrichum bimater*, representative collection. Cormoid base, without rhizomes.

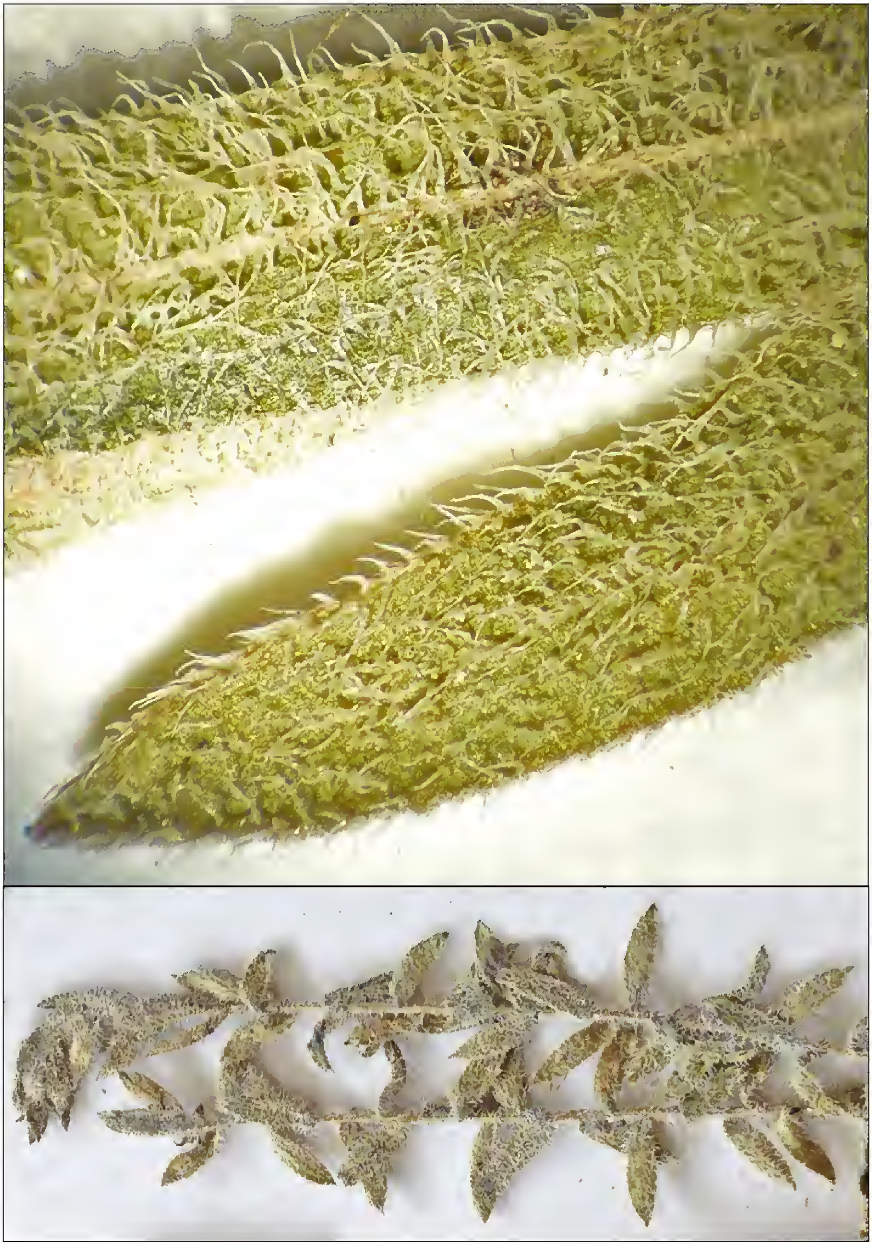

Figure 13. *Symphyotrichum bimater*, representative leaf vestiture. Upper photo shows abaxial (raised midvein) and adaxial surfaces.

ACKNOWLEDGEMENTS

Many of the mapped records are from study of collections from herbaria during floristic studies at the University of Texas, ca. 1987-1995. I'm grateful for the opportunity for recent study at BRIT-SMU-VDB, CAS-DS, TEX-LL and UC-JEPS. Thanks to John Strother (UC) for many helpful edits.

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MIMOSA MONCLOVENSIS (LEGUMINOSAE), A NEW NAME FOR A TAXON IN SER. *QUADRIVALVES* IN THE SOUTHERN USA AND NORTHEASTERN MEXICO

ROSAURA GRETHER
Departamento de Biología, División CBS
Universidad Autónoma Metropolitana-Iztapalapa
09340 México, D.F., México
*Author for correspondence: rogg@xanum.uam.mx

MARCELO F. SIMON
Embrapa Recursos Genéticos e Biotecnologia
Brasília, D.F. 70770-917, Brazil
marcelo.simon@embrapa.br

ABSTRACT

As a result of the preparation of a treatment of the genus *Mimosa* (Leguminosae) for the Flora of North America North of Mexico, as well as from a revision of species included in the sections and series of *Mimosa* for a phylogenetic study of the genus, a new name at specific rank is proposed for a taxon in ser. *Quadrivalves.* The nomenclatural status of other taxa in this series is discussed as well.

RESUMEN

Como resultado de la preparación de un tratamiento del género *Mimosa* (Leguminosae) para la Flora de Norteamérica al Norte de México, así como de una revisión de las especies incluidas en las secciones y series de *Mimosa* para un estudio filogenético del género, se propone un nombre nuevo a nivel específico para un taxon de la serie *Quadrivalves.* El estatus nomenclatural de otros taxa de esta serie se discute también.

As a result of the preparation of a treatment of the genus *Mimosa* L. (Leguminosae) for the Flora of North America North of Mexico, as well as from a revision of species included in the sections and series of *Mimosa* for a phylogenetic study of the genus, a new name at the specific rank is proposed for *M. subinermis* (S. Wats.) B.L. Turner, a member of *Mimosa* ser. *Quadrivalves*, as this is a later homonym of *M. subinermis* Benth.

The genus *Mimosa* in the Flora of North America includes 20 species, 8 of them members of *Mimosa* sect. *Batocaulon* DC. ser. *Quadrivalves* Barneby. Series *Quadrivalves* was established by Barneby (1991) to include the whole genus *Schrankia* Willd., which previously had been maintained apart from *Mimosa* because of its tetragonal, unarticulated legumes; the fruits are apparently tetragonal because the margin usually is as wide as or wider than the valves; however, this morphology also occurs in diverse groups of *Mimosa*, such as in some species of ser. *Leiocarpae* Benth., *Pachycarpae* Benth., and *Stipellares* Benth. All known taxa of *Schrankia* were incorporated by Barneby as varieties of *M. quadrivalvis* L. We agree with the treatment of *Schrankia* within *Mimosa*, while we disagree in considering this group of taxa as varieties of a single species (Grether 2000; Simon et al. 2011).

Several infraspecific combinations under *Mimosa quadrivalvis* proposed by Barneby (1991) have been replaced by new names at specific rank, such as *M. candollei* R. Grether, *M. robusta* R. Grether, and *M. rupertiana* B.L. Turner; some other varieties of *M. quadrivalvis* have been recognized at specific rank and transferred from *Leptoglottis* DC., *Morongia* Britton, or *Schrankia*, such as *M. hystricina* (Small) B.L. Turner, *M. latidens* (Small) B.L. Turner, *M. nuttallii* (DC.) B.L. Turner, and *M. subinermis* (S. Wats.) B.L. Turner (Grether 2000; Turner 1994a, 1994b, 1995).

Concerning other taxa in ser. *Quadrivalves*, the oldest name under *Mimosa* has been recovered: *M. tetragona* Poir. 1810 (Grether 2000), or proposed to be placed in use again: *M. microphylla* Dryand. 1797 and *M. roemeriana* Scheele 1848 (R. Grether, unpubl. manuscript).

Mimosa subinermis (S. Wats.) B.L. Turner (1994) is a later homonym of *Mimosa subinermis* Benth. (Bentham 1841). Barneby (1991) placed *Schrankia subinermis* S. Wats. in the synonymy of *M. quadrivalvis* var. *nelsonii* (Britton & Rose) Barneby, the latter based on *Leptoglottis nelsonii* Britton & Rose. We consider that this taxon should be treated at specific rank. The combination *M. nelsonii* is unavailable, as this name was published by Robinson (1898) for another Mexican taxon, which was placed at infraspecific rank as *M. tricephala* Schltdl. & Cham. var. *nelsonii* (B.L. Rob.) Chehaibar & R. Grether (Grether 2000). Therefore, a new name is proposed to replace the later homonym *Mimosa subinermis* (S. Wats.) B.L. Turner.

Mimosa monclovensis R. Grether & M.F. Simon, **nom. nov.** Replaced name: *Mimosa subinermis* (S. Wats.) B.L. Turner, Phytologia 76: 424. 1994. Basionym: *Schrankia subinermis* S. Wats., Proc. Amer. Acad. Arts 17: 350. 1882. *Leptoglottis subinermis* (S. Wats.) Britton & Rose, N. Amer. Fl. 23(3): 141. 1928, non *Mimosa subinermis* Benth., J. Bot. (Hooker) 4: 385. 1841. **TYPE**: **MEXICO**. **Coahuila**. [Mpio. Monclova]: mountains 24 mi N of Monclova, 1–6 Sep 1880, *E. Palmer 302* (holotype: GH 00063784; isotypes: G 00367736, K 000082477, NY 00003296, PH 00022629, US 00000782, US 00000783, YU 001420).

Mimosa quadrivalvis L. var. *nelsonii* (Britton & Rose) Barneby, Mem. New York Bot. Gard. 65: 302. 1991. *Leptoglottis nelsonii* Britton & Rose, N. Amer. Fl. 23(3): 142. 1928. **TYPE**: **MEXICO**. **Coahuila**. [Mpio. Sabinas]: Sabinas, 21 May 1902, *E.W. Nelson 6230* (holotype: US 00000770; isotypes: GH 00065825, NY 00002413, NY 00002414).

Mimosa monclovensis is characterized by leaves with 9–14 pairs of linear leaflets per pinna, capitula 10–12 mm in diam. with up to 40 flowers, corolla lobes 1/4–1/3 of corolla length, and sessile pods, (4.5–)7–9(–10) cm x 4–4.5(–5) mm, apex rostrate, the rostrum 5–10 mm. This species grows in dry sandy or gravelly places, at elevations of 100–200 m, in Texas and at 600–650 m in northeastern Mexico (Coahuila). It is clearly distinguished from *M. latidens*, because the latter produces leaves with 6–9 pairs of linear-oblong to oblong leaflets per pinna, capitula 10–15(–18) mm in diam. with up to 70 flowers, corolla lobes 1/2 of corolla length, and stipitate pods, 2.5–6 cm x 2.5–4 mm, apex rostrate, the rostrum 2–6 mm. This latter species also occurs on sandy loam at elevations of 0–650 m in Texas and Louisiana, and it is common at 650–1950 m in the states of Coahuila, Nuevo León, San Luis Potosí, and Tamaulipas, northern Mexico.

On the other hand, *Mimosa subinermis* Benth. was reduced by the same author (Bentham 1875, p. 408) to the synonymy of *M. rupestris* Benth., a species known from southern Rio Grande do Sul, Brazil, and from adjacent Uruguay (Rivera-Frontera). *Mimosa rupestris* is included in sect. *Mimosa* ser. *Mimosa* subser. *Obstrigosae* (Benth.) Barneby (Barneby 1991), and it is clearly distinguished from all members of ser. *Quadrivalves* by stems, petioles, and peduncles densely strigose with retrorsely appressed setae, by tetramerous, haplostemonous flowers, and by strigose, 3–4-articulate pods. It occurs in open rocky hillsides and in dry stony campo.

In the case of several varieties of *Mimosa quadrivalvis* -- var. *diffusa* (Rose) L.S. Beard ex Barneby, var. *floridana* (Chapm.) Barneby, var. *jaliscensis* (J.F. Macbr.) L.S. Beard ex Barneby, and var. *urbaniana* Barneby, further study is needed in order to determine their taxonomic status. After collecting and examining material from the USA and Mexico (Grether, unpubl. manuscript; Martínez-Bernal et al. 2008), we consider that *M. quadrivalvis* var. *quadrivalvis* is restricted to the coastal plain of the state of Veracruz, Mexico, with northern limit in the region of Cazones and southern limit in the region of Santiago Tuxtla. This latter taxon is recognized by capitula 15–20 mm in diam. with

70–100 flowers, and by glabrous or tomentulose, unarticulated prickly legumes 4–5(–8) cm long with margin 4–5 mm wide and the apex acute or shortly apiculate.

ACNOWLEDGEMENTS

Research was supported by Secretaría de Educación Pública, México, Grant 907011, Programa Integral de Fortalecimiento Institucional (PIFI 3.3) to R. Grether. The authors wish to express their appreciation to Jay A. Raveill, University of Central Missouri, James L. Zarucchi, Missouri Botanical Garden, and Michael A. Vincent, Miami University, Ohio, for their critical reviews of the manuscript. Special thanks to Guy Nesom for his improvement of the manuscript.

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ABUNDANCE AND RANGE EXPANSIONS FOR *ECLIPTA PROSTRATA* (ASTERACEAE) INTO THE NEW YORK METROPOLITAN AREA WITH NEW STATE AND COUNTY RECORDS

ERIC C. MORGAN
Department of Biology
Farmingdale State College
2350 Broadhollow Road
Farmingdale, New York 11735
morgane@farmingdale.edu

ZACHARY E. JOHNSON, MICHAEL CANGIANO
Undergraduate Research Assistants, Department of Biology
Farmingdale State College
2350 Broadhollow Road
Farmingdale, New York 11735

ABSTRACT

We present records of *Eclipta prostrata* (Asteraceae) representing a new record for Connecticut, including three counties, as well as for three new counties in neighboring New York state. We also present evidence the plant has become significantly more abundant throughout its previously reported range, based upon collections made throughout 2016-2017.

Eclipta prostrata (L.) L. commonly known as false daisy or yerba de tago (Figs. 1, 2) is a native forb whose putative native range extends throughout most of the southern two-thirds of the USA, with sporadic records further north, extending into Ontario, Canada. The species has spread prolifically throughout the world, with new countries being added to its introduced range on a regular basis. Over the past year both Croatia (Jeričević & Jeričević 2017) and Serbia (Perič & Rilak 2017) have published new records of the species while Rao et al. (2007) listed *E. prostrata* as a weed of rice crops in twenty two separate countries. The species has many attributes making it a likely species to spread, including the production of over 17,000 seeds per plant (Holm 1977), its successful germination in a pH rage of 4 to 11, and an ability to tolerate salt stress (Chauhan & Johnson 2008).

Within New York State, *Eclipta prostrata* is currently documented from eight of the southernmost counties; Orange and Rockland in “upstate” New York, Bronx, Richmond, Kings and New York Counties within New York City, and Nassau and Suffolk Counties on Long Island (USDA NRCS, 2018). Within the state of Connecticut, there are currently no records of the species found through the PLANTS database, or regional herbaria including the Bartlett Arboretum (BART) or Yale University Herbarium (YU), or in the New York Botanical Garden Herbarium (NYBG).

For New York we present new records for Queens County (*Morgan 0160002*, 40° 46’18” N, 73° 45’51” W), Westchester County (*Morgan 0170208*, 41° 06’53” N, 73° 43’35” W), and Ulster County (*Morgan 0170209*, 41° 58’05” N, 74° 16’43” W). Within Connecticut, we present records representing a new record for the state as well as three counties of record: Fairfield County (*Morgan 0170322*,41° 07’58” N, 73° 32’57” W), New Haven County (*Morgan 0170341*, 41° 17’04” N, 72° 51’19” W), and Tolland County (*Morgan 0160111*, 41° 47’37”N, 72° 26’27”W).

For each record a voucher is deposited within the Biology Department of Farmingdale State College. Duplicates were sent to the Bartlett Arboretum Herbarium (BART). While only one voucher has been designated for each new county, it should be noted that for several of the counties in both New York and Connecticut, multiple locations were found of *Eclipta prostrata.* For many of these, vouchers were also taken for the Farmingdale State College Herbarium. A summary of each new county in this study as well as surrounding counties and the total number of distinct populations documented in each is given in Table 1.

Table 1. Abundance and records for *Eclipta prostrata* in New York and Connecticut.

County name	**Number of sites**	**New county record**
Bronx Co., NY	5	no
Nassau Co., NY	17	no
Queens Co., NY	11	yes
Suffolk Co., NY	16	no
Ulster Co., NY	1	yes
Westchester Co., NY	2	yes
Fairfield, CT	6	yes
New Haven, CT	1	yes
Tolland, CT	1	yes

While hard data on the previous distribution of the species in counties prior to this work are unavailable, this work represents numerous collection sites throughout the area based upon only two years of limited sampling. Within Nassau County, the 17 sites may be a gross underestimation since the species was found at all but one of the sites visited to scout for the plant. Furthermore, at several sites, such as Crocheron Park in Queens County, the species not only represented a new county record but was abundant, with ramets numbering in the hundreds of individuals. Further west in Queens County, the margins of the campus lawns of Queens College (CUNY) consist of large patches of *Eclipta prostrata*, with plants often growing up to the edge of the sidewalks.

Figure 1. *Eclipta prostrata* in Queens Co., New York.

Figure 2. *Eclipta prostrata* along a sidewalk within lawn grasses in Queens Co., New York.

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England, J.K. 2018. New to Alabama: *Geranium pusillum* (Geraniaceae). Phytoneuron 2018-41: 1–4. Published 19 June 2018. ISSN 2153 733X

NEW TO ALABAMA: *GERANIUM PUSILLUM* (GERANIACEAE)

J. KEVIN ENGLAND
Department of Biological and Environmental Sciences
University of West Alabama
Livingston, Alabama 35470
alabamaplants@gmail.com

ABSTRACT

Geranium pusillum (Geraniaceae) is reported new for the vascular flora of Alabama from collections made in disturbed areas along major highways and streets throughout the Highland Rim Physiographic Region of northern Alabama. This species is considered introduced in Alabama and has been documented as a non-native herb throughout most of Canada and the USA, including Hawaii and Alaska. A key to the Alabama species of *Geranium* is provided.

Recent collections of *Geranium pusillum* L. (small-flowered crane's-bill) from Alabama apparently are the first from the state. The taxon was not included in *Plant Life of Alabama* (Mohr 1901), a recently published comprehensive checklist for the state (Kral et al. 2011), or the Alabama Plant Atlas (Keener et al. 2018). No Alabama records were found in BONAP (2017), NatureServe (2017), SERNEC (2018), or USDA (2018).

Voucher specimens. **USA. Alabama**. Lauderdale Co.: 2.7 air mi ESE of Rogersville, along W side of Co. Rd 70, 0.02 mi N of jct. with US Hwy 72, 29 Apr 2018, *England 9124* (TROY, UWAL, herb. England). Lawrence Co.: Downtown Moulton, along N side of Downing St., 0.01 mi E of jct. with Market St. (AL Hwy 33), 29 Apr 2018, *England* 9113 (TROY, UWAL, herb. England). Limestone Co.: 2.5 air mi NE of Decatur, along W side of US Hwy 31 (Hunter Ln), ca. 0.1 mi N of jct with Alt US Hwy 72 (Joe Wheeler/Bee Line Hwy), 29 Apr 2018, *England 9116* (UWAL, herb. England). Madison Co.: 2.6 air mi NE of Oakland, along S side of US Hwy 72, 0.02 mi W of jct. with Balch Rd, 29 Apr 2018, *England 9118* (UWAL, herb. England). Morgan Co.: 2.4 air mi NW of Priceville, along N side of AL Hwy 67, ca. 0.1 mi W of jct with Co. Rd 40 (Upper River Rd.), 27 Apr 2018, *England 9100* with Jamie England (AMAL, AUA, BRIT, JSU, NCU, TROY, UNA, UWAL, herb. England); 3.4 air mi SSE of Decatur, Wheeler National Wildlife Refuge, along E side of Country Club Rd SE, ca. 0.1 mi N of jct with AL Hwy 67, 28 Apr 2018, *England 9105* (AUA, UWAL).

Geranium pusillum is native to Europe, central Asia, and north Africa (Aedo 2012). It has naturalized throughout most of Canada and USA, including Hawaii and Alaska (BONAP 2017; USDA 2017). It has also been introduced in New Zealand, north-central Pacific, Caribbean (Aedo et al. 1998; Aedo 2000), Chile, and Argentina (Aedo 2012). According to Aedo (2012), this species is found in disturbed areas (cultivated and waste places), open habitats, rocky slopes, meadows, edge of forests, and dry grasslands. Weakley (2015) has added roadsides and pastures as documented habitats.

The erect to decumbent stems of *Geranium pusillum* are much like those of other annual *Geranium* species in Alabama (Fig. 1), with a mixture of short glandular and eglandular hairs. Flowers are in 2-flowered, solitary cymules on peduncles with short glandular and eglandular hairs (Fig. 2). Each flower has 5 light purple petals with an emarginate apex and 10 stamens (5 fertile and 5 sterile) (Fig. 3). The rostrum has short (< 0.5 mm) glandular and eglandular hairs without a narrowed apex (Fig. 4). All collections by the author were made in disturbed areas along major highways and streets throughout the Highland Rim Physiographic Region of northern Alabama (Fig. 5). Typical associates present were *Erodium cicutarium, Geranium carolinianum, G. dissectum, G. molle, Galium sherardia, Medicago lupulina,* and *Trifolium repens.*

Figure 1. Growth habit of *Geranium pusillum*.

Figure 2. Upper stem of *Geranium pusillum*.

Figure 3. Flower of *Geranium pusillum.*

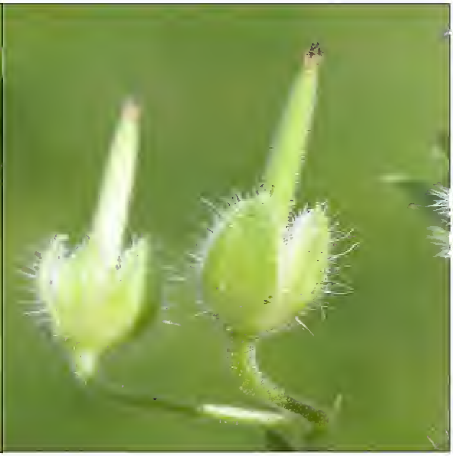

Figure 4. Fruit of *Geranium pusillum*

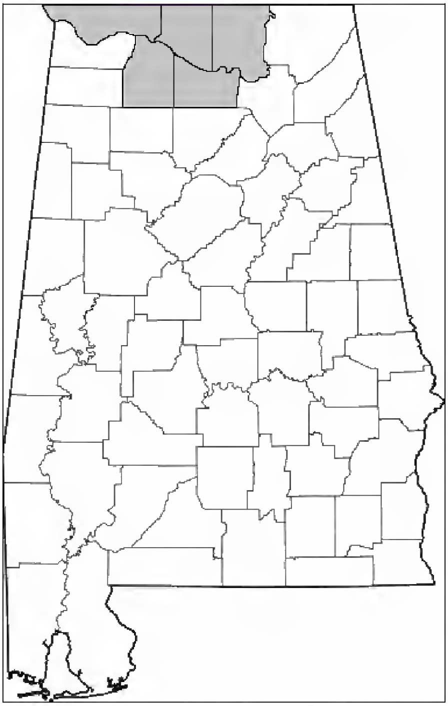

Figure 5. Map of Alabama with counties of documented *Geranium pusillum* populations in gray.

KEY TO THE ALABAMA SPECIES OF *GERANIUM*

[measurements follow Aedo (2012)]

1. Perennial, from a rhizome; petals 12–16 mm long, 8–13 mm wide .... **Geranium maculatum**
1. Annual (rarely biennials), from a taproot; petals 2–8.5 mm long, 1–5 mm wide.
  2. Fertile stamens 5, staminodes (3–)5; rostrum without a narrowed apex ...... **Geranium pusillum**
  2. Fertile stamens 10; rostrum with a narrowed apex 0.3–7 mm long.
    3. Sepals with a mucro 0.1–0.3 mm long; mericarps reticulately ridged .... **Geranium molle**
    3. Sepals with a mucro 0.8–2 mm long; mericarps smooth.
      4. Petals light pink to light purple; mericarps with long appressed hairs about 1 mm long .... **Geranium carolinianum**
      4. Petals dark purple; mericarps with spreading hairs about 0.5 mm long .... **Geranium dissectum**

ACKNOWLEDGEMENTS

I'm grateful to Brian R. Keener for reading the manuscript and providing helpful suggestions.

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A MULTIVARIATE MORPHOMETRIC ANALYSIS OF *SOLIDAGO* SUBSECT. *NEMORALES* (ASTERACEAE: ASTEREAE)

JOHN C. SEMPLE, KATHERINE KORNOBIS, and SOFIA BZOVSKY
Department of Biology
University of Waterloo
Waterloo, Ontario Canada N2L 3G1
jcsemple@uwaterloo.ca

ABSTRACT

A multivariate morphometric study of the goldenrod group *Solidago* subsect. *Nemorales* was conducted to assess the morphological differences among *Solidago californica, S. hintoniorum, S. mollis, S. nana, S. nemoralis* (subsp. *decemflora* and subsp. *nemoralis* combined), *S. radula*, and *S. velutina* (including *S. sparsiflora*). Analyses of a matrix of 335 specimens by 30 traits provided support for recognizing 7 species. The two subspecies within *S. nemorales* were previously investigated and were not reanalyzed. Based on the analyses and morphological studies, the *S. velutina* complex was split into a western *S. californica* and a Great Basin/Rocky Mountain cordilleran *S. velutina*; the results did not support dividing the latter species into a northern race (*S. sparsiflora* or *S. velutina* subsp. *sparsiflora*) and a more southern race (*S. velutina* subsp. *velutina*). The results indicated a close similarity between *S. mollis* and *S. radula*, although the two obviously differ in diagnostic leaf hair traits not included in the analyses and in growth pattern differences. One specimen (*Baker 722*, COLO) was strongly placed in *S. nana* and was not *S. rigida* as previously identified and reported in the literature.

Solidago subsect. *Nemorales* includes 5-9 species depending upon the taxonomic treatment (Nesom 1989a, b; Semple et al. 1990; Nesom 1993; Semple & Cook, 2006; Semple 2018 frequently updated): *S. californica* Nutt., *S. hintoniorum* Nesom, *S. macvaughii* Nesom, *S. mollis* Bartl., *S. nana* Nutt., *S. nemoralis* Ait., *S. radula* Nutt. *S. sparsiflora* A. Gray, and *S. velutina* DC. There are multiple synonyms under *S. nemoralis, S. sparsiflora,* and *S. velutina.* All members of the subsection have short to elongated rhizomes, densely short-hairy stems, leaves that are largest proximally and much reduced distally and sometimes trinervate, arrays of heads that are weakly to strongly secund conical, and phyllaries that are strongly graduated and either oblong or lanceolate. Species differ primarily in hair traits and leaf traits.

Solidago californica has densely short-wooly canescent stem hairs, densely hairy pedicels, and sparsely to moderately hairy ovate to broadly lanceolate outer phyllaries (Figs. 1-2); it has been treated as *S. velutina* subsp. *californica* (Nutt) Semple. *Solidago hintoniorum* (Figs. 3-4; Nesom 1989a) is the only Mexican endemic species in the subsection; it is distinguished by its often scabrous leaves with distally oriented hairs that create strong drag when a finger is run over the surface from leaf apex to base; hairs may be dense only near the leaf apex obscuring the scabrous condition. Nesom (1993) included *S. hintoniorum* Nesom (and *S. speciosa* Nutt.) in *S.* subsect. *Thyrsiflorae* A. Gray, but these were not included in subsect. *Thyrsiflorae* by Semple et al. (2017). *Solidago hintoniorum* has traits typical of subsect. *Nemorales* including large lower stem leaves. *Solidago macvaughii* is endemic to northern Aquascalientes, Mexico and is known from a few collections; it was considered to be closely related to or a synonym of *S. velutina* (Nesom 1989b), but Semple (2018) showed that its lower stem leaves were typical of species in the *Tortifoliae* group of *S.* subsect. *Triplinerviae* (Torr. & A. Gray) G.L. Nesom and it is excluded from further consideration here. *Solidago mollis* (Fig. 5-6) has usually broadly oblanceate, trinervate lower and mid stem leaves that are moderately strigose and often somewhat grayish in color; individuals can form numerous-stemmed extensive rhizomatous clones. *Solidago nana* (Figs. 7-9) has short, densely hairy stems, grayish-green to whitish leaves, and arrays of heads that are very strongly secund to the point of

Figure 1. Very robust and small shoots of *Solidago californica*, *Semple & Heard 8465* (WAT).

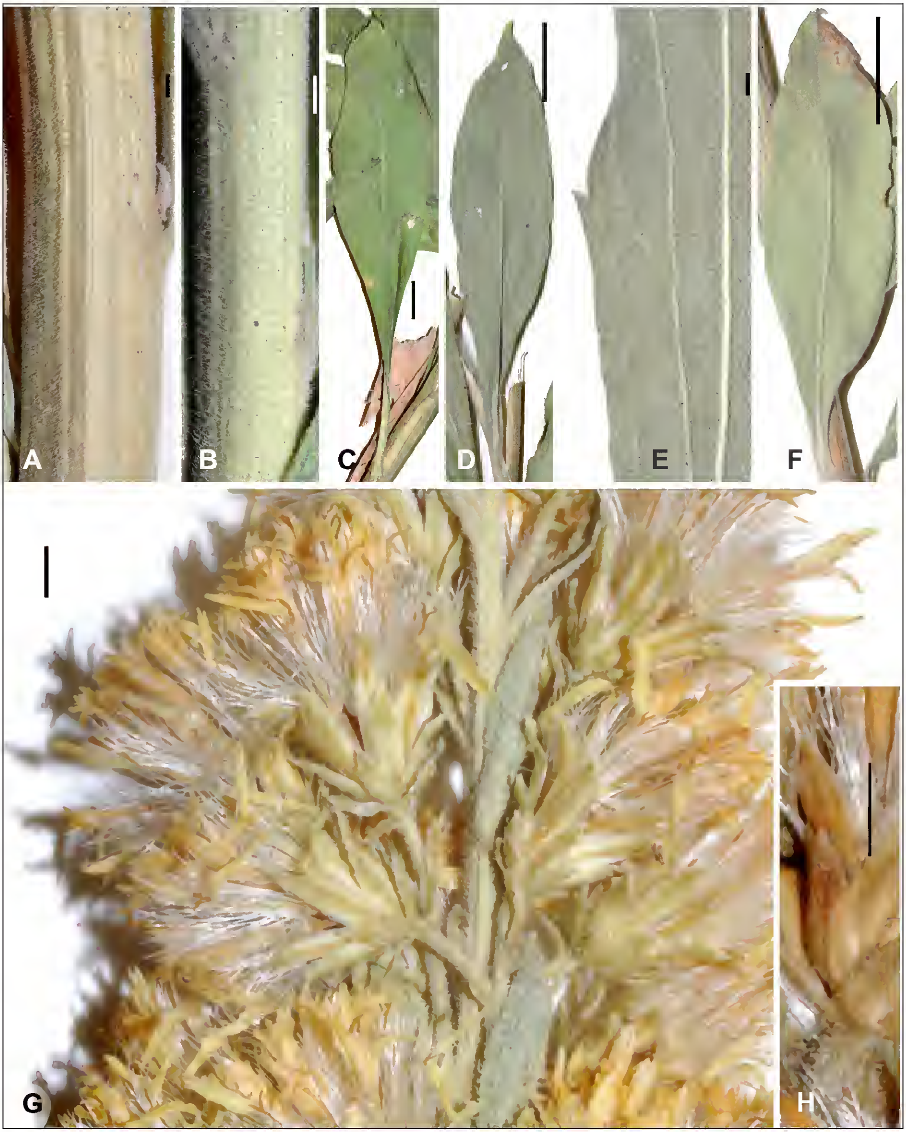


Figure 2. Details of the morphology of *Solidago californica*. **A-B.** Lower and upper stem, *Semple et al. 9365* (WAT). **C.** Lower stem leaf, *Semple et al. 9365* (WAT). **D.** Lower mid stem leaf, *Semple et al. 9300* (WAT). **E.** Lower mid stem leaf mid vein and adaxial surface, *Semple & Brouillet 7131* (WAT). **F.** Upper mid stem, *Semple & Heard 8651* (WAT. **G.** Heads, *Semple & Heard 8465* (WAT). **H.** Peduncle and outer phyllaries, *Dunkle 3775* (RSA). Scale bars = 1 mm in A-B, E and G-H; = 1 cm in C, E-F.

Figure 3. *Solidago hintoniorum*, *Patterswon 6331* (TEX) from Nuevo León, Mexico.

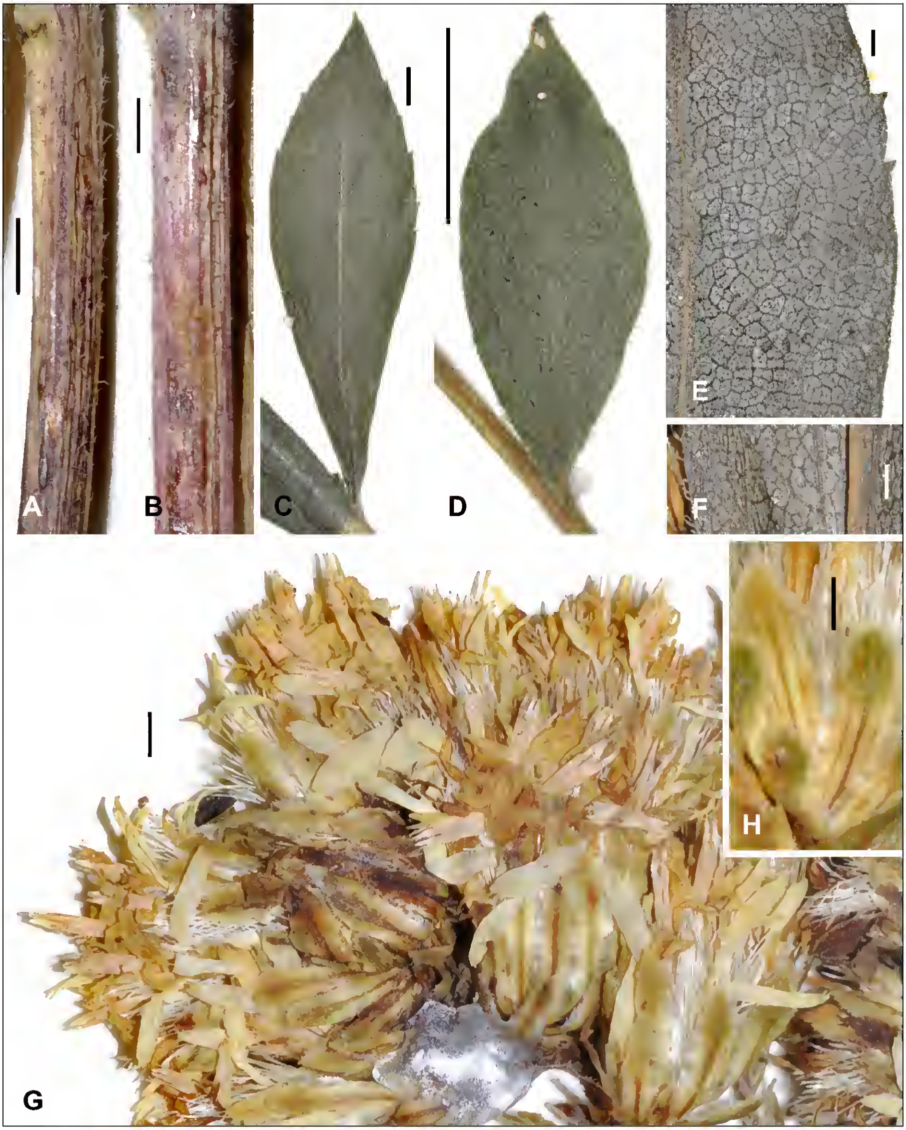


Figure 4. Details of the morphology of *Solidago hintoniorum*. **A-B.** Lower and mid stems, *Hinton 20867* (TEX). **C.** Lower mid stem leaf, *Hinton 22053* (TEX). **D.** Upper stem leaf, *Patterson 6331* (TEX). **E-F.** Upper stem leaf mid vein and adaxial surface detail. **E.** *Hinton 23323* (TEX). **F.** *Hinton et al 17884* (TEX). G. Heads, *McDonald 2561* (TEX). H. Multi-veined phyllaries, *Hinton et al. 17884* (TEX). Scale bars = 1 mm in A-B, F-H; = 1 cm in C-D.

University of Waterloo
Herbarium

Name Solidago mollis Bartl.
stet! 9 08-2012

Family Compositae

Collector J. & B. Semple

No. 6620 Date 24 August 19 82

Locality USA : WY : Goshen Co.: (S of Lusk) just S of county line US-85, grassland.

Remarks

Specimens in: WAT. COLO UAC USF

Det. 19

Multivariate Studies in *Solidago*
Solidago subsect. *Nemorales*
Specimen No 112
S Bzovsky & J C Semple
WAT 2012 University of Waterloo

Figure 5. *Solidago mollis, J. Semple & B. Semple 6620* (WAT) from Goshen Co., Wyoming.

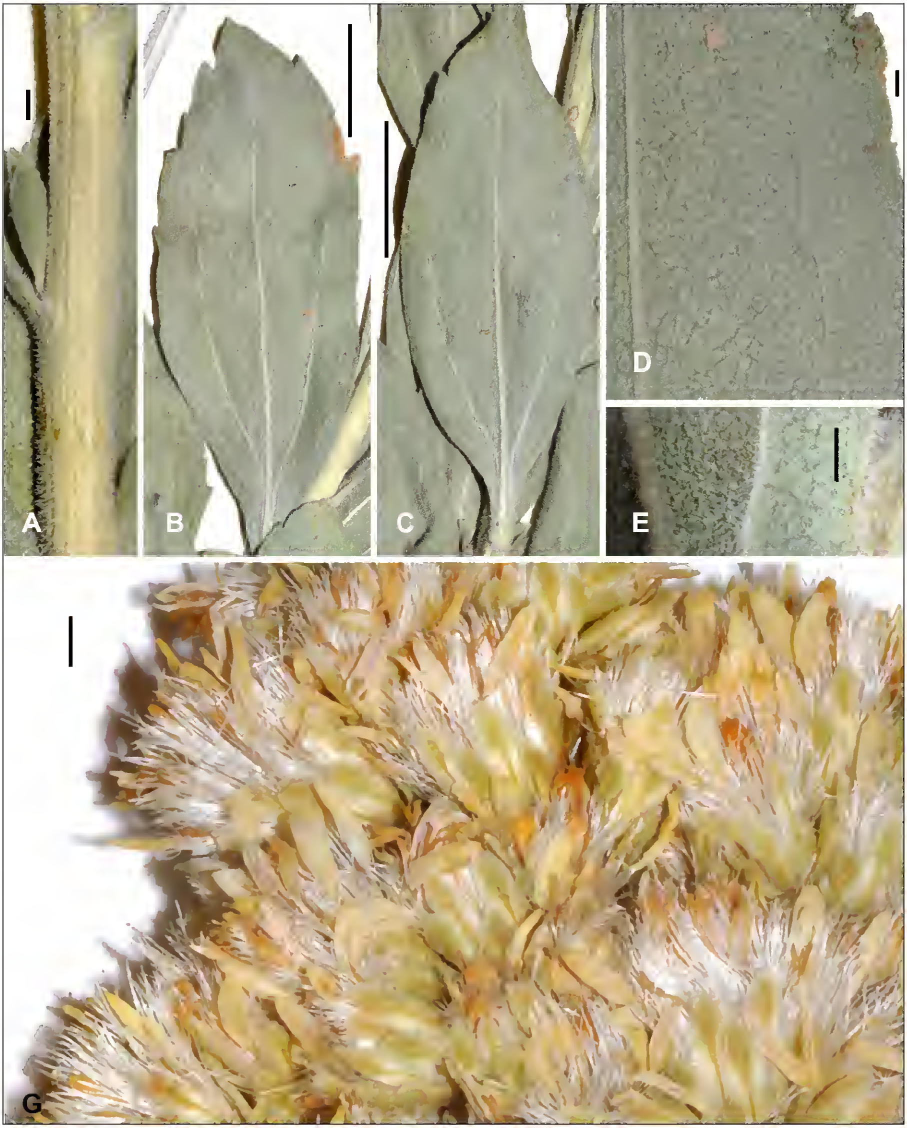


Figure 6. Details of the morphology of *Solidago mollis*. **A.** Upper stem, *J. & B. Semple 11391* (WAT). **B-C.** Lower mid stem and mid stem leaves, *Semple & Xiang 10201* (WAT). **D.** Mid stem leaf adaxial surface detail, *J. & B. Semple 10640* (WAT). **E.** Upper mid stem leaf adaxial surface detail, lateral vein, *J & B Semple 6655* (WAT). **F.** Heads, *J. & B. Semple 6655* (WAT). Scale bars = 1 mm in A, D-G; = 1 cm in B-C.

Figure 7. *Solidago nana*, *Semple et al. 9235* (WAT) from Summit Co., Utah.

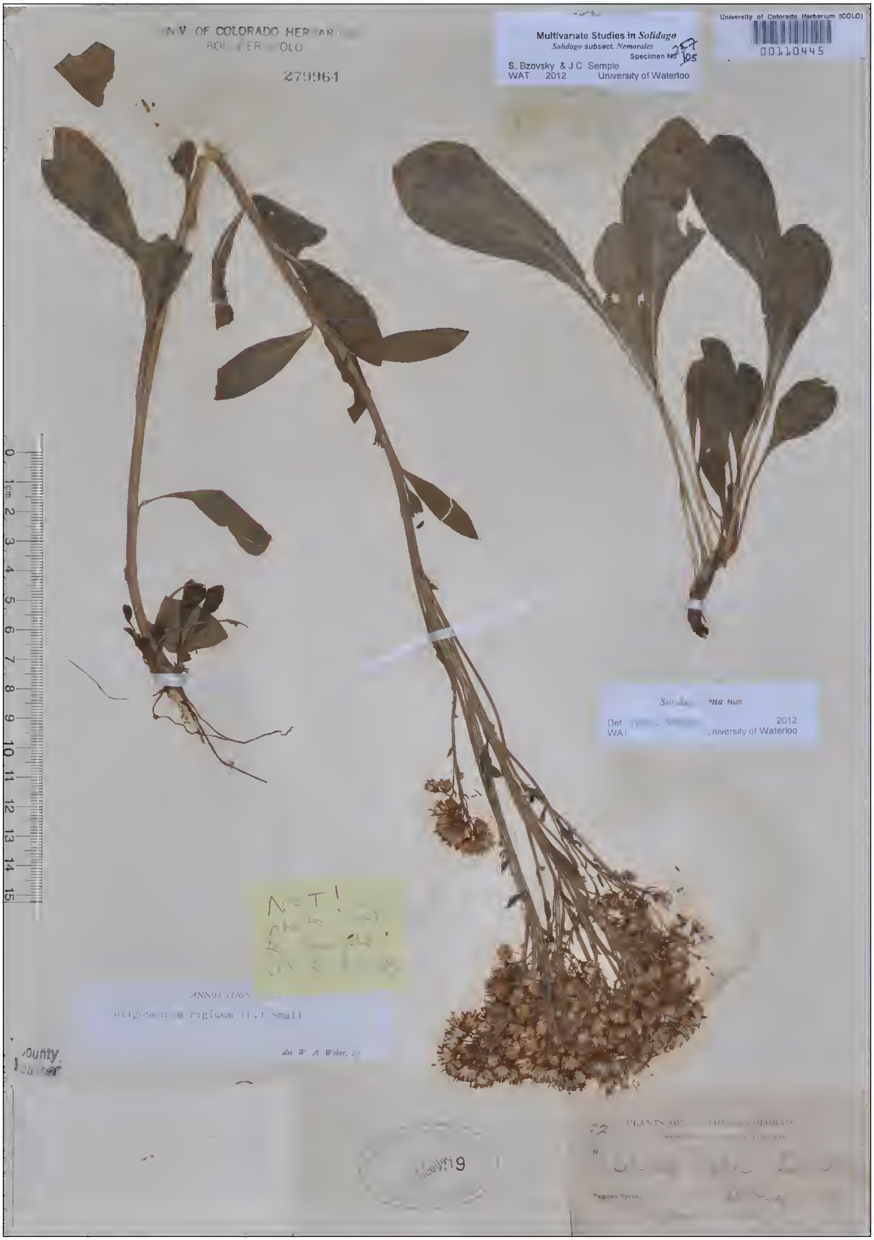


Figure 8. A robust plant of *Solidago nana*, *Baker 722* (COLO) from Archuleta Co., Colorado.

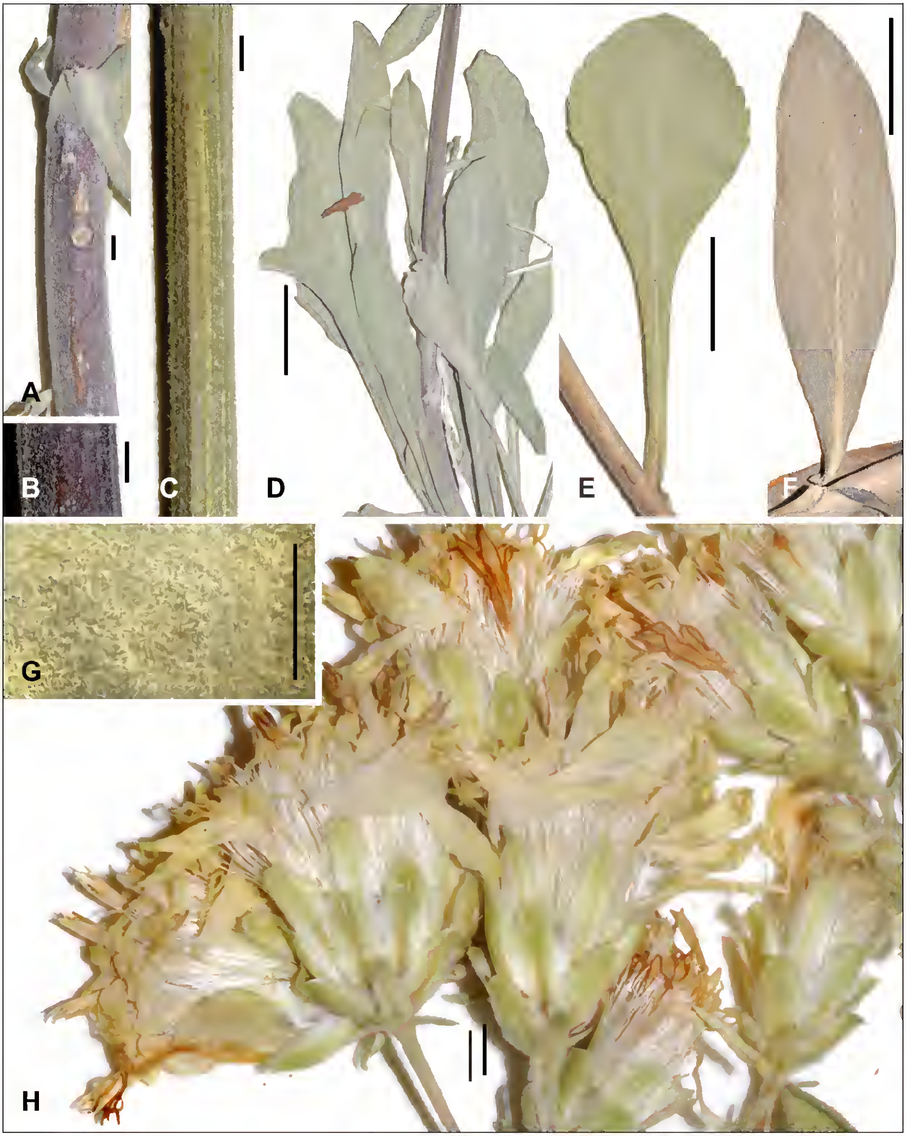
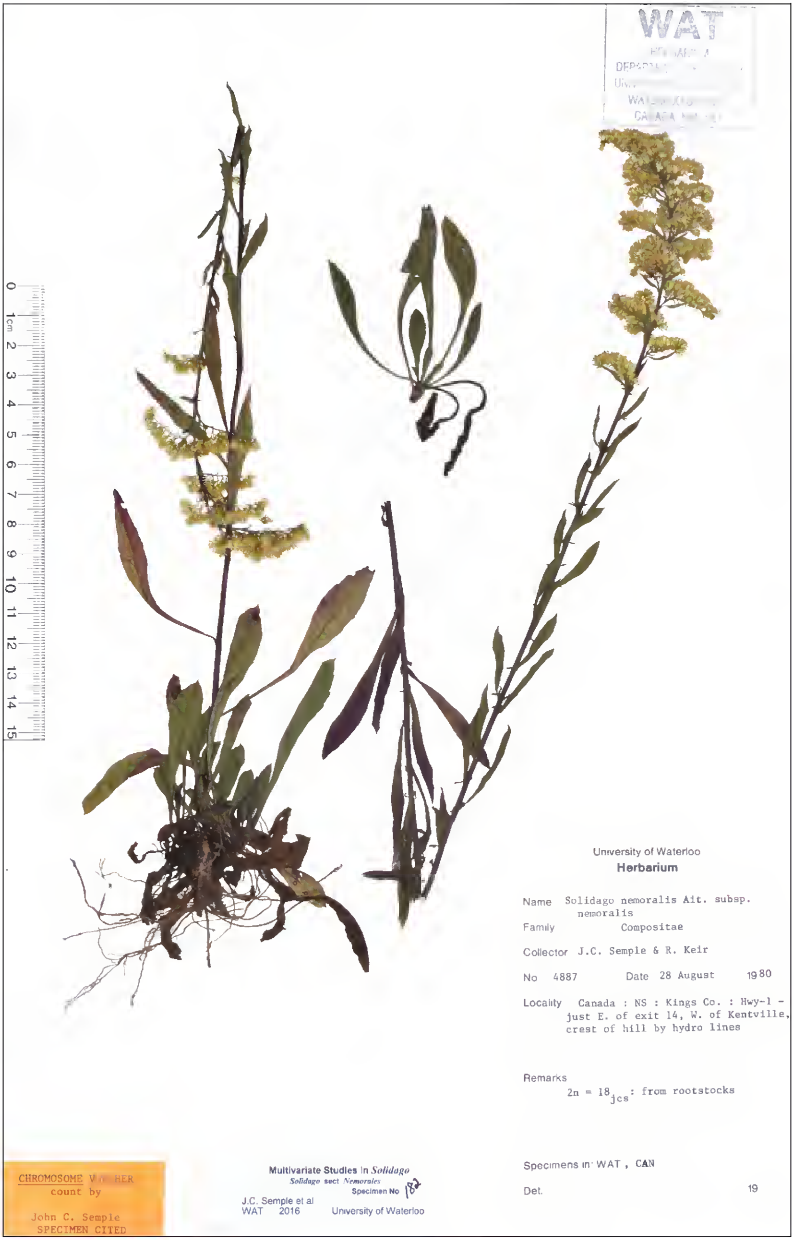


Figure 9. Details of the morphology of *Solidago nana*. **A-B.** Lower stem, *Semple et al. 9267* (WAT). **C.** Mid stem, *Semple et al. 9235* (WAT). **D.** Lower stem leaves, *Semple et al. 9267* (WAT). **E.** Lower mid stem leaf, *Jones 36536* (COLO). **F.** Mid stem leaf, *Baker 722* (COLO). **G.** Mid stem adaxial surface, *Semple & Heard 7803* (WAT). **H.** Heads, *Semple et al. 9267* (WAT). Scale bars = 1 mm in A-B and G-H; = 1 cm in D-F.

appearing somewhat flat-topped. *Solidago nemoralis* (Figs. 10-11) includes mostly diploid eastern subsp. *nemoralis* and tetraploid subsp. *decemflora* on prairies; rhizomes are short to very short and basal rosette leaves are often present; stems and leaves are short canescent and often grayish-green; arrays of heads are secund conical and sometimes distally reflexed. *Solidago radula* (Figs. 12-13) is the other eastern North American species in the subsection and is distinguished by its scabrous leaves with hairs and texture like those of *S. hintoniorum*; it can be similar in appearance to *S. nemoralis* but the leaves are obviously scabrous.

Solidago velutina (Figs 14-16) includes considerable variation in stem height, leaf shape, leaf density, and inflorescence size and shape, some of which have been recognized nomenclaturally – *Solidago californica* Nutt. var. *nevadensis* A. Gray, Bot. Calif., 1: 319. 1876; *Solidago sparsiflora* A. Gray, Proc. Amer. Acad. 12: 58. 1877; *Solidago mollis* Rothrock in A. Gray, Wheeler Rep. Geogr. Surv. W100th Merid., Bot. 146. 1879. non Bartl. 1836; *Solidago trinervata* Greene, Pittonia 3: 100. 1896; *Solidago sparsiflora* A. Gray var. *subcinerea* A. Gray, Proc. Amer. Acad. Arts & Sci. 17: 197. 1882; *Solidago canadensis* L. var. *arizonica* A. Gray, Proc. Amer. Acad. Arts & Sci. 17: 197. 1882; *Solidago arizonica* (A. Gray) Woot. & Standl., Contrib. U.S. Nat. Herb. 16: 181. 1913.; *Solidago radulina* Rydb., Bull. Torrey Bot. Club 31: 650. 1904 [1905]; *Solidago howellii* Woot. & Standl., Contrib. U.S. Natl. Herb. 16: 181. 1913; *Solidago garrettii* Rydb. Bull. Torrey Bot. Club 37: 134. 1910; *Solidago velutina* DC. var. *nevadensis* (A. Gray) C. & J. Taylor, Sida 10: 246. 1984.; *Solidago velutina* DC. subsp. *sparsiflora* (A. Gray) Semple, Sida 20: 1616. 2003. Phyllaries tend to be lanceolate with somewhat attenuate acute tips and little surface indument (Fig. 17I), although rarely not attenuate and very rarely ovate in the southern end of the range in central Mexico, where the outer phyllaries are sometimes sparsely strigose. Phyllaries can be minutely stipitate glandular distally. Leaves of *S. velutina* are often triple-nerved (Fig. 17E) but variable in leaf density and shape (Figs. 17E-G). Some specimens lacking lower stem leaves could be mistaken for species in subsect. *Triplinervae* (Fig. 16). Morton et al. (2018) discussed such specimens in their presentation of chromosome numbers in the genus *Solidago*, noting that the holotype of *S. canadensis* var. *arizonica* A. Gray was one of these subsect. *Triplinerviae*-like specimens of *S. velutina*. *Solidago ×scabrida* DC. appears to be a hybrid *S. velutina* x *S. paniculata* (Nesom 1989b), although the range of *S. velutina* shown below does not appear to overlap with that of *S. paniculata* (Semple 2018 frequently updated). Further research is needed on this taxon/hybrid.

The distributions of the seven species are allopatric to partially or completely sympatric with one or more other species in the subsection. *Solidago californica* is allopatric and native to disturbed soils and open habitats in much of California (except the eastern desert areas) and adjacent southern Oregon (Fig. 18). *Solidago hintoniorum* is native to disturbed soils in pine oak woods in south-central Nuevo León and adjacent Coahuila and Tamaulipas, Mexico (Fig. 19). *Solidago mollis* is native to the Great Plains from southern Alberta east to southern Manitoba south to Panhandle Texas and western Oklahoma and disjunct in central New Mexico (Fig. 20). *Solidago nana* is native to the eastern Great Basin mountains and western Rocky Mountains of Idaho south to New Mexico (Fig. 21); habitats include open pine woods, sagebrush and rabbit brush scrub, dry grasslands, roadsides and sandstone ledges. *Solidago nemoralis* is the most widely distributed species in the subsection and occurs in grasslands on the Great Plains from Alberta and Manitoba south to Texas and in disturbed habitats in much of eastern North America from eastern Manitoba to the Prince Edward Island south to Louisiana and northern Florida (Fig. 22). *Solidago radula* occurs in disturbed soils and open woods in the western portion of the eastern deciduous forest from Illinois southwest to Texas and on the prairies and in the Hill Country of Texas with scattered populations occurring eastward in the southeastern USA. (Fig. 23). *Solidago velutina* occurs in grasslands and open pine and oak forests and is frequently collected in disturbed roadsides of the Rocky Mountain cordillera and Great Basin from southern Montana and eastern California south to Zacatecas and San Luis Potosí, Mexico (Fig. 24).



University of Waterloo
Herbarium

Name Solidago nemoralis Ait. subsp. nemoralis
Family Compositae
Collector J.C. Semple & R. Keir
No 4887 Date 28 August 1980
Locality Canada : NS : Kings Co. : Hwy-1 - just E. of exit 14, W. of Kentville, crest of hill by hydro lines
Remarks $2n = 18_{jcs}$: from rootstocks
Specimens in: WAT , CAN
Det. 19

CHROMOSOME VOUCHER
count by
John C. Semple
SPECIMEN CITED

Multivariate Studies in *Solidago*
Solidago sect *Nemorales*
Specimen No 182
J.C. Semple et al
WAT 2016 University of Waterloo

Figure 10. *Solidago nemoralis* subsp. *nemoralis*, *Semple & Keir 4887* (WAT) from Kings Co., Nova Scotia.

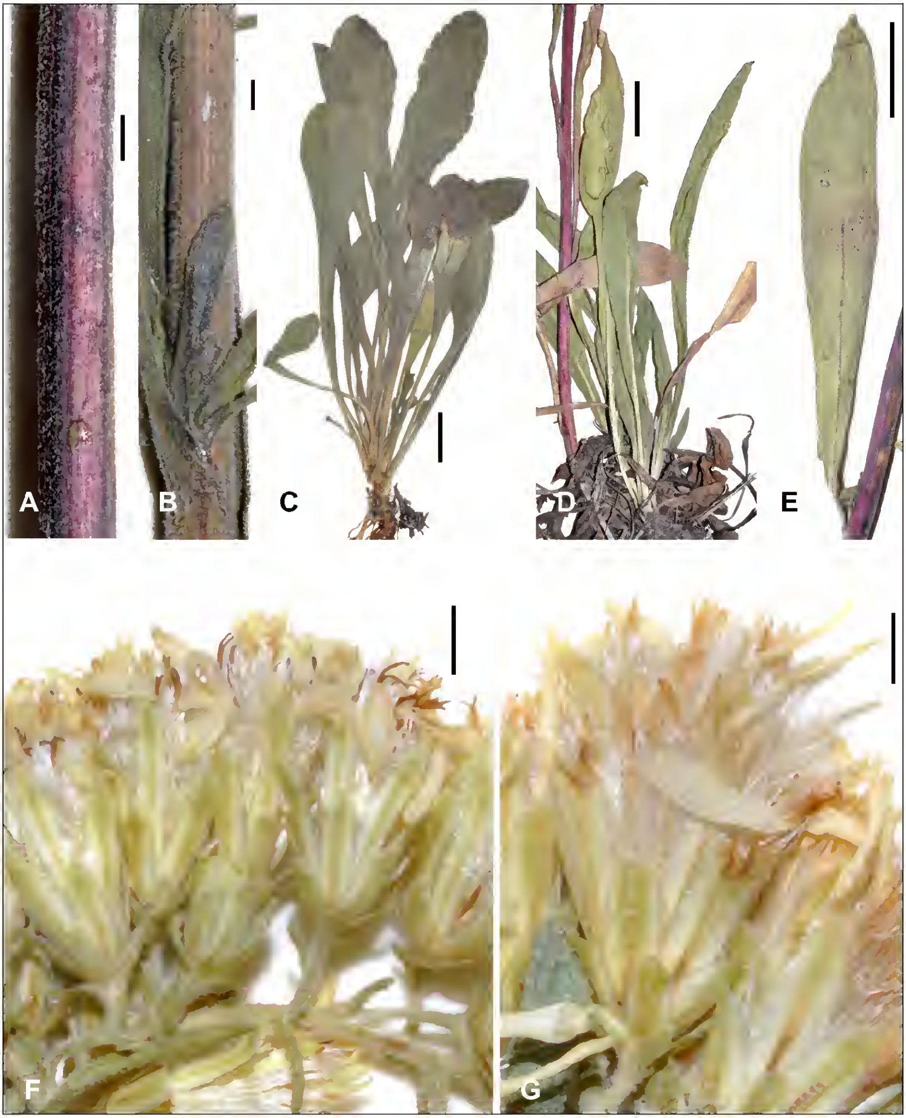


Figure 11. Details of the morphology of *Solidago nemoralis*. **A.** Lower stem, *Morton NA2285* (TRT). **B.** Mid stem, *Semple & Brammall 2305* (WAT). **C-D.** Basal rosettes, *Semple & Brammall 2305* (WAT) and *Semple & Brouillet 4216* (WAT). **E.** Mid stem leaf, *Semple & Brouillet 7131* (WAT). **F-G.** Heads, *Semple & Chmielewski 4990* (WAT) and *Semple & Brouillet 4489* (WAT); subsp. *nemoralis*, B, C and G; subsp. *decemflora*, A, D, E and G. Scale bars = 1 mm in A-B and F-G; = 1 cm in C-E.

HERBARIUM
NORTHEAST LOUISIANA UNIVERSITY, MONROE

Flora of LOUISIANA Parish: NATCHITOCHES

SOLIDAGO RADULA Nutt.

Clearcut area in pine woods on clay soil beside an unimproved road west of U.S.F.S. 321, 0.2 miles north of U.S.F.S. 360 north of Mink in Kisatchie National Forest; Sec. 11, T5N, R7W. Clay soil.

Collectors: R. Dale Thomas, Dennis Bell, Trudie Dorris, and Kathie & Annie Tatum

No.: 105,653 & 219 Date: 9 July 1988

Multivariate Studies in *Solidago*
Solidago subsect. *Nemorales*
Specimen No. 121
S. Bzovsky & J.C. Semple
WAT 2012 University of Waterloo

Figure 12. *Solidago radula, Thomas et al. 105653* (WAT) from Natchitoches Par., Louisiana.

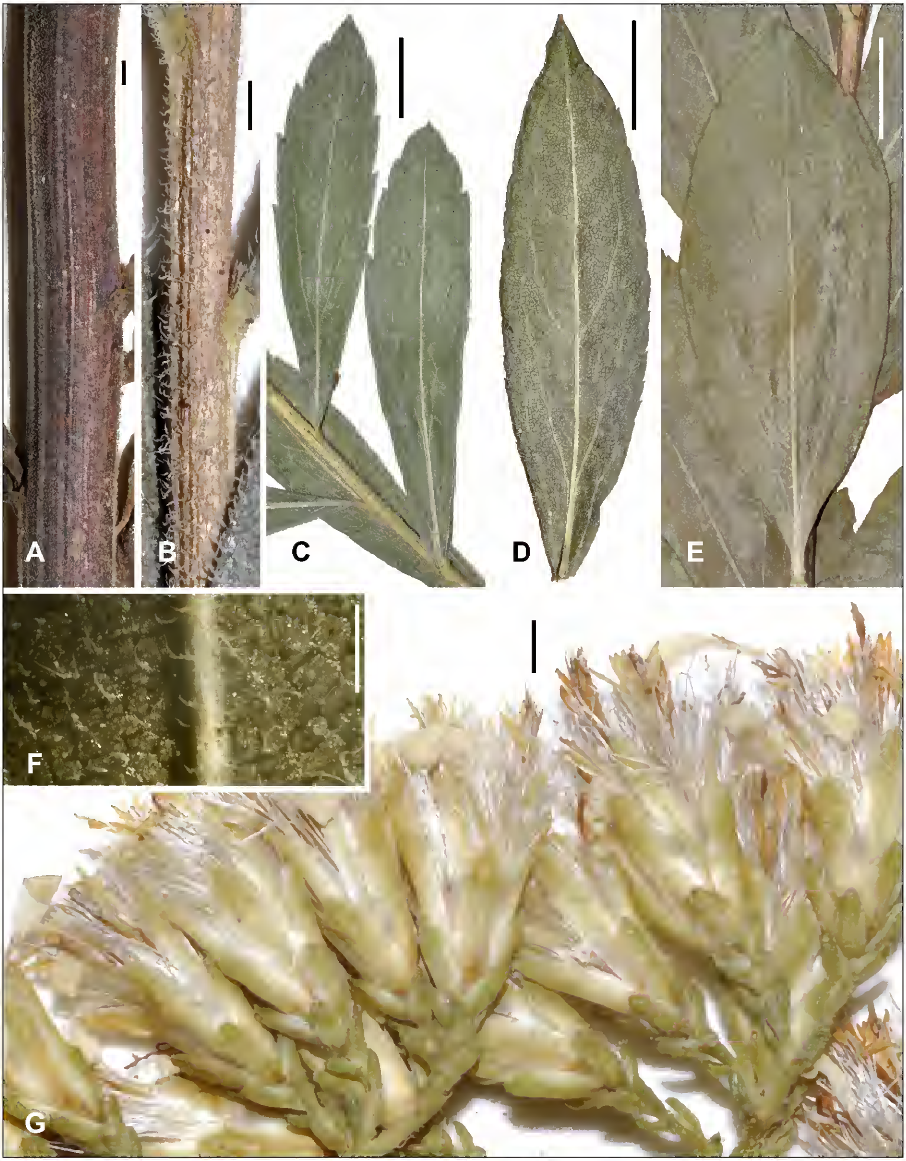


Figure 13. Details of the morphology of *Solidago radula*. **A.** Lower mid stem, *Thomas et al. 91476* (WAT). **B.** Upper mid stem, *Thomas et al. 105653* (WAT). **C.** Lower mid stem leaves, *Morton & Venn NA16258* (TRT), greenhouse grown transplant. **D.** Mid stem leaf, *Redfearn & Shimizu 33184* (WAT). **E.** Mid stem leaf, *Morton & Venn NA16362* (TRT). **F.** Upper stem leaf mid vein and adaxial surface, *Redfearn & Shimizu 33184* (WAT). **G.** Heads, *Taylor et al. 5555* (WAT). Scale bars = 1 mm in A-B, F- G; = 1 cm in C-E.

Figure 14. *Solidago velutina, Jones 4453* (WAT) from Garfield Co., Colorado.

Figure 15. *Solidago velutina, Correll & Johnston 20140 (LL)* from W of Durango, Mexico.

Figure 16. *Solidago velutina*, *Semple & Heard 7926 (WAT)* from Gila Co., Arizona; a tall shoot with narrow leaves and inflorescence.

Figure 17. Details of the morphology of *Solidago velutina*. **A.** Lower stem, *Henrickson 22412* (TEX). **B.** Lower mid stem; *Davies & Turner A55* (TEX). **C.** Lower stem, *Hinton et al. 27924* (TEX). **D.** Lower stem leaf, *Hinton et al. 28069* (TEX). **E.** Lower stem leaf, *Jones 4453* (WAT). **F.** Mid stem leaf, *Bogler & Atkins* 191 (TEX). **G.** Mid stem leaf, *Riskind 2215* (TEX). **H-I.** Heads, *Tenorio 1646* (TEX) and *Hinton 27918* (TEX). Scale bars = 1 mm in A-C and H-I; = 1 cm in D-G.

Numerous chromosome number reports have been published for taxa in *Solidago* subsect. *Nemorales* including diploids 2*n*=9II or 2n=18, tetraploids 2*n*=18II or 2*n*=36, and hexaploids 2*n*=54. *Solidago californica* includes diploids and a few tetraploids (Raven et al. 1960; Beaudry 1969; Semple et al. 1984; Semple 1985; Semple et al. 1989; Semple et al. 1992; Semple et al. 2000; Morton et al. 2018). No chromosome number has been reported for *S. hintoniorum*. *Solidago mollis* is known to include tetraploids and hexaploids (Anderson et al. 1974; Löve & Löve 1982; Semple et al. 1984; Semple 1985; Semple & Chmielewski 1987; Semple et al. 1993; Morton et al. 2018). *Solidago nana* has been reported to be diploid a few times (Keil & Pinkava 1979; Semple & Chmielewski 1987 corrected identification in Semple et al. 1992; Semple et al. 1989; Semple et al. 2000). *Solidago nemoralis* includes mostly diploids and scattered tetraploids in subsp. *nemoralis* and only *tetraploids* in subsp. *decemflora* (Beaudry & Chabot 1959; Beaudry 1963; Kapoor 1977; Morton 1981; Semple et al. 1981; Löve & Löve 1982; Semple et al. 1984; Brammal & Semple 1990; Semple et al. 1993; Semple & Cook 2004; Semple et al. 2015; Morton et al. 2018; unpublished data); the cytogeography was presented by Brammall and Semple (1990). *Solidago radula* includes diploids and some tetraploids (Beaudry 1969; Semple et al. 1984 as *S. mollis* var. *angustifolia*; Semple & Chmielewski 1987; Semple et al. 1993; Semple et al. 2015; Morton et al. 2018); tetraploids occur in Arkansas and Texas, with the latter being similar to the type of *Solidago mollis* var. *angustifolia* from Texas treated here as a synonym of *S. radula*. *Solidago velutina* (often reported under the synonyms *S. sparsiflora* and *S. velutina var. nevadensis* (A. Gray) C. & J. Taylor) includes diploids, tetraploids, and a few hexaploids in the USA, while only diploids have been reported from Mexico (Raven et al. 1960; Turner et al. 1962; Anderson et al. 1974; Keil & Stuessy 1977; Keil & Pinkava 1979; Semple et al. 1984; Semple 1985; Ward & Spellenberg 1986; Semple & Chmielewski 1987; Keil et al. 1988; Semple et al. 1989; Semple et al. 1992; Zhao Zai-Ming 1996; Semple et al. 2001; Morton et al. 2018); based on involucre height variation it seems likely that some plants in Mexico are polyploid but this has not been documented.

The purpose of this study was to the determine statistical support for recognizing the species and subspecies/varieties proposed within *Solidago* subsect. *Nemorales*, the levels of distinctiveness among the taxa, and what technical traits could be used to separate taxa besides those used to define the taxa as groups a priori. No previous study has included all species. Semple et al. (1990) compared *S. californica*, *S. sparsiflora*, and *S. nemoralis* (subsp. *decemflora* and subsp. *nemoralis*).

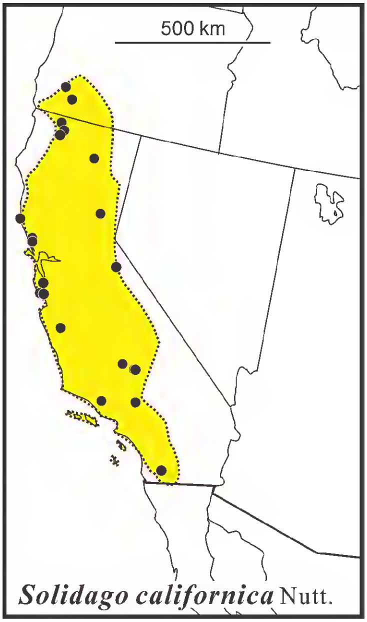


Figure 18. Range of distribution of *Solidago californica* in California and Orgeon and the distribution of 21 specimens of included in the multivariate analyses of *Solidago* subsect. *Nemorales*; range based on all collections seen.

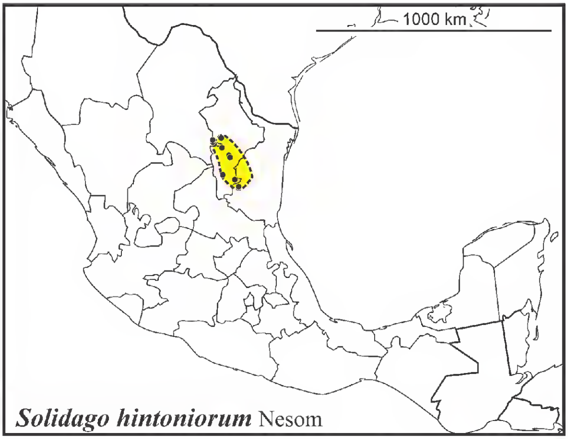


Figure 19. Range of distribution of *Solidago hintoniorum* in Nuevo León and Tamaulipas, Mexico, and the distribution of 5 specimens included in the multivariate analyses of *Solidago* subsect. *Nemorales* and other collections seen.

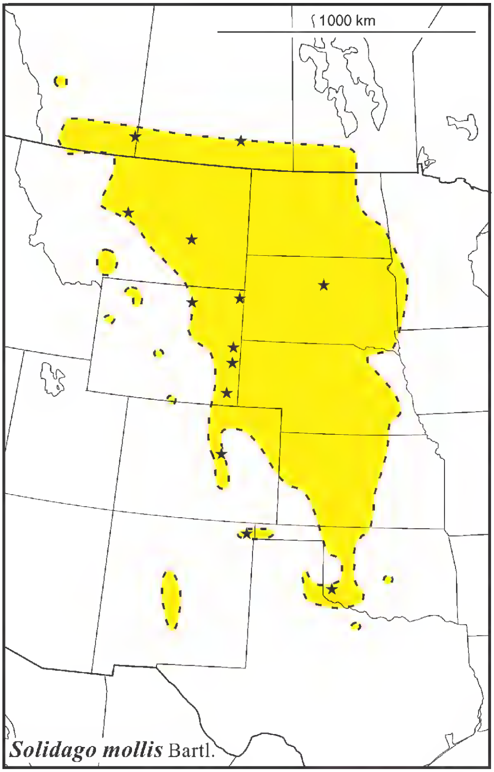


Figure 20. Range of distribution of *Solidago mollis* on the Great Plains in the USA and the distribution of 13 specimens included in the multivariate analyses of *Solidago* subsect. *Nemorales*; range based on all collections seen and literature.

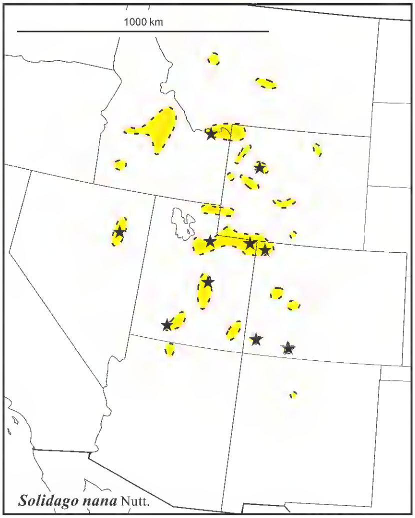


Figure 21. Range of distribution of *Solidago nana* in the Great Basin and central Rocky Mts. in the USA and the distribution of 12 specimens included in the multivariate analyses of *Solidago* subsect. *Nemorales*; range based on all collections seen and literature.

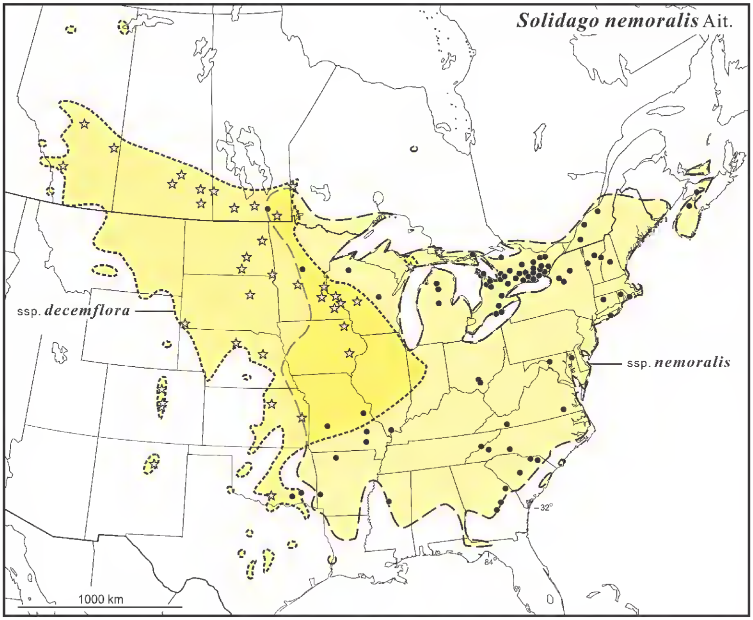


Figure 22. Range of distribution of *Solidago nemoralis* on the Great Plains and in eastern Canada and the USA and the distribution of 177 specimens included in the multivariate analyses of *Solidago* subsect. *Nemorales*; range based on all collections seen and literature; some symbols in densely sampled areas not shown for clarity.

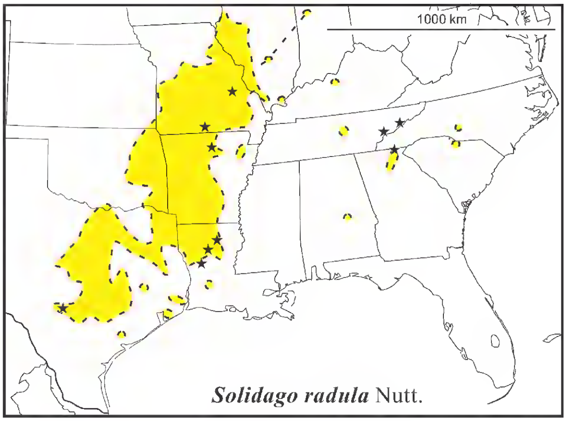


Figure 23. Range of distribution of *Solidago radula* on the Great Plains and in western portion of the eastern deciduous forest area of the USA scattered in disjunction locations further east; the distribution of 13 specimens included in the multivariate analyses of *Solidago* subsect. *Nemorales* are indicated by stars; range based on all collections seen and literature.

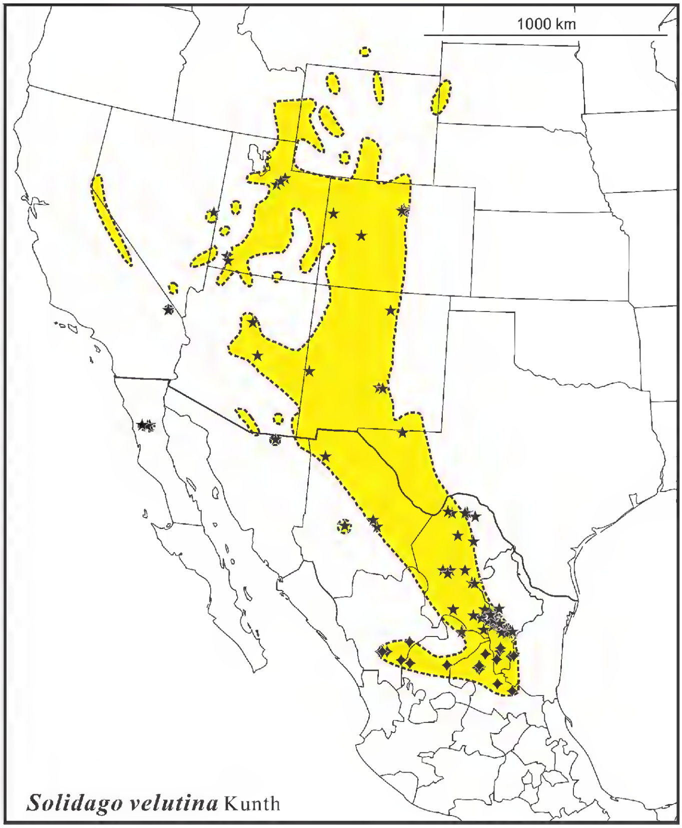


Figure 24. Range of distribution of *Solidago velutina* in the Great Basin and central Rocky Mts. in the USA south into central Mexico and the distribution of 96 specimens included in the multivariate analyses of *S.* subsect. *Nemorales* (putative subsp. *sparsiflora*, stars; putative subsp. *velutina*, diamonds; some symbols not shown due to density of sampling on southern Nuevo León); range based on all collections seen and literature.

MATERIAL AND METHODS

Herbarium specimens were borrowed and examined from the following herbaria: COLO, the J.K. Morton personal herbarium now in TRT, LL, MT, TEX, UNM, and WAT in MT (Thiers continuously updated). More than 1550 specimens were examined, from which 335 were chosen and measured for the statistical analyses based on completeness of the specimen, maturity, and geographical distribution: 21 specimens of *Solidago californica*, 5 of *S. hintoniorum*, 12 of *S. mollis*, 12 of *S. nana*, 177 of *S. nemoralis*, 13 of *S. radula*, and 96 of *S. velutina*). In total, 18 vegetative and 12 floral traits were scored for the final analyses (Table 1). Additional stem, leaf, inflorescence, and phyllary indument traits were used in assigning specimens to a priori groups.

All analyses were performed using SYSTAT v.10 (SPSS 2000). Details on the methodology were presented in Semple et al. (2016) and are not repeated here. Five analyses were performed. In the first analysis, *Solidago californica*, *S. hintoniorum*, *S. mollis*, *S. nana*, *S. nemoralis*, *S. radula*, and *S. velutina* were included in a STEPWISE discriminant analysis and then a COMPLETE discriminant analysis with four traits because only five specimens of *S. hintoniorum* could be included. In the second analysis, *S. mollis*, *S. nana*, and *S. radula* were included in a STEPWISE discriminant. In the third analysis, *S. mollis* and *S. radula*, were included in a STEPWISE discriminant. In the fourth, the *S. californica/S. sparsiflora/S.velutina* complex was investigated via a STEPWISE analysis. In the fifth, *S. californica* and *S. velutina* sensu lato (including *S. sparsiflora*) were included in a STEPWISE discriminant analysis. Numerous additional preliminary analyses were run over multiple years as the sample sizes of the taxa were increased but are not reported here.

Table 1. Traits scored for the multivariate analyses of 150 specimens of *Solidago* subsect. *Nemorales*.

Abbreviation	**Description of trait scored**
STEMHT	Stem height measured from the stem base to tip (cm)
BLFLN	Basal rosette leaf length including petiole (mm)
BLFPETLN	Basal rosette leaf petiole length (not scored if winged margins broad)
BLFWD	Basal rosette leaf width measured at the widest point (mm)
BLFWTOE	Basal rosette leaf measured from the widest point to the end (mm)
BLFSER	Basal rosette leaf-number of serrations on 1 side of margin
LLFLN	Lower leaf length measured from the leaf base to tip (mm)
LLFWD	Lower leaf width measured at the widest point (mm)
LLFWTOE	Lower leaf measured from the widest point to the end (mm)
LLFSER	Lower leaf dentation-number of serrations of lower leaf
MLFLN	Mid leaf length measured from the leaf base to tip (mm)
MLFWD	Mid leaf width measured at the widest point (mm)
MLFWTOE	Mid leaf measured from the widest point to the end (mm)
MLFSER	Mid leaf dentation-number of serrations of mid leaf
ULFLN	Upper leaf length measured form the leaf base to tip (mm)
ULFWD	Upper leaf width measured at the widest point (mm)
ULFWTOE	Upper leaf measured from the widest point to the end (mm)
ULFSER	Upper leaf dentation-number of serrations of upper leaf
CAPL	Length of inflorescence (cm)
INVOLHT	Involucre height at anthesis (mm)
RAYNUM	Number of ray florets per head

RSTRAPLN	Ray strap length top of the corolla tube to the tip of the strap (mm)
RSTRAPWD	Ray strap width measured at the widest point (mm)
RACHLN	Ray floret ovary/fruit body length at anthesis (mm)
RPAPLN	Ray floret pappus length at anthesis (mm)
DCORLN	Disc floret corolla length from the base to tip of the corolla lobes (mm)
DLOBLN	Disc floret corolla lobe length lobe (mm)
DACHLN	Disc floret ovary/fruit body length at anthesis (mm)
DPAPLN	Disc floret pappus length at anthesis (mm)
DACHPUB	Number of hairs on disc floret ovary/fruit body

Placement of specimens of *Solidago velutina* into subsp. *velutina* was made based on geographic location. The lectotype (Nesom 1989b) of *S. velutina* is *Berlandier 930* (G-DC!), whose exact provenance is uncertain. Berlandier was in the range of *S. velutina* in late 1827 and January 1828 starting from Mexico City and passing through San Luis Potosí and Nuevo León to Saltillo and Monterey, and later again in April of 1830 in the Monterey area (Lawson 2012). Assuming *Berlandier 930* came from San Luis Potosí, then the southern portion of the range including Zacatecas would include plants of subsp. *velutina* and plants from further north could be assigned to subsp. *sparsiflora* as shown in Fig. 24. Nesom (1989b) did not divide the species in infraspecific taxa.

RESULTS

Seven species level a priori groups analysis

The Pearson correlation matrix yielded r > |0.7| for most pairs of leaf traits reducing the number to be used to the number of mid stem leaf margin serrations. Basal rosette leaves were often not present and were not included in the analyses. Lower stem leaves were present on many specimens but were not included in the analyses because their traits correlated highly among themselves and with mid and upper stem leaf traits. Among the floral traits scored, only ray floret pappus length and disc floret pappus length correlated highly; the latter was included in the analyses.

In the COMPLETE discriminant analysis of 335 specimens of seven species level a priori groups (*Solidago californica*, *S. hintoniorum*, *S. mollis*, *S. nana*, *S. nemoralis*, *S. radula* and *S. velutina*), the following four of seven traits selected in a STEPWISE analysis were used in the COMPLETE analysis and are listed in order of decreasing F-to-remove values: disc corolla lobe length (98.31), ray floret lamina length (84.13), number of disc florets (77.89), and number of ray florets (32.07). Wilks's lambda, Pillai's trace, and Lawley-Hotelling trace tests of the null hypothesis that all groups were the samples of one group had probabilities of p = 0.000 that the null hypothesis was true. The F-matrix for the discriminant analysis is presented in Table 2. F-values based on Mahalanobis distances of the between group centroids indicated the largest separation was between *S. nemoralis* and *S. velutina* (281.084); the smallest separations were between *S. mollis* and *S. radula* (1.548) and between *S. hintoniorum* and *S. radula* (9.861).

In the Classificatory Discriminant Analysis of 335 specimens of the seven species level a priori groups (*Solidago californica*, *S. hintoniorum*, *S. mollis*, *S. nana*, *S. nemoralis*, *S. radula* and *S. velutina*), percents of correct a posterori assignment to the same a priori group ranged from 58-94%. The Classification matrix and Jackknife classification matrix are presented in Table 3. Results are presented in order of decreasing percents of correct placement. One-hundred and sixty-five of 176 specimens of the *S. nemoralis* a priori group (94%) were assigned a posteriori into the *S. nemoralis* group; 147 specimens with 90-100% probability, 7 specimens with 80-89% probability, 3 specimens

Table 2. Between groups F-matrix for the seven priori groups in a COMPLETE analysis (df = 4 325).

Group	*californica*	*hintoniorum*	*mollis*	*nana*	*nemoralis*	*radula*
hintoniorum	22.143					
mollis	28.057	15.848				
nana	44.090	20.792	20.175			
nemoralis	64.127	46.325	34.100	104.887		
radula	29.236	9.861	1.548	15.556	46.453	
velutina	34.437	11.294	39.829	90.162	281.084	34.065

Wilks' lambda = 0.0540 df = 4 6 328; Approx. F= 61.8377 df = 24 1134 prob = 0.0000

with 72-77% probability, 3 specimens with 62-65% probability, and 3 specimens with 59% (28% to *S. mollis,* 6% to *S. radula* and 6% *S. californica*; *Semple & Brouillet 3472* WAT, subsp. *nemoralis*, from Carroll Co., New Hampshire; diploid), 54% probability (32% *S. velutina* and 13% *S. californica*; *Semple & Heard 8079* WAT, subsp. *decemflora* from San Miguel Co., New Mexico; tetraploid), and 52% probability (33% *S. velutina* and 15% *S. californica*; *Semple & Chmielewski 5094* WAT, subsp. *decemflora* from Pope Co., Minnesota; tetraploid). Eleven specimens of the *S. nemoralis* a priori group were assigned to other species: 6 specimens of subsp. *decemflora* to *S. californica* with 93% probability (*Semple & Brouillet 4273* WAT from Banff N.P., Alberta), 89% probability (*Semple & Brouillet 4212* WAT from E of Bredenbury, Saskatchewan; tetraploid), 59% probability (*Semple & Brouillet 6960* WAT from Barnes Co., North Dakota; tetraploid), 49% probability (*Semple & Heard 8079* WAT from San Miguel Co., New Mexico; tetraploid), 48% probability (*Semple & B. Semple 6676* WAT from Stutsman Co., North Dakota; tetraploid), and 40% probability *(Semple & Chmielewski 5258* WAT from Miami Co., Kansas; tetraploid); 3 specimens to *S. velutina* with 99% probability (*Semple & Brouillet 4216* WAT from W of Springside, Saskatchewan; tetraploid), 90% probability (*Semple & Chmielewski 5168* WAT from Winneskiek Co., Iowa; tetraploid), and 50% probability (29% *S. mollis*, 10% to *S. radula*; *Brunton 18486* WAT from Burnt Lands Prov. Pk., Ontario); and 2 specimens of subsp. *nemoralis* to *S. mollis* with 46% probability (42% to *S. nemoralis*; *Semple & Heard 8265* WAT from Pushmataha Co. Oklahoma) and 43% probability (27% to *S. nemoralis* and 26% *to S. radula*; *Semple & Heard 8275* WAT from Polk Co., Arkansas). Eleven of 12 specimens of the *S. nana* a priori group (92%) were assigned a posteriori into the *S. nana* group; 10 specimens with 96-100% probability, and 1 specimen with 88% probability. One specimen of the *S. nana* a priori group was assigned to *S. radula* with 51% probability (36% to *S. mollis* and 14% to *S. nana*; *Cronquist 8807* COLO from Clarke Co., Idaho). Ten of 13 specimens of the *S. mollis* a priori group (77%) were assigned a posteriori into the *S. mollis* group; 4 specimens with 71-79% probability, 1 specimen with 61% probability, and 5 specimens with 57% probability (42% to *S. radula*; 266 *Semple & B. Semple 11391* WAT from Judith Basin Co., Montana), 56% probability (42% to *S. radula*; *Semple & B. Semple 10644* WAT from E of Walsh AB in Saskatchewan), 54% probability (34% to *S. nemoralis* and 12% to *S. radula*; *Semple & B. Semple 6624* WAT from Niobrara Co., Nebraska), 53% probability (43% to *S. radula*; *Hubbard s.n.* UNM from Union Co., New Mexico), and 51% probability (32% to *S. radula* and 12% to *S. velutina*; *Semple & Brouillet 6984* WAT from Rosebud Co., Montana; hexaploid). Three specimens of the *S. mollis* a priori group were assigned to *S. radula* with 59% probability (38% to *S. mollis*; *Calvert s.n.* WAT from Lumsden, Saskatchewan), 56% probability (43% to *S. mollis*; *Semple & Xiang 10188* WAT from Crook Co., Wyoming; tetraploid), and 50% probability (29% to *S. mollis* and 20% to *S. nana*; *Semple & B. Semple 6655* WAT from Potter Co., South Dakota). Sixteen of the 21 specimens of the *S. californica* a priori group (76%) were assigned a posteriori to the *S. californica* group; 10 specimens with 90-100% probability, 3 specimens with 81-89% probability, 1 specimen with 78% probability, and 2 specimens with 57% probability (42% to *S. nemoralis*; *Semple & Heard 8607*

WAT from Monterey Co., California) and 53% probability (22% to *S. velutina* and 21% to *S. nemoralis*; *Semple & Heard 8730* WAT from Tuolumne Co., California). Five specimens of the *S. californica* a priori group were assigned to other species: 4 specimens to *S. velutina* with 75% probability (25% to *S. californica*; *Ringius 1473* WAT from Santa Cruz Co., California), 61% probability (35% to *S. californica*; *Ringius 1495* WAT from Sonoma Co., California), 61% probability (14% to *S. radula*, 12% to *S. hintoniorum*, and 7% to *S. californica*; *Semple & Heard 8465* WAT from Siskiyou Co., California; diploid), and 52% probability (28% to *S. mollis*, 8% to *S. radula*; *Semple & Heard 8486* WAT from Siskiyou Co., California); and 1 specimen to *S. nemoralis* with 65% probability (17% to *S. velutina* and 14% to *S. californica*; *Semple & Brouillet 7131* WAT from Jackson Co., Oregon). Sixty-nine of 96 specimens of the *S. velutina* a priori group (72%) were assigned a posteriori into the *S. velutina* group; 40 specimens with 91-100% probability, 13 specimens with 80-89% probability, 6 specimens with 72-78% probability, 3 specimens with 61-68% probability, and 3 specimens with 59% probability (25% to *S. nemoralis* and 16% to *S. californica*; *Semple & B Semple 5547* WAT from Coconino Co., Arizona; diploid), 56% probability (25% to *S. californica* and 10% to *S. hintoniorum*; *Chiang et al. 7883* LL from Zacatecas, Mexico) and 55% probability (45% to *S. californica*; *Semple & B Semple 5748* WAT from Wheeler Peak, Nevada). Twenty-seven specimens of the *S. velutina* a priori group were assigned to other species: 9 specimens to *S. californica* with 50-100% probability; 8 specimens to *S. hintoniorum* with 36-79% probability, 3 specimens to *S nemoralis* with 79-88% probability, and 3 specimens to *S. radula* with 46-56% probability; additional details on these specimens are not presented. Three of 5 specimens of the *S. hintoniorum* a priori group (60%) were assigned a posteriori to the *S. hintoniorum* group: 2 specimens with 100% probability and 1 specimen with 92% probability. Two specimens of the *S. hintoniorum* a priori group were assigned a posteriori to *S. velutina* with 99% probability (*Hinton et al. 23323* TEX from Nuevo León, Mexico) and 66% probability (26% to *S. hintoniorum*; *Hinton et al. 21492* TEX from Nuevo León, Mexico; this was an upper shoot on the same sheet with one of the specimens with 100% to *S. hintoniorum*). Seven of 12 specimens of the *S. radula* a priori group (58%) were assigned a posteriori into the *S. radula* group; 1 specimen with 79% probability, 4 specimens with 64-68% probability, and 1 specimen 51% probability (48% to *S. mollis*; *Morton & Venn NA16362* TRT from Kerr Co., Texas; tetraploid). Five specimens of the *S. radula* a priori group were assigned a posteriori to other species; 1 specimen to *S. californica* with 68% and 4 specimens to *S. mollis* with 62% probability (38% to *S. radula*; *Cook et al. C-628* WAT from Towns Co., Georgia), 62% probability (*Morton & Venn NA16364* TRT from Kerr Co., Texas; tetraploid), 58% probability (42% to *S. radula*; Semple *et al. 9388* WAT from Washington Co., Missouri; diploid), and 55% probability (45% to *S. radula*; *Morton & Venn NA16258* TRT from Stone Co., Arkansas; tetraploid).

Table 3. Linear and jackknife classification matrices from the Classificatory Discriminant Analysis of four a priori groups; a posteriori placements to groups in rows.

Group	***californica***	***hintoniorum***	***mollis***	***nana***	***nemoralis***	***radula***	***velutina***	**% correct**
californica	16	0	0	0	1	0	4	76
hintoniorum	0	3	0	0	0	0	2	60
mollis	0	0	10	0	0	3	0	77
nana	0	0	0	11	0	1	0	92
nemoralis	6	0	2	0	165	0	3	94
radula	1	0	4	0	0	7	0	58
velutina	9	8	2	0	4	4	69	72
Totals	32	11	18	11	170	15	78	84

Jackknifed classification matrix

Group	*californica*	*hinton-iorum*	*mollis*	*nana*	*nemoralis*	*radula*	*velutina*	% correct
californica	15	0	0	1	1	0	4	71
hintoniorum	0	2	0	1	0	0	2	40
mollis	0	0	9	0	0	4	0	69
nana	0	0	0	11	0	1	0	92
nemoralis	6	0	2	0	165	0	3	94
radula	1	0	4	0	0	7	0	58
velutina	10	8	2	0	4	4	68	71
Totals	32	10	17	13	170	16	77	83

Two dimensional plots of CAN1 versus CAN3 and CAN1 versus CAN2 canonical scores for 334 specimens of *Solidago californica*, *S. hintoniorum*, *S. mollis*, *S. nana*, *S. nemoralis*, *S. radula* and *S. velutina* are presented in Fig. 25. Eigenvalues on the first three axes were 3.829, 1.485, and 0.500.

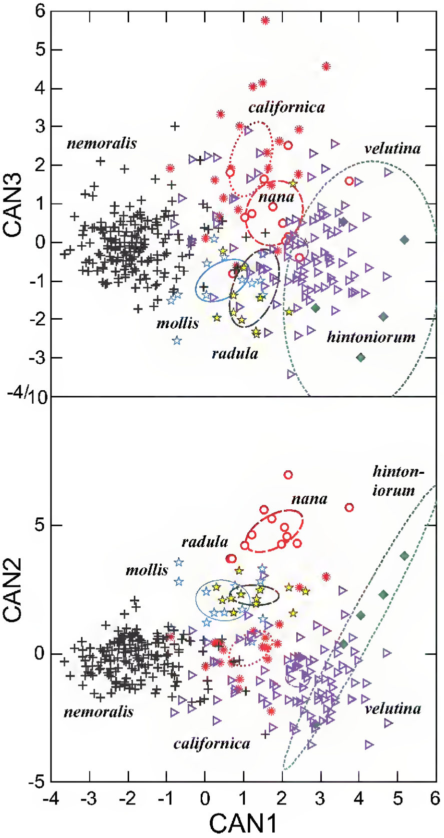


Figure 25. Plot of canonical scores (CAN1 vs CAN3 and CAN1 vs CAN2) for 335 specimens of *Solidago* subsect. *Nemorales*: *S. californica* (red star bursts), *S. hintoniorum* (green diamonds), *S. mollis* (open blue stars), *S. nana* (red circles), *S. radula* (yellow stars), and *S. velutina* (right oriented violet triangles); COMPLETE discriminant analysis using four traits.

Three species level a priori groups analysis

The Pearson correlation matrix for traits of specimens of *Solidago mollis*, *S. nana*, and *S. radula* included r > |0.7| for most pairs of basal and lower leaf traits and mid and upper leaf reducing the number used to mid stem leaf width and serrations. Basal rosette leaves were rarely present and were not included in the discriminant analyses. Many floral traits were correlated, and only the numbers of ray and disc florets and the lengths of disc corolla, corolla lobes, fruit/ovary body, and pappus were included in the STEPWISE analysis.

In the STEPWISE discriminant analysis of 37 specimens of three species level a priori groups in (*Solidago mollis*, *S. nana*, and *S. radula*), the following four traits were selected and are listed in order of decreasing F-to-remove values: number of disc florets (35.70), disc corolla lobe length (5.95), number of ray florets (4.19), and mid leaf width (4.01). Wilks's lambda, Pillai's trace, and Lawley-Hotelling trace tests of the null hypothesis that all groups were the samples of one group had probabilities of p = 0.000 that the null hypothesis was true. The F-matrix for the discriminant analysis is presented in Table 4. F-values based on Mahalanobis distances of the between group centroids indicated the largest separation was between *S. mollis* and *S. nana* (14.334); the smallest separation was between *S. mollis* and *S. radula* (1.574).

Table 4. Between groups F-matrix for the four species level a priori groups analysis (df = 7 26).

Group	***mollis***	***nana***
nana	14.334	
radula	1.574	11.642

Wilks' lambda = 0.1391 df = 8 2 34; Approx. F= 5.67263 df = 16 54 prob = 0.0000

In the Classificatory Discriminant Analysis of 37 specimens of the four species level a priori groups (*S. mollis*, *S. nana* and *S. radula*), percents of correct a posterori assignment to the same a priori group ranged from 58-100%. The Classification matrix and Jackknife classification matrix are presented in Table 5. Results are presented in order of decreasing percents of correct placement. All 12 specimens of the *S. nana* a priori group (100%) were assigned a posteriori into the *S. nana* group; 11 specimens with 97-100% probability and 1 specimen with 55% probability (35% to *S. radula* and 10% to *S. mollis*. Eleven of 13 specimens of the *S. mollis* a priori group (85%) were assigned a posteriori into the *S. mollis* group; 1 specimen with 94% probability, 1 specimen with 82% probability, 4 specimens with 71-78% probability, 2 species with 67% and 62% probabilities, and 3 specimens with 55% probability (45% to *S. radula*), 52% probability (46% to *S. radula*), and 52% probability (47% to *S. radula*). Two specimens of the *S. mollis* a priori groups were assigned to *S. radula* with 69% probability (31% to *S. mollis*; *Sauleda & Sauleda 6323* WAT from Elbert Co., Colorado; 39.5 cm tall shoots with congested smallish stem leaves and small involucres) and 61% probability (39% to *S. mollis*; *Calvert s.n.* WAT from Lumsden, Saskatchewan; 58.5 cm tall shoot with no lower stem leaves and 4.1 mm tall involucres). Seven of 12 specimens of the *S. radula* a priori group (58%) were assigned a posteriori into the *S. radula* group; 1 specimen with 96% probability, 1 specimen with 87% probability, 3 specimens with 79% probability, and 2 specimens with 69% probability (16% to *S. mollis* and 14% to *S. nana*; *Thomas et al. 102874* WAT from Winn Par., Louisiana; a *S. nemoralis*-like general appearance) and 62% probability (38% to *S. mollis*; *Redfearn & Shimizu 33184* WAT from Taney Co., Missouri). Five specimens of the *S. radula* a priori group were assigned to *S. mollis* with 68% probability (32% to *S. radula; Morton & Venn NA16364* TRT from Kerr Co., Texas; tetraploid), 68% probability (32% to *S. radula*; *Morton & Venn NA16258* TRT from Stone Co., Arkansas; tetraploid), 67% probability (33% to *S. radula*; *Morton &*

Venn NA16362 TRT from Kerr Co., Texas; tetraploid), 64% probability (36% to *S. radula*; Cook et al. C-628 WAT from Towns Co., Georgia), and 54% probability (46% to *S. radula*; *Semple et al. 9388* WAT from Washington Co., Missouri; diploid).

Table 5. Linear and jackknife classification matrices from the Classificatory Discriminant Analysis of four a priori groups; a posteriori placements to groups in rows.

Group	*mollis*	*nana*	*radula*	% correct
mollis	11	0	2	85
nana	0	12	0	100
radula	5	0	7	58
Totals	16	12	9	81

Jackknifed classification matrix

Group	*mollis*	*nana*	*radula*	% correct
mollis	7	0	6	54
nana	0	11	14	92
radula	5	0	7	58
Totals	12	11	14	68

Two dimensional plot of CAN1 versus CAN2 canonical scores for 37 specimens of *Solidago mollis*, *S. nana*, and *S. radula* is presented in Fig. 26. Eigenvalues on the first two axes were 3.999 and 0.213.

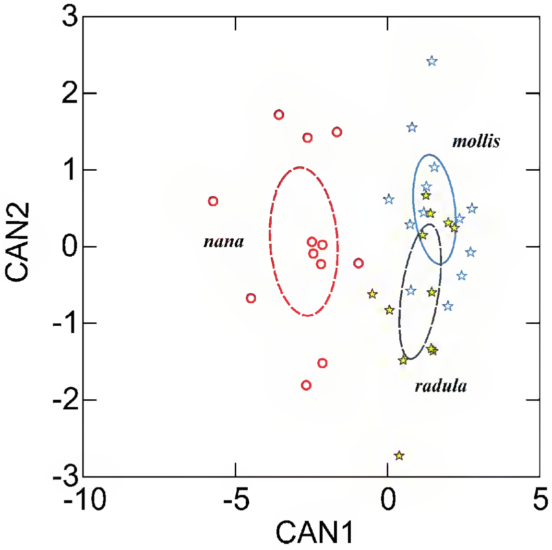


Figure 26. Plot of canonical scores (CAN1 vs CAN2) analysis for 37 specimens of *Solidago* subsect. *Nemorales*: *S. mollis* (open blue stars), *S. nana* (red circles), and *S. radula* (yellow stars).

Two species level a priori groups analysis: Solidago mollis and S. radula

The Pearson correlation matrix yielded r > |0.7| for most pairs of leaf traits reducing the number to be used to mid stem leaf width and number of serrations and upper stem leaf length. Most floral traits were not highly correlated. Involucre height correlated with ray floret pappus length and disc floret corolla length. Ray floret fruit body and pappus lengths correlated with disc floret fruit body length and disc floret corolla length, respectively; the latter two traits were included in the analyses.

In the STEPWISE discriminant analysis of 23 specimens of two species level a priori groups (*S. mollis* and *S. radula*), the following three traits selected in a STEPWISE analysis are listed in order of decreasing F-to-remove values: involucre height (5.91), number of ray florets (4.73), and disc floret lobe length at anthesis (4.09). Wilks's lambda, Pillai's trace, and Lawley-Hotelling trace tests of the null hypothesis that all groups were the samples of one group had probabilities of p = 0.0143 that the null hypothesis was true. *Solidago mollis* and *S. radula* had an F-to separate value of 4.505 (Wilks' lambda = 0.5967 df = 3 1 22; Approx. F= 4.5054 df = 3 20 prob = 0.0143).

In the Classificatory Discriminant Analysis of 23 specimens of the two species level a priori groups (*S. mollis* and *S. radula*), percents of correct a posterori assignment to the same a priori group were 77% and 73%. The Classification matrix and Jackknife classification matrix are presented in Table 6. Ten of the 13 specimens of the *S. mollis* a priori group (77%) were assigned a posteriori into the *S. mollis* group; 3 specimens with 91-98% probability, 3 specimens with 82-88% probability, 2 specimens with 79% and 77% probabilities, and 2 specimens with 67% and 64% probabilities. Three specimens of the *S. mollis* a priori groups were assigned to *S. radula* with 79% (*Calvert s.n.* WAT from Lumsden, Saskatchewan), 58% probability (*Sauleda & Sauleda 6323* WAT from Elbert Co., Colorado), and 53% probability (*Semple & Brouillet 6984* WAT from Rosebud Co., Montana; hexaploid). Eight of 11 specimens of the *S. radula* a priori group (75%) were assigned a posteriori into the *S. radula* group; 4 specimens with 91-99% probability, 2 specimens with 72% and 71% probabilities, 1 specimen with 68% probability, and 1 specimen with 51% probability (*Thomas et al. 102874* WAT from Winn Par., Louisiana). Three specimens of the *S. radula* a priori group were assigned to *S. mollis* with 67% probability (*Taylor et al. 5555* WAT from Ouachita Par., Louisiana), 66% probability (*Morton & Venn NA16364* TRT from Kerr Co., Texas; tetraploid), and 64% probability (*Morton & Venn NA16362* TRT from Kerr Co., Texas; tetraploid).

Frequencies of CAN1 canonical scores for 23 specimens of *S. mollis* and *S. radula* are presented in histograms in Fig. 27. The Eigenvalue on the first axis was 0.676.

Table 6. Linear and jackknife classification matrices from the Classificatory Discriminant Analysis of three varietal level a priori groups; a posteriori placements to groups in rows; Nesom (2008) variety concept.

Group	*mollis*	*radula*	% correct
mollis	10	3	77
radula	3	8	73
Totals	13	10	75

Jackknifed classification matrix

Group	*mollis*	*radula*	% correct
mollis	10	3	77
radula	4	7	64
Totals	14	10	71

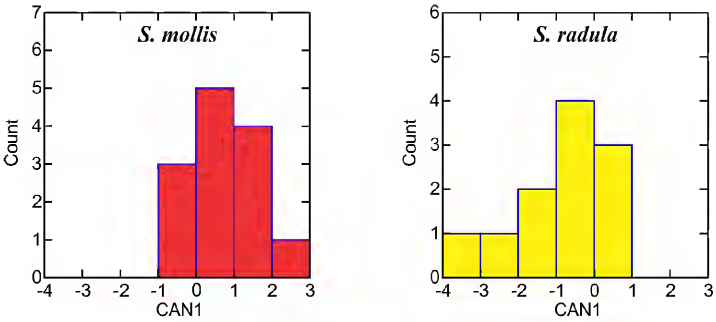


Figure. 27. Histograms of CAN1 canonical scores for 23 specimens of *S. mollis* (left) and *S. radula* (right).

Three species/subspecies level a priori groups analysis of S. velutina s.l.

The Pearson correlation matrix yielded r > |0.7| for most pairs of leaf traits reducing the number to be used to mid stem leaf length, width and number of serrations and upper stem leaf length. Multiple floret traits were correlated and involucre height, ray floret number, ray floret lamina length and width, disc floret number, and disc floret corolla, lobe and fruit body lengths were included in the analyses.

In the STEPWISE discriminant analysis of 99 specimens of three subspecies level a priori groups of *Solidago velutina s.l.* (subsp. *californica*, subsp. *sparsiflora*, and subsp. *velutina*) plus 14 specimens only included a posteriori, the following three traits selected in a STEPWISE analysis are listed in order of decreasing F-to-remove values: disc floret number (9.90), disc corolla length (9.40), and ray floret lamina length (4.57). Wilks's lambda, Pillai's trace, and Lawley-Hotelling trace tests of the null hypothesis that all groups were the samples of one group had probabilities of p = 0.000 that the null hypothesis was true. The F-matrix for the discriminant analysis is presented in Table 7. F-values based on Mahalanobis distances of the between group centroids indicated the largest separations were between subsp. *californica* and subsp. *sparsiflora* (22.426) and subsp. *californica* subsp. *velutina* (20.332); the smallest separation was between putative subsp. *sparsiflora* and putative subsp. *velutina* (1.146).

Table 7. Between groups F-matrix for the three varietal level a priori groups analysis (df = 3 91); alternative varietal limits.

Group	***californica***	***sparsiflora***
sparsiflora	22.426	
velutina	20.332	1.146

Wilks' lambda = 0.5387 df = 3 2 93; Approx. F= 10.9958 df = 6 182 prob = 0.0000

In the Classificatory Discriminant Analysis of 99 specimens of the three species/subspecies level a priori groups in *S. velutina s.l.* (subsp. *californica*, subsp. *sparsiflora*, and subsp. *velutina*) plus 14 specimens only included a posteriori, percents of correct a posterori assignment to the same a priori group ranged from 32-92%. The Classification matrix and Jackknife classification matrix are presented in Table 8. Results are presented in order of decreasing percents of correct placement. Ten of the 11 specimens of the *S. californica/*subsp. *californica* a priori group (92%) plus 6 specimens included a posteriori were assigned a posteriori into the subsp. *californica* group; 12 specimens with 91-100% probability, 2 specimens with 83% and 85% probabilities, 2 specimens with 72-73% probability, and 1 specimens with 69% probability, and 1 specimen with 52% probability (28% to subsp. *sparsiflora* and 20% to subsp. *velutina*; *Semple et al. 9365* WAT from Kern Co., California). One specimen of the *S. californica*/subsp. *californica* a priori group plus one specimen included a posteriori were assigned to subsp. *sparsiflora* with 53% probability (29% to subsp. *californica* and 18% to subsp. *velutina*; *Ringius 1495* WAT from Sonoma Co., California) and 52% probability (27% to subsp. *californica* and 21% to subsp. *velutina*; *Semple & Brouillet 7131* WAT from Jackson Co., Oregon). Nine of the 16 specimens of the subsp. *velutina* a priori group (56%) plus 3 specimens only included a posteriori were assigned a posteriori into the subsp. *velutina* group; 1 specimen with 75% probability, 9 specimens with 50-59% probability, and 1 specimen with 49% probability (47% to subsp. *velutina*; *Nesom & Wells 6698* TEX from southern Nuevo León). Seven specimens of the subsp. *velutina* a priori group plus 1 specimens included a posteriori were assigned a posteriori to subsp. *sparsiflora* with 56% probability (44% to subsp. *velutina*; *Chiang et al. 8001* LL from southern Nuevo León, Mexico), 55% probability (44% subsp. *velutina*; *Reyes A. 820* TEX from San Luis Potosi, Mexico), 52% probability (48% subsp. *velutina*; *Gonzalez 435* TEX from southern Durango, Mexico), 50% probability (50% subsp. *velutina*; *Lundell 5104* TEX from San Luis Potosi, Mexico), 49% probability (47% subsp. *velutina*; *Nesom & Wells 6726* TEX from southern Nuevo León, Mexico), 49% probability (45% subsp. *velutina*; *Wilson 10979* TEX from Zacatecas, Mexico), and 48% probability (48% to subsp. *velutina*; *Rzedowski 6815* TEX from San Luis Potosi, Mexico). Twenty-two of 68 specimens of the subsp. *sparsiflora* a priori group (32%) plus 6 specimens included a posteriori were assigned a posteriori to the subsp. *sparsiflora* group; 2 specimens with 60-61% probability, 21 specimens with 50-49% probability, 3 specimens with 40-49% probability, and 1 specimen with 34% probability. Thirty-eight specimens of the subsp. *sparsiflora* a priori group plus 7 specimens included a posteriori were assigned to other subspecies; 11 specimens to subsp. *californica* with 38-99% probability and 41 specimens to subsp. *velutina* with 49-61% probability); the details are not presented here.

A two dimensional plot of CAN1 versus CAN3 canonical scores for 118 specimens of *Solidago velutina* (subsp. *californica*, subsp. *sparsiflora*, and subsp. *velutina*) are presented in Fig. 28. Eigenvalues on the first two axes were 0.636 and 0.021.

Table 8. Linear and jackknife classification matrices from the Classificatory Discriminant Analysis of three varietal level a priori groups; a posteriori placements to groups in rows; alternative variety concept.

Group	*californica*	*sparsiflora*	*velutina*	% correct
californica	11	1	0	92
sparsiflora	8	22	38	32
velutina	0	7	9	56
Totals	19	30	47	44

Jackknifed classification matrix

Group	*californica*	*sparsiflora*	*velutina*	% correct
californica	11	1	0	92
sparsiflora	10	17	41	25
velutina	0	9	7	44
Totals	19	27	48	36

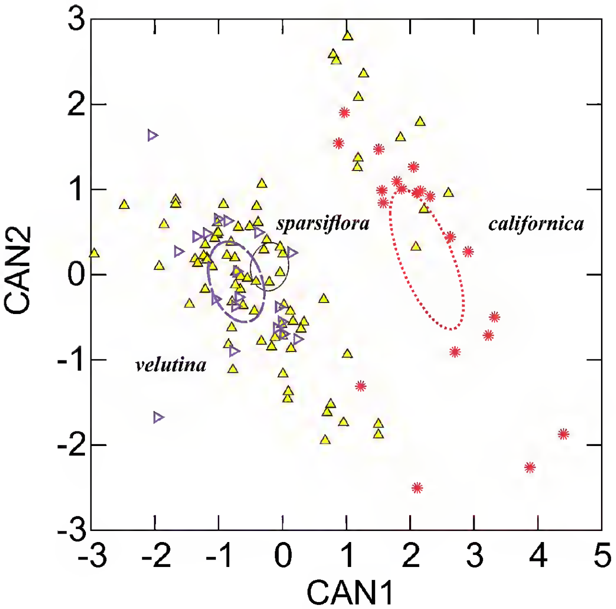


Figure 25. Plot of canonical scores (CAN1 vs CAN2) analysis for 119 specimens of *Solidago* subsect. *Nemorales*: *S. californica* (red star bursts), putative *S. sparsiflora* (yellow triangles), and putative *S. velutina* (right oriented violet triangles).

Two species level a priori groups analysis: Solidago californica and S. velutina

The Pearson correlation matrix yielded r > |0.7| for some pairs of leaf traits reducing the number to be used to mid stem leaf length, width and upper stem leaf width. The traits used in the analyses were the same as used for the subspecies analyses within *S. velutina.*

In the STEPWISE discriminant analysis of 109 specimens of two species level a priori groups (*S. californica* and *S. velutina*), the following four traits selected in a STEPWISE analysis are listed in order of decreasing F-to-remove values: number of disc florets (17.77), ray floret lamina length (5.27), disc floret corolla length at anthesis (4.62), and disc floret ovary/fruit body length at anthesis (4.38). Wilks's lambda, Pillai's trace, and Lawley-Hotelling trace tests of the null hypothesis that all groups were the samples of one group had probabilities of p = 0.000 that the null hypothesis was true. *Solidago californica* and *S. velutina* had an F-to separate value of 15.3231 (Wilks' lambda = 0.6292 df = 4 1 107; Approx. F= 15.3231 df = 4 104 prob = 0.0000).

In the Classificatory Discriminant Analysis of 109 specimens of the two species level a priori groups (*S. californica* and *S. velutina*) plus 16 additional specimens included a posteriori, percents of correct a posterori assignment to the same a priori group were 92% and 89%. The Classification matrix and Jackknife classification matrix are presented in Table 9. Eleven of the 12 specimens of the *S. californica* a priori group (92%) plus 7 specimens include a posteriori were assigned a posteriori into the *S. californica* group; 11 specimens with 92-100% probability, 2 specimens with 86% and 88% probabilities, 3 specimens with 70-78% probability, 1 specimen with 64% probability, and 1 specimen with 58% probability (*Semple & Heard 8607* WAT from Monterey Co., California).

One specimen of the *S. californica* a priori group and 1 additional specimen included a posteriori were assigned a posteriori to *S. velutina* with 58% probability (*Semple & Brouillet 7131* WAT from Jackson Co., Oregon) and 56% probability (*Ringius 1495* WAT from from Sonoma Co., California). Eighty-six of the 97 specimens of the *S. velutina* a priori group (89%) plus 10 additional specimens included a posteriori were assigned to the *S. velutina* a priori group: 72 specimens with 90-100% probability, 7 specimens with 83-88% probability, 7 specimens with 70-78% probability, 3 specimens with 65-66% probability, and 3 specimens with 57% probability (*Semple & Heard 8142* WAT from Lincoln Co., New Mexico; diploid), 55% probability (*Semple & Heard 7863* WAT from Washington Co., Utah; diploid), and 53% probability (*Powell et al. 1474* TEX from Coahuila, Mexico). Eleven specimens of the *S. velutina* priori group plus 1 specimen included a posteriori were assigned a posteriori to *S. californica* with 99% probability (*Semple & B Semple 5749* WAT from Wheeler Peak, Nevada; peduncles sparsely strigtose, outer phyllaries not strigose, tetraploid), 97% probability (*Semple & B Semple 6536* WAT from Boulder Co., Colorado; diploid), 95% probability (*Semple & B Semple 5812* WAT from Boulder Co., Colorado), 87% probability (*Semple & B Semple 5806* WAT from Gilpin Co., Colorado; tetraploid), 87% probability (*Semple & B Semple 5748* WAT from Wheeler Peak, Nevada), 83% probability (*Semple & Heard 7926* WAT from Gila Co., Arizona; diploid; Fig. 16), 83% probability (*Henrickson 11780* LL from Coahuila, Mexico), 82% probability (*Johnston 2603* TEX from Coahuila, Mexico), 74% probability (*Jones 4453* WAT from Garfield Co., Colorado; Fig. 16), 72% probability (*Semple & Chmielewski 8876* WAT from Wasatch Co., Utah; tetraploid), 59% probability (*Semple & Chmielewski 8882* WAT from Utah Co., Utah; diploid), and 55% probability (*Cowan et al 5373* TEX from Coahuila, Mexico).

Table 9. Linear and jackknife classification matrices from the Classificatory Discriminant Analysis of two species level a priori groups; a posteriori placements to groups in rows.

Group	*californica*	*velutina*	% correct
californica	11	1	92
velutina	11	86	89
Totals	22	87	89

Jackknifed classification matrix

Group	*californica*	*velutina*	% correct
californica	11	1	92
velutina	12	85	88
Totals	23	86	88

Frequencies of CAN1 canonical scores for 125 specimens of *S. californica* and *S. velutina* are presented in histograms in Fig. 30. The Eigenvalue on the first axis was 0.589.

DISCUSSION

The results from all the discriminant analyses support the recognition the following taxa in the *Solidago* subsect. *Nemorales*: *Solidago californica, S. hintoniorum, S. mollis, S. nana, S. nemoralis* (subsp. *decemflora* and subsp. *nemoralis*), *S. radula* and *S. velutina* (including *S. sparsiflora* in synonymy). However, not all *a priori* groups separated strongly and the percentages of specimens assigned *a posteriori* to their corresponding *a priori* groups differed considerably and for some specimens the assignment probabilities were low. Overall, the seven species are likely closely related and have not diverged greatly in multiple characters in multiple cases. Historically, *S.*

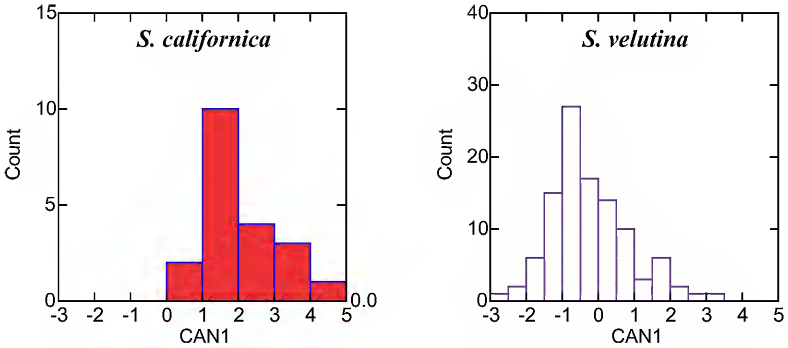


Figure. 30. Histograms of CAN1 canonical scores for 125 specimens of *S. californica* (left) and *S. velutina* (right).

californica has been included in *S. velutina* either as a subspecies (Semple & Cook 2006) or as a synonym of *S. velutina* (Nesom 1989b). *Solidago nemoralis* was found to be the most morphologically distinct species in the subsection with 94% of the 176 specimens being placed into the species group a posteriori even though only four floral traits were used in the discriminant analysis. Semple et al. (1990) concluded that *S. nemoralis* should be divided into two subspecies. This conclusion was not tested again because only one additional specimen of *S. nemoralis* was added to the matrix in the current study.

Solidago nana was also found to separate strongly from the other species using only four floral characters. This is not surprising because the species is easily recognized by its generally dense indument of soft canescent hairs and its often superficially corymbiform inflorescence. Its range is in part sympatric with that of *S. velutina*, but the two are not likely to be confused. Included in the analysis was *Baker 722* (COLO; Fig. 8) from Pagosa Springs, Archuleta Co., Colorado which was placed a posteriori into *S. nana* with 100% probability. *Baker 722* (COLO) was the unseen voucher that Semple and Nesom (2013) cited as the only specimen of *S. rigida* being present in the Flora of the Four Corners Region and noted it to possibly be introduced. The specimen had been first identified by E.L. Green as *S. rigida* and annotated later as *Oligoneuron rigidum* (L.) Small by W.A. Weber. The specimen is just a robust individual of *S. nana* and is now annotated as such. The phyllaries of *S. rigida* are multi-veined, while those of *S. nana* are always single veined. There is no known collection of *S. rigida* from the area covered by the Flora of the Four Corners Region.

The results presented here support the conclusion of Semple et al. (1990) that *S. californica* should be treated as a separate species but that *S. sparsiflora* should be reduced to a synonym under *S. velutina* as Nesom (1989b) suggested. In the analysis of the three possible subspecies within *S. velutina*, the *californica* group was supported as distinct, but only 34% of the *sparsiflora* group specimens were placed into that group in the a posteriori classification analysis. When *S. californica* and *S. velutina* including all the putative *S. sparsiflora* specimens were compared, 19 of the 21 specimens of *S. californica* were placed into that species, and 92 of 105 specimens of *S. velutina* were placed a posteriori into the that species. In all cases, the misplaced specimens had the diagnostic traits of the species they were assigned to a priori. Our conclusion is that sometimes floral traits of the two species overlap in ranges of variation, but when all traits are considered, identification to the correct species is likely. This includes the few collections of *S. velutina* from the Mohave Desert in eastern and southeastern California and the few collections of *S. velutina* from the San Pedro Martir region of northern Baja California, Mexico.

The most unexpected result of the multivariate analyses was the lack of strong separation of *Solidago mollis* and *S. radula*. *Solidago mollis* was found to be very similar to *S. radula* based on the traits used in the analyses, but differences in stem density in clones, inflorescence shape, leaf hair density, and leaf shape make placement of specimens into one of the two species reliable. Tetraploids of *S. radula* had technical traits similar to those of the tetraploid/hexaploidy *S. mollis*. The ranges are allopatric but approach each other closely in western Oklahoma and southern Panhandle Texas in the Red River region. We conclude that the two species are closely related. *Solidago mollis* may be derived from *S. radula*.

Lastly, *Solidago hintoniorum* was not well differentiated from *S. velutina*. The sample size of only five specimens for *S. hintoniorum* accounts for some of the statistical results. Additional specimens of *S. hintoniorum* were examined in this study, but these had immature heads and thus could not be scored for floral traits. In the protologue of *S. hintoniorum*, Nesom (1989a) compared the species to *S. petiolaris* and *S. wrightii*. Later, Nesom (1993) included *S. hintoniorum* in *S.* subsect. *Thyrsiflorae* in his overview of the entire genus. In this study in Table 2, the F-value based on the Mahalanobis distance is slightly lower for the group centroids of *S. hintoniorum* and *S. radula* than for *S. hintoniorum* and *S. velutina*, although two of the five specimens of *S. hintoniorum* were assigned a posteriori to *S. velutina* and none to *S. radula*. Some specimens of *S. hintoniorum*, e.g. *Patterson 6331* (TEX; Fig. 3), not included in the multivariate analysis due to missing data points look very similar to some specimens of *S. radula*. As noted by Nesom (1989a) and confirmed in this study, the phyllaries of some specimens annotated by Nesom in 1989 as *S. hintoniorum* have broad oblong multi-veined phyllaries (Fig. 4H) that would be very atypical in *S. velutina* but fit better with the single-veined phyllaries of *S. radula*. At this point, conclusions about the status of *S. hintoniorum* are tentative. Further field work is needed to collect more flowering samples of *S. hintoniorum* and to ascertain how different its habitat is from *S. velutina* in the southern half of Nuevo León, Mexico.

In conclusion, the seven species of *Solidago* subsect. *Nemorales* are clearly closely related but differ sufficiently in some obvious and some technical traits, so that identification of most specimens to species should not be a great challenge when geography is also considered.

Key to taxa in *Solidago* subsect. *Nemorales*

1. Heads secund, in rounded, secund, pseudo-corymbiform paniculiform arrays; often alkaline meadows and flats, Montana and Idaho south to New Mexico and Arizona .... **Solidago nana**
1. Heads usually in narrowly to broadly pyramidal, paniculiform arrays, branches secund.
    2. Plants with short-branched caudices; leaves softly canescent; arrays secund to apically recurved; prairies and open ground in eastern deciduous forests .... **Solidago nemoralis**
        3. Pappus bristles usually not or barely exceeding ray floret corolla tubes and bases of disc floret lobes; disc corolla lobes 0.5–0.9(–1) mm; involucres usually 2.6–4.2 mm (tetraploids have larger heads); cypselae usually only sparsely strigose; basal leaves usually crenate, oblanceolate to obovate; open areas and open woods in eastern deciduous forest .... **Solidago nemoralis** subsp. **nemoralis**
        3. Pappus bristles usually exceeding ray floret corolla tubes and bases of disc corolla lobes; disc corolla lobes (0.6–)0.8–1.5 mm; involucres usually 4.6–5.8 mm; cypselae moderately strigose; basal leaves usually not crenate, often linear-oblanceolate; prairies (rarely in forested areas) from Indiana westward to the Rocky Mountains, British Columbia to New Mexico .... **Solidago nemoralis** subsp. **decemflora**
    2. Plants with short to long creeping-rhizomatous; heads in thyrsiform to secund-pyramidal, paniculiform arrays.
        4. Leaves finely scabrous, not or weakly 3-nerved; central and eastern USA ... **Solidago radula**

4. Leaves coarsely scabrous, hispid or soft-canescent, sometimes strongly 3-nerved; prairies and w USA to central Mexico.
    5. Heads in paniculiform arrays, usually compact, branches broadly thyrsiform to somewhat secund pyramidal, proximal branches reflexed-recurved distally, basal leaves withering by flowering; prairies of Great Plains .... **Solidago mollis**
    5. Heads in cone-shaped arrays with branches narrowly secund, or open, lax, pyramidal; basal leaves often present at flowering; from near sea to mid montane elevations, Wyoming to s Oregon, south to central Mexico.
        6. Peduncles moderately to densely strigose; outer phyllaries lanceolate to ovate, sparsely strigose; stems densely villose-strigose; California and s Oregon .... **Solidago californica**
        6. Peduncles very sparsely to moderately strigose; outer phyllaries lanceolate with attenuate acute tips, usually glabrous (rarely sparsely strigose in Zacatecas); stems moderately to densely short-canescent; Great Basin and Rocky Mountain USA to central Mexico.
            7 7.3 mean number of ray florets; inner phyllaries single-veined .... **Solidago velutina**
            7. 4.3 mean number of ray florets; inner phyllaries sometimes multi-veined .... **Solidago hintoniorum**

ACKNOWLEDGEMENTS

This work was supported by a Natural Sciences and Engineering Research Council of Canada Discovery Grants to the first author. Joan Venn is thanked for her curatorial assistance with loans. The following herbaria are thanked for loaning specimens of *Solidago* subsect. *Nemorales* and giving permission to dissect heads: COLO, the J.K. Morton personal herbarium now in TRT, LL, MT, TEX, UNM, and WAT in MT. Andrew Lam assisted in recording location data on specimens of *Solidago* subsect. *Nemorales*. Specimens used in the multivariate study of *S. nemoralis*, *S. californica*, and *S. sparsiflora* (Semple et al. 1990) were included in this study. The staff of the de Candolle Herbarium at Conservatoire et Jardin botaniques de la Ville de Genève is thanked for providing a high resolution digital image of the type material of *Solidago velutina* DC. Kanchi Gandhi is thanked for guidance on determining the provenance of the lectotype of *S. velutina*.

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TWO PREVIOUSLY UNREPORTED PLANT SPECIES FOR WILLACY COUNTY, TEXAS

CHRISTOPHER J. MUÑOZ
School of Earth, Environmental and Marine Sciences
Ocean, Coastal and Earth Sciences Program
University of Texas Rio Grande Valley
Edinburg, Texas
Christopher.munoz01@utrgv.edu

ABSTRACT

Two plant species are reported as new records for Willacy Co., Texas: *Vachellia schaffneri* (Fabaceae) and *Hamatocactus bicolor* (Cactaceae). These findings are likely not biogeographic anomalies, warranting further botanical surveys within Willacy County. *Hamatocactus bicolor* is reported to occur within counties contiguous to both Kenedy Co. and Willacy Co., with no significant differences in environmental parameters changing across these county lines. Similarly, *Vachellia schaffneri* is reported to occur within counties surrounding Brooks, Kenedy, and Willacy counties.

Hamatocactus bicolor and *Vachellia schaffneri* are reported as new records for Willacy Co., Texas, resulting from field surveys conducted along Texas Highway 186. Both specimens are located just south of the Kenedy County line—also a county for which neither species has been reported. This proximity suggests a likelihood that both species occur in Kenedy County as well. This is further substantiated by the fact that counties contiguous to Willacy Co. and Kenedy Co. are within the known range of *H. bicolor*. Though *V. schaffneri* is not reported to occur within Brooks or Kenedy county, contiguous counties are within the known range of this species. Voucher specimens for both species were collected and deposited at PAUH (University of Texas Rio Grande Valley Herbarium). County records were determined by referring to the TEX-LL Occurrence Records database (Lundell Plant Diversity Portal), the Atlas of the Vascular Plants of Texas (Turner et al. 2003), and regional literature (Richardson & King 2011).

VACHELLIA SCHAFFNERI (S. Wats.) Seigler & Ebinger (Fabaceae)

Voucher. **Texas**. Willacy Co.: Texas Hwy 186, 5.3 mi SW of Port Mansfield, with *Prosopis glandulosa, Vachellia farnesiana, Karwinskia humboldtiana, Schaefferia cuneifolia, Maytenus phyllanthoides, Yucca treculeana, Zanthoxylum hirsutum, Borrichia frutescens,* and various grasses, unconsolidated, well-sorted, medium to fine-grained sand (part of the South Texas Sand Sheet, STSS), 26.503633° -97.490275°, elev. 8 ft, 3 Jun 2018, *Muñoz s.n.* (PAUH). The water table at the collection site probably is shallow (0.5 to 1 m in depth) due to proximity of the site to the Laguna Madre.

Vachellia schaffneri is often mistaken for *V. farnesiana*, particularly when fruits are absent. In addition to producing diagnostically longer legumes than *V. farnesiana*, *V. schaffneri* can be distinguished by the presence of a petiolar gland on the upper portion of the rachis directly between the first set of pinnae (Plants of Texas Rangelands 2018).

Figure 1. *Vachellia schaffneri* individual (center) and associated vegetation, Willacy Co., Texas.

Figure 2. Fruit of *Vachellia schaffneri*, Willacy Co., Texas.

Figure 3. Petiolar gland of *Vachellia schaffneri* between the first set of pinnae, Willacy Co., Texas.

Figure 4. *Hamatocactus bicolor*, Willacy Co. Texas.

HAMATOCACTUS BICOLOR (Terán & Berlandier) I.M. Johnst. (Cactaceae)

Vouchers. **Texas**. Willacy Co.: Texas Hwy 186, 3 mi SW of Port Mansfield, sand (part of the South Texas Sand Sheet, STSS), one of a population, with *Rhynchosia americana*, *Prosopis glandulosa*, *Schaefferia cuneifolia*, *Maytenus phyllanthoides*, *Yucca treculeana*, *Zanthoxylum hirsutum*, 26.518704° -97.453287°, elev. 9 ft, 3 Jun 2018, *Muñoz s.n.* (PAUH).

Hamatocactus bicolor is morphologically similar to *Ferocactus hamatacanthus* var. *sinuatus* but can be distinguished by both the color of the fruits (red) and the inner region of its flowers (red) (Richardson & King 2011). *Ferocactus hamatacanthus* var. *sinuatus* has green fruits and completely yellow flowers.

ACKNOWLEDGEMENTS

The author thanks Juan González, Andrew McDonald, and Guy Nesom for reviewing this paper and Ken King for information on sources for biogeographic records.

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NOTES ON *STENOTUS* AND *NESTOTUS*
(ASTERACEAE: ASTEREAE)

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109
guynesom@sbcglobal.net

ABSTRACT

The genus *Nestotus* is enlarged to three species with the addition of *Stenotus lanuginosus*, as **Nestotus lanuginosus** (A. Gray) Nesom, **comb. nov.** and **Nestotus lanuginosus** var. **andersonii** (Rydb.) Nesom, **comb. nov.** *Stenotus pulvinatus* is maintained as a member of *Stenotus* sensu stricto, a genus of three species (also including *S. acaulis* and *S. armerioides*). Illustrations of habit and diagnostic details are provided for species of each genus.

Molecular studies by Roberts (2002) and Roberts and Urbatsch (2003, 2004) showed that *Stenotus* as previously circumscribed (Rydberg 1900; Nesom 1989 and Morse 1998, as 6 species) is not monophyletic. *Stenotus acaulis* (the type) and *S. armerioides*, as sister species in the analyses, together are most closely related to *Petradoria* (1 or 2 species) and *Toiyabea* (monotypic). *Stenotus stenophyllus* and *S. macleanii* show as sister species and were segregated by Roberts et al. (2005) as the genus *Nestotus*. Curiously, in the cladogram published by Brouillet et al. (2009), it is *S. stenophyllus* and *S. macleanii* that show as sister to *Petradoria* and *Toiyabea*, and the positions of *S. acaulis* (Baja California) and *S. armerioides* (western USA and Saskatchewan) are unresolved.

The relationships of *Stenotus lanuginosus* and *S. pulvinatus* were not resolved in the molecular analyses by Roberts and colleagues (or by Brouillet et al.), but Roberts et al. (2005) maintained them within *Stenotus*. For the FNANM treatment, *Stenotus* was regarded as a genus of 4 species (Morse 2006), *Nestotus* as a genus of 2 (Urbatsch et al. 2006). The taxonomic positions of *S. lanuginosus* and *S. pulvinatus* are considered here.

1. STENOTUS LANUGINOSUS

A close similarity between *Nestotus* (Stenotus) *macleanii* (A. Gray) Urbatsch et al. and *Nestotus* (Stenotus) *stenophyllus* (Brandeg.) Urbatsch et al. was observed by Morse (1998), who placed *Stenotus lanuginosus* close to these, based on the common production of thin, stipitate-glandular leaves and stipitate-glandular, thin-herbaceous phyllaries of equal or subequal lengths in 2 series. All three species also have a mat-forming habit with solitary, yellow-rayed heads and narrow leaves, and *N. stenophyllus* and *S. lanuginosus* both produce at least small amounts of cobwebby vestiture.

Molecular analyses (Roberts 2002; Roberts & Urbatsch 2003, 2004; summarized by Roberts et al. 2005) place *Nestotus macleanii* and *Nestotus stenophyllus* as sister species but suggest that *Stenotus lanuginosus* is basal to a clade comprising *Chrysothamnus*, *Amphipappus*, *Acamptopappus*, *Tonestus*, *Eastwoodia*, *Oreochrysum*, and *Lorandersonia*. Only in a single morphological feature, however, is *S. lanuginosus* excluded from the generic description given by Roberts et al. (2005, 2006) for *Nestotus* –– the linear leaves of *N. macleanii* and *N. stenophyllus* are 1-nerved, while the slightly wider leaves of *S. lanuginosus* are 3-nerved.

Molecular data may suggest that the evolutionary origin of *Stenotus lanuginosus* involved hybridization or introgression, perhaps apart from *Nestotus macleanii* and *N. stenophyllus*, but the strong morphological similarity among these three species supports a hypothesis of close common ancestry, and the third species is added here to *Nestotus*.

Nestotus lanuginosus (A. Gray) Nesom, **comb. nov.** *Haplopappus lanuginosus* A. Gray in C. Wilkes et al., U.S. Expl. Exped. 17(2): 347. 1874 (as *Aplopappus*). *Aster pickeringii* Kuntze (nom. nov.), Revis. Gen. Pl. 1: 316. 1891. *Stenotus lanuginosus* (A. Gray) Greene, Erythea 2: 72. 1894. **TYPE**: **USA**. **Washington**. [Chelan Co.?]: Upper Columbia, early Jun 1841, *C. Pickering & W.D. Brackenridge 1050* (holotype: US image!, fragment GH image!).

a. **Nestotus lanuginosus** (A. Gray) Greene var. **lanuginosus**

b. **Nestotus lanuginosus** var. **andersonii** (Rydb.) Nesom, **comb. nov.** *Stenotus andersonii* Rydb., Bull. Torrey Bot. Club 27: 615. 1900. *Haplopappus lanuginosus* subsp. *andersonii* (Rydb.) H.M. Hall, Publ. Carnegie Inst. Wash. 389: 172. 1928. *Haplopappus lanuginosus* var. *andersonii* (Rydb.) Cronq., Vasc. Pl. Pacif. N.W. 5: 219. 1955. *Stenotus lanuginosus* (A. Gray) Greene var. *andersonii* (Rydb.) Morse, Sida 21: 2093. 2005. **TYPE**: **USA**. **Montana.** [Broadwater Co.]: Belt Mountains, on open hills, 14 Jul 1886, *F.W. Anderson 3561* (holotype: NY image!).

Key to the species of Nestotus

1. Leaves linear-oblanceolate, 3-nerved, mostly 1.5–5 mm wide, longer, surfaces sparsely to moderately lanate .... **Nestotus lanuginosus**
1. Leaves mostly linear-oblong to linear-oblanceolate, 1-nerved, mostly 1–1.5 mm wide, shorter, surfaces glabrous or hirsute to hirsutulous.

2. Leaf surfaces glabrous, eglandular, margins usually ciliate with short, stiffly spreading hairs .... **Nestotus macleanii**
2. Leaf surfaces hirsute to hirsutulous, often stipitate-glandular, margins eciliate .... **Nestotus stenophyllus**

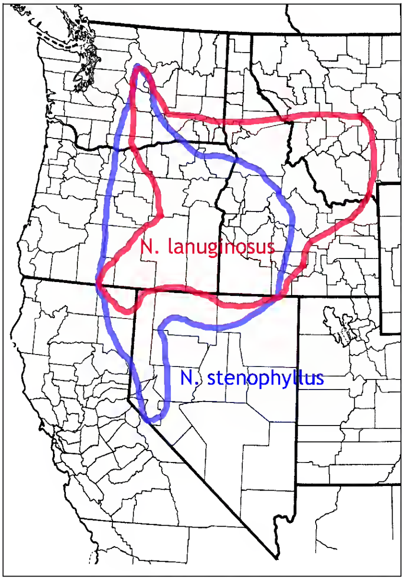

Figure 1. Generalized distributions of *Nestotus* species. *Nestotus macleanii* is endemic to central Yukon.

Figure 2. *Nestotus stenophyllus*, representative plants and heads. Above, photo by Paul Slichter, 20 Apr 2011, Washington.

Figure 3. *Nestotus stenophyllus,* representative plants.

Figure 4. *Nestotus stenophyllus*, leaf vestiture. Photo G.D. Carr, 2010. WTU

Figure 5. *Nestotus stenophyllus* involucre. Photo by Richard Spellenberg, 24 May 2015, California.

Figure 6. *Nestotus stenophyllus,* characteristic involucral morphology.

Figure 7. *Nestotus macleanii.* Photo by Syd Cannings, iNaturalist, 28 May 2011, Yukon Territory.

Figure 8. *Nestotus macleanii.* Characteristic habit.

Figure 9. *Nestotus macleanii.* Characteristic vestiture, stiffly ciliate leaf margins.

Figure 10. *Nestotus lanuginosus.* Photo by Paul Slichter, 28 June 2008, northeastern Oregon.

Figure 11. *Nestotus lanuginosus* Characteristic habit.

Figure 12. *Nestotus lanuginosus*, involucre. Photo by Paul Slichter, 2 June 2012, Steens Mountain, Oregon.

Figure 13. *Nestotus lanuginosus*, characteristic involucral morphology. Note similarity with that of *Nestotus stenophyllus*, Fig. 6.

2. STENOTUS PULVINATUS

Stenotus pulvinatus is an endemic of the Sierra de San Pedro Mártir in Baja California, where it grows in rocky habitats at 7500–9200 feet elevation. It has a mat-forming habit (from a taproot and woody, multicipital caudex, often with long branches), narrow, coriaceous leaves with stipitate-glandular vestiture, rayless, solitary heads on peduncles no longer than the basal leaves, and oblong-lanceolate phyllaries with acute apex, slightly thickened, in 3–4 series strongly graduate in length. The phyllaries have a herbaceous apical patch and white-indurate base. All of these features except the lack of ray flowers and consistently foreshortened peduncles are similar to those of at least some forms of *Stenotus acaulis*; peduncles of *S. acaulis* vary greatly in length.

No other North American species of Astereae beside *Stenotus acaulis* closely resembles S. *pulvinatus* and it seems a reasonable hypothesis that now-isolated *S. pulvinatus* originated as a variant of a once more widely distributed *S. acaulis*. *Stenotus acaulis* itself includes numerous formally named variants (Morse 2006). The genus *Stenotus* -- including three species, *S. acaulis*, S. *armerioides*, and *S. pulvinatus*, excluding *Nestotus* [Stenotus] *lanuginosus* -- is a morphologically and geographically coherent group.

Stenotus pulvinatus (Moran) Nesom, Phytologia 67: 113. 1989. *Haplopappus pulvinatus* Moran, Trans. San Diego Soc. Nat. Hist. 15: 161, fig. 7. 1969. TYPE: **MEXICO**. **Baja California**. Sierra de San Pedro Mártir, E slope of Cerro "2828," on E rim, near 31° 02' N, 115° 27' W, scarce, in crevices of N- and E-facing rocks and cliffs, 2800 m, 5 Jul 1968, *R. Moran 15262* (holotype: SD image!; isotypes: CAS!, GH image, K image, KANU as cited, MEXU image!, RSA!, UC!, US image!).

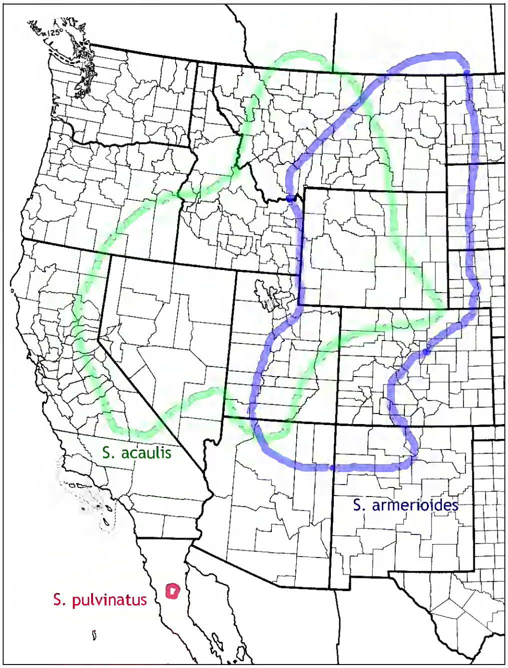

Figure 14. Generalized distribution of *Stenotus* species.

Figure 14. *Stenotus acaulis.* Above: photo by Paul Slichter, Steens Mountain, Oregon, 2 June 2012, Saskatchewan. Below: photo by Steve Matson, Mono Co., California, 18 May 2008.

Figure 15. *Stenotus acaulis.* Top left: photo by Steve Matson, California, 2005. Top right: photo by Gary Monroe, Nye Co., Nevada, May 13, 2006.

Figure 16. *Stenotus armerioides*. Above, photo by Al Schneider, 4 May 2005, Utah. Below: Representative plants with details of involucres.

Figure 17. *Stenotus armerioides* involucres. Above, photo by Glen Lee, Saskatchewan. Below: photo by Al Schneider, 4 May 2005, Utah.

Figure 18. *Stenotus pulvinatus*. Above, photo by Jon Rebman, 12 Jun 2016, Sierra San Pedro Mártir. Below: Representative plant with short peduncle.

Figure 19. *Stenotus pulvinatus* involucres. Left, photo by Jon Rebman, 12 Jun 2016.

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TERNSTROEMIA (THEACEAE) IN THE ARKANSAS FLORA

BRETT E. SERVISS
Department of Biological Sciences
Box H-7570
Henderson State University
1100 Henderson Street
Arkadelphia, Arkansas 71999
servisb@hsu.edu

JONATHAN W. HARDAGE
Bismarck, Arkansas 71929
jh201098@reddies.hsu.edu

KEENAN B. SERVISS
Sylvia Street
Arkadelphia, Arkansas 71923

BROOK L. OLSEN
Bismarck, Arkansas 71929
brooklolsen@gmail.com

JAMES H. PECK
P.O. Box 705
Cedar Key, Florida 32625
james.peckck@gmail.com

ABSTRACT

The first known occurrence of *Ternstroemia gymnanthera* outside of cultivation in Arkansas is reported here. One escaped plant of *T. gymnanthera* was discovered growing at the base of a steep slope, at the top of a stream bank of an intermittent stream in a disturbed, urban greenbelt in Clark County. Photographs of *T. gymnanthera*, including the escaped plant in habitat, along with notes on *Ternstroemia* and the Theaceae family in Arkansas, are provided.

In 2017, a single, escaped plant of *Ternstroemia gymnanthera* (Wight & Arnolt) Beddome (glossy ternstroemia) was found on the bank of an intermittent stream within a highly disturbed, urban greenbelt in Clark County (Figs. 1–2). The plant was growing at the top of the stream bank, at the base of a steep, semi-wooded slope. The site is directly bordered on both sides by residential areas. Three cultivated, reproductively mature plants of *T. gymnanthera* were present at one of the homesites bordering the greenbelt; these plants presumably were the source of the escaped plant. In addition to *T. gymnanthera*, a number of other non-native angiosperm species were naturalized at the site.

Voucher specimens: **Arkansas**. Clark Co.: Arkadelphia, urban greenbelt immediately NW of intersection of 24th St. and Crawford St., one escaped plant at top of bank of intermittent stream at base of steep slope in a disturbed, semi-wooded greenbelt, cultivated plants of *T. gymnanthera* about 12 m away at top of slope in adjacent residential area, 17 Nov 2017, *Serviss 8609* (HEND); Arkadelphia, highly disturbed area of homesite adjacent to intersection of 13th St. and Henderson St., spontaneous juvenile plant, less than 1 m tall, 28 Feb 2007, *Serviss 7113* (HEND).

Serviss and Peck (2008) previously documented the presence of spontaneous, juvenile plants of *Ternstroemia gymnanthera* in the immediate vicinity of cultivated individuals of the species; spontaneous juveniles of *T. gymnanthera* have been observed from multiple locations in Clark County in 2005 and 2007 (Serviss, unpublished data—Fig. 3). The 2017 record of *T. gymnanthera*, although still in relative proximity to cultivated plants of the species, was separated from them downslope by more than 12 m, indicating probable seed dispersal (via birds or water and/or gravity) from the cultivated plants, followed by subsequent establishment of the escaped plant. The seeds probably are bird-dispersed (Min & Bartholomew 2007), which is supported by the red to reddish-orange, fleshy covering of the seeds. Cultivated plants of *Ternstroemia* (in Arkansas) sometimes produce fruits with seeds.

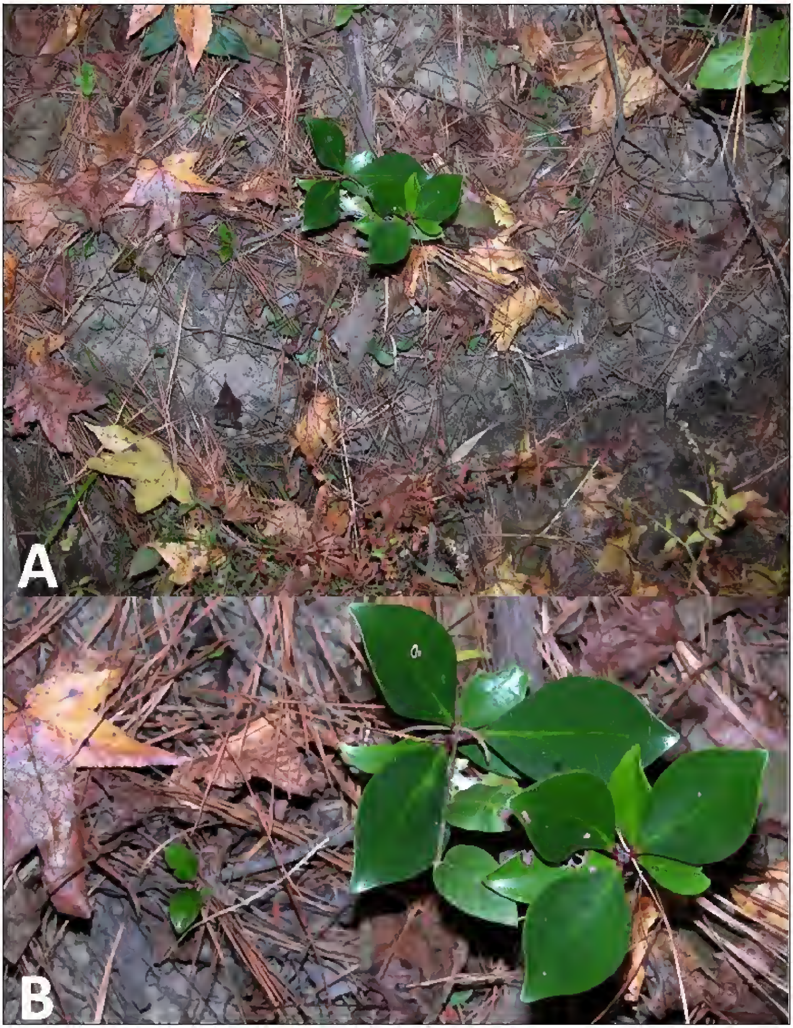

Figure 1. *Ternstroemia gymnanthera* escaped in Clark Co., Arkansas. (A) Plant was less than 1 m tall. A portion of the stream bank may be seen below the plant in Fig. 1A. (B) Close-up of plant. Notice the conspicuous red to reddish-purple petioles (also see Fig. 2).

Figure 3. Spontaneous, juvenile plants of *Ternstroemia* in Clark County. (A–B) Small plants from self-seeding by a large, cultivated plant on the Henderson State University (HSU) campus; several similar seedlings were present in the area surrounding the cultivated plant (Fig. 3A shows two of these plants). (B) Close-up of one of the plants shown in Fig. 3A (notice the occasional, widely-spaced, serrate teeth on some of the leaves). The purple coloration seen on the plants in Figs. 3A–B sometimes occurs during winter periods and is normal, at least for young plants. (C) Slightly older plant than those shown in Figs. 3A–B (after discovery, some of these plants were collected and eventually transplanted to allow for continued observation).

Figure 2. Close-up of a portion of the escaped *Ternstroemia gymnanthera* plant showing new growth in spring (2018). The leaves sometimes are serrately-toothed, even in mature plants.

Ternstroemia gymnanthera is a large, evergreen shrub or small tree, sometimes to 10 or 15 m, native to China, India, Japan, Vietnam, and other areas of southern Asia (Bailey & Bailey 1976; Krüssmann 1978; Min & Bartholomew 2007). This species is an easily grown, shade-tolerant ornamental, with attractive, glossy, evergreen foliage. *Ternstroemia gymnanthera* regularly is cultivated in the southern USA, including Arkansas, and has been reported as a component of the naturalized floras of Alabama, Florida, and South Carolina (Payne 2010; Weakley 2015; Keener et al. 2018; Wunderlin et al. 2018). The genus was not treated in Flora of North America (Prince 2009).

At least some of the *Ternstroemia* material cultivated and naturalized in the southeastern USA is not unequivocally identifiable as *T. gymnanthera*—these taxa may represent other species, hybrids, or horticultural selections out of the normal morphological range of wild *T. gymnanthera* (a number of horticultural varieties of *T. gymnanthera* do exist), as described by Min and Bartholomew (2007) in the Flora of China (Weakley 2015). This is certainly the case for Arkansas, as many cultivated *Ternstroemia* plants observed produce flowers with pedicels considerably longer than the 1–1.5 cm attributed for that species in the Flora of China *Ternstroemia* treatment. Ohwi (1965) and Walker (1976), in two treatments of the Japanese flora, list a pedicel length for the flowers of up to 2 cm, which is somewhat closer to what has been observed in cultivated and spontaneous *Ternstroemia* plants in Arkansas. The University of Arkansas Cooperative Extension Service (2018) lists a pedicel length of ca. 1 in (2.54 cm); this is clearly within the range of pedicel lengths observed with Arkansas plants. The cultivated *Ternstroemia* plants that presumably generated the 2017 escaped plant described here had flowers with pedicel lengths ranging from 1.9–3.5 cm (Fig. 4), but in most, if not all other respects, appear similar to the plants classified as *T. gymnanthera* that regularly are cultivated in this country.

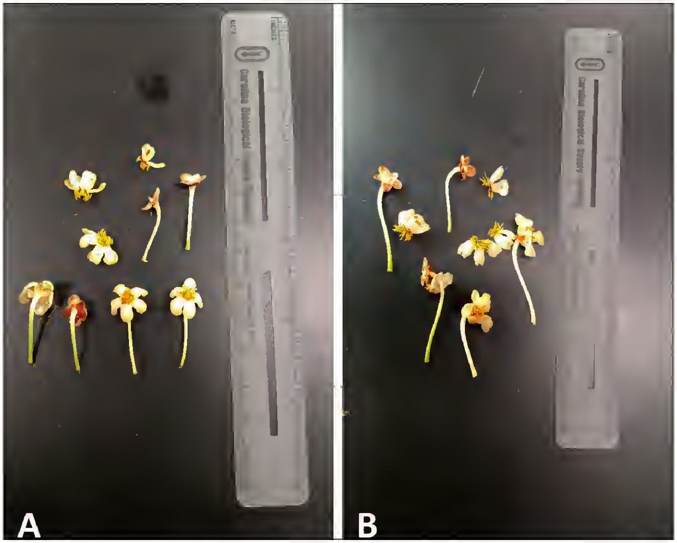

Figure 4. (A–B) Comparison of flowers and pedicel lengths between two of the cultivated *Ternstroemia* plants, which are the presumed source of the 2017 escaped *Ternstroemia* plant. Pedicel length in Fig. 4A ranges from 1.9–2.5 cm, in Fig. 4B from 2.4–3.5 cm. Overall, both plants were similar to one another in appearance but the 4A plant had slightly smaller leaves and a more dense growth habit. Petal width of the flowers shown in A is approximate to the stated range for the species; some of the flowers in B had slightly wider petals (to ca. 8 mm) than described for *T. gymnanthera* (Min & Bartholomew 2007).

Ternstroemia gymnanthera is the only species in the genus listed in Bailey and Bailey (1976) as cultivated in the USA, and it is the only cultivated *Ternstroemia* species listed in Griffiths (1992) and Krüssmann (1978), both of which offer a more broad-reaching scope of coverage for plants in cultivation. Interestingly, one of the spontaneous plants (documented from 2005, 2007—Figs. 3, 5A–D) produced flowers (in 2018) with pedicels 2 cm and longer. It is morphologically similar to cultivated *Ternstroemia* plants in the Arkadelphia area (and elsewhere). As a result of these apparent discrepancies, unequivocal identification of at least some Arkansas *Ternstroemia* material as *T. gymnanthera* is problematic. To date, however, escaped *Ternstroemia* plants documented from the state appear to resemble most closely *T. gymnanthera*.

The genus *Ternstroemia* is sometimes placed within the Pentaphyllaceae family, although traditional placement within the Theaceae is maintained here.

The Theaceae family in Arkansas predominately is represented by exotic taxa; only *Stewartia malacodendron* L. (silky camellia) is native. *Camellia sasanqua* Thunb. (fall-flowering camellia) is sparingly naturalized in the Arkansas flora (Serviss & Peck 2016), and elsewhere in the southeastern USA (Byrd & Diamond 2018). This species is shade-tolerant and often prolifically self-seeds, and numerous occurrences of spontaneous seedlings and juveniles, well over 100 plants in number, have been documented from multiple sites in Clark County (Serviss & Peck 2008; Serviss & Peck 2016); these occurrences almost always in direct association with cultivated individuals of *C. sasanqua*. Additional occurrences of escaped and naturalized plants of *C. sasanqua* should be expected in urban natural areas that occur in proximity to where plants of the species are cultivated.

Camellia japonica L. (Japanese camellia), while not currently known from truly naturalized plants in the state's flora, has demonstrated the ability to generate spontaneous seedlings, which were observed previously in association to cultivated plants of *C. japonica* (Serviss & Peck 2008). *Camellia japonica* has been documented outside of cultivation in a few other southeastern states (Diamond 2013; Weakley 2015), and escaped or naturalized plants of *C. japonica* also should be expected in Arkansas.

The following key may be used to distinguish the Theaceae species currently known from the Arkansas flora.

1. Plant deciduous, leaves not leathery; flowers white, filaments of stamens purple; native and rare in the Arkansas flora .... **Stewartia malacodendron**

1. Plant evergreen, leaves more or less leathery; flowers white to yellowish-cream, or variously colored in shades of pink, lavender, lilac, magenta, purple, or red, stamens yellow to orange-yellow; introduced.

  2. Leaf margins entire or nearly so (occasionally with one or a few large teeth, especially on young plants); seeds small (ca. 6 mm long), red to reddish-orange .... **Ternstroemia gymnanthera**

  2. Leaf margins with numerous, small, serrate teeth; seeds large (ca. 9 mm long or longer), dark brown.

    3. Stems, leaves, ovaries, and fruits with oppressed pubescence .... **Camellia sasanqua**
    3. Stems, leaves, ovaries, and fruits glabrous .... **Camellia japonica**

Figure 5. *Ternstroemia gymnanthera* plant and habit (from Arkansas plants). (A) Leaves. (B) Bark. (C–D) Flowers—the flower shown in D is staminate. (E) Mature fruit with seeds. The photographs shown in Figs. 5A–D were taken in 2018 and are from one of the spontaneous Arkansas plants (shown in Fig. 3) over a decade subsequent to discovery. Figure 5E is from a cultivated *Ternstroemia* plant on the HSU campus.

ACKNOWLEDGEMENTS

We are grateful to the Henderson State University Department of Biological Sciences and the Ellis College of Arts and Sciences for supporting this work.

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LEPTOLOMA SYRTICOLA (POACEAE: PANICOIDEAE): A NEW SPECIES FROM TEXAS AND NEW COMBINATIONS IN *LEPTOLOMA* AND *TRICHACHNE*

JOSEPH K. WIPFF
3512 25th Court SE
Albany, Oregon 97322
jkwipff@gmail.com

ROBERT B. SHAW
Department of Ecosystem Science and Management
Texas A&M University
College Station, Texas 77842
rbshaw@tamu.edu

ABSTRACT

As part of ongoing work on the grasses of Texas, we propose various taxonomic changes and novelties. *Leptoloma* and *Trichachne* are recognized distinct from *Digitaria* s. str. One new species of *Leptoloma* is described –– **Leptoloma syrticola** Wipff & Shaw, **sp. nov.** Two new combinations are made in *Leptoloma* –– **Leptoloma clarkiae** (Sánchez-Ken) Wipff & Shaw, **comb. nov.**, and **Leptoloma pubiflorum** (Vasey) Wipff & Shaw, **comb. nov.** Two new combinations are made in *Trichachne* –– **Trichachne californica** (Benth.) Chase var. **villosissima** (Henrard) Wipff & Shaw, **comb. nov.**, and **Trichachne catamarcensis** (Rúgolo) Wipff & Shaw, **comb. nov.**

As part of ongoing work on the *Guide to Texas Grasses* (Shaw & Wipff, in prep.) and on the grasses of Texas in general, it is necessary to discuss aspects of the taxonomy that we are adopting –– changes in rank, generic transfers to allow for the use of generic concepts, new or old, reinstatement of genera and species previously lost to synonymy, and clarification of characters used to delineate difficult genera or species complexes. As Weakley & al. (2017) have stated,

> "Any effort to compile a flora (the book) describing the flora (the set of taxa) for a region involves the reassessment of previous taxonomies that have been applied, along with synthesis of new information. ... Each floristic author is faced with reassessing the taxonomic status quo of previous floristic authors, considering the accumulation of new and old monographs and other taxonomic papers, and when alternate taxonomic opinions have been expressed, weighing the evidence supporting the differing points-of-view."

Chase (1906) recognized three genera currently treated within *Digitaria* Haller s. lato: **Valota** Adans., nom. rej. (=*Trichachne* Nees), **Syntherisma** Walter (=*Digitaria* Haller, nom. cons.), and **Leptoloma**, described by her as a new genus. Chase designated *L. cognatum* (Schultes) Chase as the type species and transferred *Panicum divaricatissimum* R. Br., *P. macratenium* Benth., and *P. coenicola* F. Muell. into the genus. Chase (1906) distinguished between the three genera as follows. **Valota**: upper spikelet lanceolate-acuminate; second glume and sterile lemma clothed with long hairs exceeding the spikelet; caryopsis unequally biconvex. **Syntherisma**: upper spikelet elliptic; second glume and sterile lemma clothed with short hairs or nearly glabrous; caryopsis planoconvex in section; spikelets disposed in 1-sided racemes which are digitate or racemose. **Leptoloma**: upper spikelet elliptic; second glume and sterile lemma clothed with short hairs or nearly glabrous; caryopsis planoconvex in section; spikelets upper spikelet elliptic; second glume and sterile lemma clothed with short hairs or nearly glabrous; caryopsis planoconvex in section; spikelets in panicles divergent at maturity. Chase (1911), Nash (1912) and Hitchcock (1920) followed Chase (1906) in recognizing these three genera. Chase (1911) designated *Syntherisma praecox* Walter [=*Digitaria* *sanguinalis* (L.) Scop.] as the type for *Syntherisma.* Hitchcock (1920) designated *Valota insularis* (L.) Chase as the type for the genus.

Hitchcock (1927a) recognized *Syntherisma* and *Trichachne* as distinct genera. *Valota,* however, was treated as synonym of *Trichachne* because under the then existing provisions of the Type-Basis Code (old American Code) Article 2 (Hitchcock 1921). *Valota* was not "effectively published" and thus "invalid" for the lack of inclusion of even a single binomial specific name by Adanson. And the earliest effectively published name, *Acicarpa* Raddi (1823) is a later homonym (non Juss., 1803). Green (1935) proposed (Proposal 1178) to retain both *Vallota* (Amaryllidaceae) and *Valota* (Poaceae). But the Special Committee for Phanerogamae and Pteridophyta appointed by the 6th International Congress voted to conserve *Vallota* (Amaryllidaceae) and reject *Valota* (Poaceae), since they considered the two names as orthographic variants of the same name (Green & al. 1940). *Syntherisma* was used for a short period by a few authors (e.g. Nash 1895; Chase 1906, 1911; Nash 1912; Hitchcock 1920, 1927a). Additionally, Hitchcock (1927b) argued for placing the name *Digitaria* on the list of *nomina conservanda.* Rauschert (1969, 1973) also proposed the conservation of *Digitaria.* The proposal of Rauschert (1973) to conserve *Digitaria* was accepted at the 12th International Botanical Congress, Leningrad 1975 (Stafleu & Voss 1975).

Silveus (1933) and Hitchcock (1935, 1951) recognized *Digitaria, Leptoloma,* and *Trichachne.* Henrard (1950) treated *Trichachne* as a section and *Leptoloma* as a subgenus of *Digitaria.* Gould (1975) and Pohl (1980) recognized *Digitaria* (including *Trichachne*) and *Leptoloma.* Vega & al. (2009) studied the phylogenetic relationships within the genus and the monophyly of the currently recognized subgeneric taxa based on morphological evidence. Their results were more consistent with the classification of Chase (1906) than with Henrard (1950) in that species of both sect. *Trichachne* (incl. sect. *Trichophorae*) and subg. *Leptoloma* formed well supported clades outside the core *Digitaria* clade. Vega & al. (2009) treated the two well defined clades of *Leptoloma* and *Trichachne* + *Trichophorae* as infrageneric taxa within *Digitaria* s. lato. Lo Medico & al. (2017) provided molecular and morphological evidence for the taxonomic delimitation of *Digitaria* sect. *Trichachne* (incl. *Trichophorae*). The morphological and molecular data, in our opinion, support the phylogenetic independence of *Leptoloma* and *Trichachne* from *Digitaria.* The follow name combinations are thus required.

Leptoloma clarkiae (Sánchez-Ken) Wipff & Shaw, **comb. nov.** *Digitaria clarkiae* Sánchez-Ken, Phytotaxa 321: 126 (Figs. 1, 2). 2017. TYPE: **MÉXICO**. **Puebla**: Mpio. Tilapa, 2 km del entronque con la carretera Cuautla-Izúcar por la carretera a Atlapanala, aprox. 5 km W de Izúcar, [18°35' N, 98°33' W], 320 m, 4 Sep 1995, *L. Aragón 362* (holotype: MEXU; isotype MEXU).

Leptoloma pubiflorum (Vasey) Wipff & Shaw, **comb. nov.** *Panicum autumnale* Bosc ex Spreng. var. *pubiflorum* Vasey, Bull. Bot. Div. Dept. Agric. (Washington, D.C.) 8: 35. 1889. *Digitaria cognata* (Schult.) Pilg. subsp. *pubiflora* (Vasey) Wipff, Sida 13: 120. 1988. *Digitaria pubiflora* (Vasey) Wipff, Sida 19: 923. 2001. LECTOTYPE (Wipff & Hatch, Syst. Bot. 19: 625. 1994): **Texas**. El Paso Co.: Mts. near Paso del Norte, May 1881, *G.R. Vasey s.n.* (US 928188!; isolectotype: US 744304!).

Trichachne californica var. **villosissima** (Henrard) Wipff & Shaw, **comb. nov.** *Digitaria californica* (Benth.) Henrard var. *villosissima* Henrard, Monogr. Digitaria, 109. 1950. TYPE: **Aruba**. Koolwijk, 1885, *Suringar s.n.* (holotype: L-0819940 image! (908, 92–2468); isotype: US-927379 image!).

Trichachne catamarcensis (Rúgolo) Wipff & Shaw, **comb. nov.** *Digitaria catamarcensis* Rúgolo, Hickenia 1: 22. 1976. TYPE: **Argentina**. **Catamarca**. Capayán, Miraflores. 12 Feb 1941, *Parodi 14356* (holotype: SI!; isotypes: BAA–4190 image!, LP image!).

Key to genera

1. Inflorescences an open panicle (as long as wide); spikelets solitary (or paired or three's) on long or short pedicels; pedicels mostly 2-several times as long as the spikelets, mostly spreading (sometimes distally appressed on branches); the entire panicle usually detaching at maturity .... **Leptoloma**

1. Inflorescences of digitate or sub-digitate primary branches, or primary branches alternately arranged along a central axis; with (1) 2-3 (or more) spikelets per node on primary branches, arranged in two rows along one side of the branch; spikelets appressed on branches; the entire inflorescence does not detach at maturity.

  2. Inflorescences of digitate or sub-digitate primary branches, or primary branches alternately arranged along a central axis; no conspicuous elongated rachilla internodes, upper floret not stipitate; upper lemmas pale yellow, tan, gray, purple-tinged, purple, brown or dark brown; spikelets glabrous to variously pubescent; hairs various, smooth or verrucose walled, apex acute or dilated .... **Digitaria**

  2. Inflorescences of primary branches alternately arranged along a central axis; all the rachilla internodes more or less conspicuously elongated, hence upper florets stipitate; upper lemmas dark brown at maturity; spikelets densely short to long pubescent, hairs generally exceeding the length of the spikelet and hairs spreading at maturity; hairs smoothed walled, apex acute .... **Trichachne**

Digitaria Haller, *nom. cons.*

Plants perennial or annual or indefinite (in tropics). Inflorescence a panicle of primary branches that are digitate or sub-digitate or alternately arranged on a central axis. The entire inflorescence does not detach at maturity. Branches with (1) 2-3 (or more) spikelets per node on primary branches; spikelets in 2 rows along one side of the branch, spikelets appressed on primary branches. Spikelets glabrous to variously pubescent; hairs various, smooth or verrucose walled, apex acute or dilated. Spikelets without elongated rachilla internodes. Upper florets not stipitate; lanceolate to elliptic, apex acute; upper lemmas pale yellow, tan, gray, purple-tinged, purple, brown or dark brown.

Trichachne Nees

Perennial, taxa native to the New World, with knotty or spreading rhizomes. Inflorescence of primary branches alternate along a central axis; primary branches unbranched or with secondary branches. The entire inflorescence does not detach at maturity. Spikelets in pairs, one subsessile and the other pedicellate; spikelets in 2 rows along one side of the branch, appressed on the branch. Indumentum of unicellular hairs, hairs smooth walled, apex acute, whitish-silvery, sometimes whitish with purplish tints or ochraceous, abundant in upper glume and lower lemma (scarce in *T. laxa*), generally exceeding the length of the spikelet and spreading at maturity (shorter in *T. hitchcockii*). Spikelets with all the rachilla internodes more or less elongated, the upper florets stipitate. Upper florets lanceolate to narrowly lanceolate with acuminate apices; upper lemmas dark brown at maturity (Lo Medico & al. 2017).

Leptoloma Chase

Plants perennial or annual; densely or loosely cespitose, with or without rhizomes. Inflorescence an open panicle, the entire inflorescence disarticulating [not in *L. clarkiae* (Sánchez-Ken, 2017)] at maturity. Spikelets solitary (or paired or three's), on usually long pedicels; pedicels mostly 2-several times as long as the spikelets, mostly spreading (sometimes distally appressed on branches). Spikelets glabrous, puberulent, or densely pubescent; hairs smooth walled, apex acute. Spikelets with elongated rachilla internodes between the two glumes (Vega & al. 2009), upper florets not stipitate; upper floret elliptic to narrowly elliptic, apex acute; dark brown or pale green to yellowish (*L. clarkiae*) at maturity.

A new species of *Leptoloma*

Our studies have brought to light a new species of *Leptoloma.* This entity previously has been identified as *L. pubiflorum* but the latter is found in dry, rocky, heavy or sandy soils in Texas, Oklahoma, Colorado, New Mexico, Arizona, and México (Wipff & Hatch 1994), is densely caespitose, and does not have rhizomes. The 'syrticola' taxon is loosely caespitose or tufted, rhizomatous, and is only found on stabilized and unstabilized sands and sandy soils throughout Texas and probably into Oklahoma and New Mexico.

The geographic distribution of *Leptoloma syrticola* lies completely within that of *L. pubiflorum* and it might be suspected that the formation of rhizomes is a phenotypic trait elicited by a sandy habitat. Initiation and development of rhizomes, however, are directed by complex gene mechanisms (Hu & al. 2003, 2011; Yun & al. 2014; Yoshida & al. 2016) and the morphological architecture of axillary bud formation on underground stems is different from that on aerial shoots. Other species pairs of rhizomatous/non-rhizomatous grasses are generally recognized and accepted (e.g. *Andropogon gerardii* Vitman & *A. hallii* Hack.; *Sporobolus compositus* (Poir.) Merr. & *S. macer* (Trin.) Hitchc.; *Sorghum halepense* (L.) Pers. & *S. bicolor* (L.) Moench; *Schizachyrium scoparium* (Michx.) Nash & *S. stoloniferum* Nash –– though sometimes treated at infraspecific ranks by different authors, they are still recognized as distinct taxa.

LEPTOLOMA SYRTICOLA Wipff & Shaw, **sp. nov.** (Figs. 1, 2). TYPE: **TEXAS.** Winkler Co.: 9.5 mi S on Hwy 18 from its intersection with Hwy 115 in Kermit then 16.9 mi on County Rd 404 from its intersection with Hwy 18, along roadside near fence line in Jalmar loamy fine sand, 16 Jun 1987, *J.K. Wipff 308* (holotype: TEX; isotypes: BRIT, TAES, US).

Similar to *Leptoloma pubiflorum* but differing in its extensive rhizome development (rhizomes to 60 cm) and loosely caespitose or loosely tufted habit.

Perennial, loosely caespitose or tufted; with long rhizomes present, **rhizomes** to 60 cm long; rhizome internodes 1–2 cm long, glabrous or pubescent. **Culms** 20–70 cm erect; nodes pubescent or glabrous. **Leaves** glabrous or pubescent; sheaths glabrous or pubescent; auricles erect, usually as long as the ligule; **ligules** 1–2 mm long, membranous; **blades** 1.3–7 cm long, 1.4–5 mm wide, glabrous or pubescent. **Panicles** open, the entire panicle detaches at maturity, 10–20 cm long, 11–25 cm wide; branches divergent, lower branches often with sterile pedicels at base; **pedicels** 0.5–3 cm long, divergent. **Spikelets** solitary, 2.2–3.3 mm long, narrowly elliptic; **lower glumes** 0.1–0.4 mm; **upper glumes** 1.9–3 mm, 3-veined, densely pubescent between the veins. **Lower floret neuter**; lower lemmas 2.0–3.2 mm, as long as spikelets; 5-veined, veins equidistant, densely pubescent between the veins; lower palea 0.3-1mm, veinless membrane. **Upper floret perfect**; upper lemma 2.1–3.1 mm long, indistinctly 3-veined, glabrous, dark brown at maturity, cartilaginous, margins membranous, apex narrowly acute; upper palea 1.9–2.6 mm, 2-veined, similar to upper lemma in texture. **Anthers** 0.3–0.5 mm long. **Caryopses** ellipsoidal, slightly flattened, 1.3–1.6 mm long, 0.5–0.6 mm wide. **Chromosome number** $2n=36$, 72.

Sands (stabilized and unstabilized) and loose sandy soils in Texas (Fig 3) and expected in New Mexico. Flowering April–November.

The epithet "*syrticola*" refers to the habitat of the species on deep, unconsolidated sands and on sandy soils.

Additional collections examined. TEXAS. Andrews Co.: hardish soil, 7 Jul 1943, *Tharp 43A76* (LL). Aransas Co.: Aransas Wildlife Refuge, sandy scrubland, 4 Apr 1957, *Correll 15571 & Schweinfurth* (LL). Atascosa Co.: 1 mi N of North Pleasanton, loose deep reddish sand, Sparta outcrop, few live oaks, much sparse mesquite over predominately grassland, 8 Oct 1954, *Tharp & Johnston 541740* (TEX). Bailey Co.: 0.5 mi N on Hwy 84 from Muleshoe, then 19.1 mi W on Hwy

Figure 1. *Leptoloma syrticola* from the type collection (*Wipff* 308). Photo © Annette R. Wipff, May 2018.

Figure 2. *Leptoloma syrticola* from the type collection (*Wipff* 308). Photo © Annette R. Wipff, May 2018.

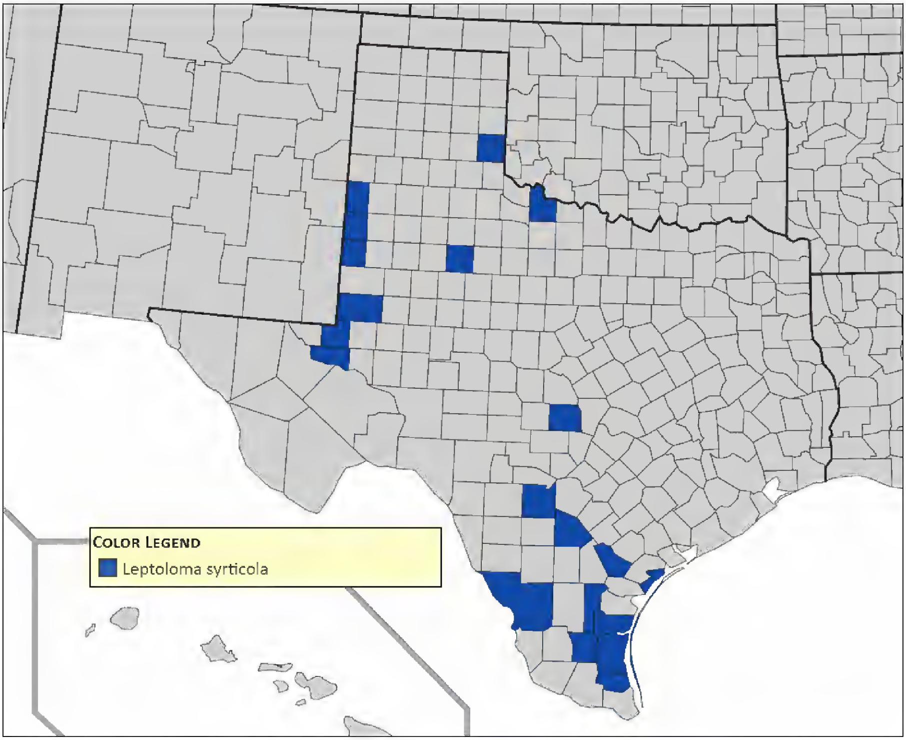

Figure 3. County distribution of *Leptoloma syrticola* in Texas. It probably also occurs in New Mexico and Oklahoma. Map made from program by Michael T. Lee (2012).

1760 from jct with Hwy 84, then 3.5 mi S on unnamed dirt road along Texas/New Mexico state line, 50 m E of road, Tivoli fine sand series (sand 15+ ft deep), very few plants flowering, 15 Jun 1987, *Wipff 301* (jkw, TEX). Bee Co.: US 181 near fence, 1 1/2 mi N of intersection US 181-FM 797, Jun 1966, *Brooks 71* (TEX). Brooks Co.: 10 mi N of Encino, near United Carbon Black Plant, loose sandy prairie, 16 Apr 1954, *Johnston 54496* (TEX). Cochran Co.: 6.4 mi W on Hwy 1585 from its jct with Hwy 214, 5.3 mi S on unnamed dirt rd., cross cattle guard and turn right and travel 0.25 mi on left side of road about 25 m into pasture, deep sand, 15 Jun 1987, *Wipff 302* (jkw, TEX); 2.2 mi W on Hwy 301 from its jct with Hwy 1780, 6.7 mi S on dirt road from its jct with Hwy 301 (Hwy 301 terminates at dirt road), 0.25 mi on main road into Beasley Ranch, 200 m E of road, Patricia Series, fine sand to a depth of 22 inches, 15 Jun 1987, *Wipff 303* (jkw, TEX); 2.7 mi S on Hwy 1780 from its jct with Hwy 301, 50 m W of hwy in pasture, Amarillo fine sandy loam, *Wipff 304* (jkw, TEX). Collingsworth Co.: stabilized dunes, 2-3 mi S of Salt Fork of Red River, 15 Sep 1950, *Tharp 50-L 1—6* (TEX). Jim Wells Co.: brushy prairie 12 mi N of Premont on sandy loam, 24 Nov 1954, *Johnston 542147* (TEX). Kenedy Co.: about 6 mi S of Sarita, among live oaks, side of hwy, white loose sands, 29 Apr 1949, *Tharp &York 50-L-41* (TEX-2 sheets); El Toro Island in Laguna Madre and adjacent coast, unstabilized dunes, 23 Jun 1949, *Tharp 50-L-26—40* (TEX); Laguna Madre, El Toro Island, 28 May 1948, *Tharp 48308* (TEX); below Sarita, hwy right-of-way, dune sand, 4 Dec 1948, *Tharp & al. 48-141* (TEX); 6.3 mi S of Armstrong, loose sand beneath live oaks, 13 Mar 1953, *Johnston 54290* (TEX); 2 mi E of headquarters, Norias Division of King Ranch, beneath mesquite and granjeno, sandy soil, 5 Jul 1954, *Johnston 541047* (TEX); Saltillo Pasture, Norias Division of King Ranch , loose sand prairie on flat between live oak-covered sandhills, 12 Mar 1954, *Johnston 54218* (TEX); 8 1/2 mi S of Sarita, off US Hwy 77, on sand dunes, sand-binding stoloniferous perennial, 24 Apr 1949, *Lundell 14964* (LL); King Ranch, Norias Division, on sandy plain growing in shade of mesquite, stoloniferous perennial, 27 Apr 1949, *Lundell 14980* (LL). Kent Co.: 1.5 mi SW of Jayton, O.H. Hamlin Ranch, in sandy oak shinnery, 24 Jun 1944, *Lundell 13052* (LL). Kleberg Co.: 2.8 mi S of Bishop, near King Ranch loading siding, along roadside, 30 Apr 1949, *Tharp & York 49268* (TEX). Llano Co.: 9.6 mi SW on FM 2323 from its intersection with Hwy 16, then S on unnamed paved road for ca. 100 m on E side of road in sandy soil in granite outcrop, 26 Sep 1987, *Wipff 558* (jkw, TEX). Medina Co.: 2 mi SW of Devine, in deep sandy soil of Carrizo formation, extensive rhizome system, 1 May 1954, *Johnston, Tharp & Turner 3412* (TEX); 2 mi SW of Devine, in deep sandy soil of Carrizo formation, extensive rhizome system, 1 May 1954, *Johnston, Tharp & Turner 3404* (TEX). Ward Co.: among partially stabilized coppice dunes S of Shin Oak Picnic Area, E portion of S half of Monahans Sandhills State Park, Cowden Place Quadrangle, rare in loose sand among partially stabilized coppice dunes, 20 Jun 1989, *Carr 9923* (TEX); between Imperial and Monahans, elev. 2700 ft, frequent perennial in deep sand, 30 Aug 1955, *Warnock 13148* (TEX). Webb Co.: at roadside on Hwy 83, 13 mi NW of Webb, in red sand, 16 Jul 1957, *Correll & Johnston 18120* (LL). Wilbarger Co.: W of hwy, S of Red River on Round Timbers Ranch, dunes, 14 Sep 1950, *Tharp 50-L-9-14* (TEX); sandhills about 5 mi W of Odell, in large clumps, 5 Oct 1964, *Correll 30190* (LL). Willacy Co.: Sauz Ranch, sandy loam, 23 Nov 1953, *Johnston & Davis 5319.135* (TEX). Winkler Co.: 9.5 mi S on Hwy 18 from its jct with Hwy 115 in Kermit, then E (left) 6.1 mi on County Rd 404, along roadside near fence line, Penwell fine sand, sand 9+ ft deep, 16 Jun 1987, *Wipff 305* (jkw, TEX); 9.5 mi S on Hwy 18 from its intersection with Hwy 115 in Kermit; then 16.9 mi on County Rd 404 from its intersection with Hwy 18, along roadside near fence line, Jalmar loamy fine sand. 16 Jun 1987, *Wipff 308* (BRIT, jkw, TAES, TEX); 9.5 mi S on Hwy 18 from its intersection with Hwy 115 in Kermit, then 12.9 mi E on County Rd 404 from its intersection with Hwy 18, along roadside near fence line, fine sand to a depth of 20 in. then a gypsum layer 12 inches thick, then 6.3+ ft of fine sand, 16 Jun 1987, *Wipff 310* (jkw, TEX). Yoakum Co.: about 12 mi SW of Plains, grassy brushland in sandy soil, in clumps, 29 Oct 1962, *Correll 26500* (LL).

Key to the species of *Leptoloma* in Texas

1. Spikelets 3.5–4.6 mm long; upper glumes 5–7 veined; anthers more than 1 mm long; coastal dunes .... **Leptoloma arenicola**
1. Spikelets 2.2–3.3 mm long; upper glumes 3(–5)-veined; anthers less than 1 mm long; various habitats.

    2. Lower lemmas 7-veined; outer veins not equally spaced; spikelets glabrous to short pubescent .... **Leptoloma cognatum**
    2. Lower lemmas 5-veined; veins equally spaced; spikelets densely pubescent.

        3. Plants without rhizomes; densely caespitose .... **Leptoloma pubiflorum**
        3. Plants with long rhizomes; loosely caespitose or loosely tufted .... **Leptoloma syrticola**

ACKNOWLEDGMENTS

We thank George Yatskievych, TEX-LL Curator, for access to the collection. We are grateful for the reviews of the manuscript by Kanchi Gandhi, David Rosen, and Guy Nesom. We also thank Annette R. Wipff for preparing the photographs of the type collection.

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UNA NUEVA ESPECIE DE *ROLDANA* (COMPOSITAE, SENECIONEAE) DE LA SIERRA MADRE ORIENTAL DE QUERÉTARO (MÉXICO)

JERZY RZEDOWSKI
Instituto de Ecología, A.C.
Centro Regional del Bajío
Apartado postal 386
61600 Pátzcuaro, Michoacán, México
jerzedowski@gmail.com

RESUMEN

Se describe e ilustra a **Roldana elizondoarum** Funston ex Rzed., especie nueva colectada una sola vez en el sector queretano de la Sierra Madre Oriental, por lo que al parecer representa un estrecho endemismo local. Se relaciona con *R. heracleifolia* (Hemsl.) H. Rob. & Brettell, de la que más difiere en sus hojas muy profundamente palmatisectas y en un mayor número de flores del disco de cada cabezuela.

ABSTRACT

Roldana elizondoarum Funston ex Rzed., a new species collected only once in the Sierra Madre Oriental in northeastern Querétaro, Mexico, is described and illustrated. It probably is a narrow, local endemic. It is related to *R. heracleifolia* (Hemsl.) H. Rob. & Brettell, differing mainly in its very deeply palmatisect leaves and in its larger number of disk flowers per head.

El género *Roldana*, inicialmente propuesto por La Llave (1825) y durante muchos años sumergido a la sinonimia de *Senecio*, fue reivindicado por Robinson y Brettell (1974) para incorporar las especies anteriormente consideradas como componentes de la sección *Palmatinervii* Hoffm. de *Senecio,* añadiendo algunas otras que se consideraron cercanamente relacionadas. Estos autores proporcionaron asimismo una clave para la identificación de sus elementos hasta esa fecha conocidos. Años más tarde Turner (2005) ofreció un más amplio estudio del grupo, extendiendo algo su circunscripción, y finalmente Funston (2008) publicó la revisión más moderna del conjunto, basada en su disertación doctoral.

La distribución geográfica total conocida del género se extiende del suroeste de Estados Unidos a Panamá. Sin embargo, de las 49 especies sancionadas hasta ahora (48 por Funston y una más descrita en 2009 por Quedensley y Villaseñor), todas menos una se registran del territorio de la República Mexicana. Lo anterior significa que *Roldana* es uno de los componentes muy propios y característicos de la flora de nuestro país. Varias de sus especies corresponden a microendemismos, no pocas a su vez son plantas bastante comunes, vistosas en la floración, y de moderadamente amplia repartición en las regiones montañosas.

El propósito de la presente contribución es de completar a medio centenar el número de representantes inventariados de *Roldana*, incorporando uno nuevo, en esta ocasión procedente de la Sierra Madre Oriental de Querétaro.

ROLDANA ELIZONDOARUM Funston ex Rzed., **sp. nov.** **TIPO**: **MÉXICO. Querétaro.** Municipio de Pinal de Amoles, entre Maguey Verde y El Madroño, ladera de cerro, bosque de *Juniperus flaccida – Pinus cembroides,* alt. 2300-2360 m, planta herbácea erecta de 50 a 80 cm de altura, flores amarillas, más o menos abundante, 12.VIII.1990, *E. Carranza 2610* (holotipo: IEB: isotipos por distribuirse). Figura 1.

Planta herbacea perennis ad 80 cm alta; caulis teres juventute araneoso-puberulus; petioli ad 10 cm longi, laminae foliares ambitu fere circulare, inferae 18-20 cm diametro, usque quasi ad centrum palmatiquinquesectae, lobis lanceolato-ellipticis ad 12 cm longis, margine grosse dentatis et saepe cum lobis secundariis anguste triangularibus ad 6.5 cm longis, supra sparse, infra densius puberulae; panicula terminalis ampla pyramidalis vel corymbiformis usque ad 100 capitulis, pedicellis ad 4 cm longis araneoso-puberulis; involucrum campanulatum phylariis 8 oblongis 8-10 mm longis coriaceis; radii flores 8 lutei ligulis oblongis 8-9 mm longis; disci flores ca. 35 corollis luteis anguste tubulosis ca. 10 mm longis; achaenia cylindrica ca. 2 mm longa glabra, pappo albo 8-9 mm longo.

Planta herbácea perenne hasta de 80 cm de alto; tallo erecto, terete, estriado, de ca. 1 cm de diámetro en la parte inferior, provisto de máculas oscuras lineares y circulares, con pubescencia araneosa diminuta en sus porciones superiores, pronto glabrescente; hojas alternas, las inferiores con peciolos de ca. 10 cm de largo, láminas casi circulares en contorno general, de 18 a 20 cm de diámetro, palmatisectas hasta cerca del centro en 5 segmentos lanceolado-elípticos, de ca. 12 cm de largo, agudos en el ápice, en el margen gruesamente dentados y algunos con lóbulos secundarios angostamente triangulares hasta de 6.5 cm de largo, verdes oscuras y algo pubérulas a lo largo de las nervaduras en el haz, más pálidas y con mucho más pubescencia en el envés, las hojas disminuyendo en forma paulatina de tamaño hacia la parte superior del tallo hasta medir menos de la mitad de diámetro de las basales; inflorescencia en forma de amplia panícula terminal, piramidal a corimbiforme, que llega a representar más de la mitad del largo de la planta y ca. 20 cm de diámetro, medianamente densa en su mitad superior, cabezuelas a menudo cerca de 100, pedicelos hasta de 4 cm de largo, araneoso-pubérulos, provistos de algunas brácteas diminutas, por lo general de menos de 1 mm de largo; calículo por lo común ausente, involucro campanulado, de 8 a 10 mm de alto y otro tanto de diámetro en su parte superior, sus brácteas 8, dispuestas en una serie, oblongas, agudas en el ápice, araneoso-pubérulas por fuera, rígidas, de textura coriácea, con el centro verdoso y los márgenes más pálidos, receptáculo convexo, desnudo; flores del radio 8, fértiles, corolas amarillas, glabras, su parte tubular de ca. 5 mm de largo, la lígula oblonga, de 8 a 9 mm de largo y 2.5 a 3 mm de ancho, patente; flores del disco ca. 35, amarillas, corolas estrechamente tubulares, glabras, de ca. 10 mm de largo, de los cuales ca. 1.5 mm corresponden a los lóbulos; aquenios cilíndricos, de ca. 2 mm de largo, con 8 costillas longitudinales, glabros, café-rojizos claros, vilano de ca. 20 cerdas capilares blancas de 8 a 9 mm de largo, fácilmente caedizas.

El epíteto de *Roldana elizondoarum* se dedica como homenaje a M. Socorro González Elizondo y a Martha González Elizondo, botánicas mexicanas, destacadas estudiosas de Cyperaceae y Ericaceae, y sobre todo del universo vegetal del estado de Durango y de la Sierra Madre Occidental.

La especie nueva solo se conoce de una localidad y muy probablemente representa un estrecho endemismo del sector queretano de la Sierra Madre Oriental.

En varias características de la inflorescencia y de las flores *Roldana elizondoarum* se asemeja en forma notable a *R. heracleifolia* (Hemsl.) H. Rob. & Brettell, con la cual está indudablemente relacionada. Esta última es una planta bastante común en la región del Bajío mexicano y en algunas partes aledañas, donde descuella en ambientes muy favorecidos por el disturbio, no pocas veces a orillas de potreros, de caminos y carreteras. Las principales características diferenciales entre estas dos especies se detallan en el Cuadro 1.

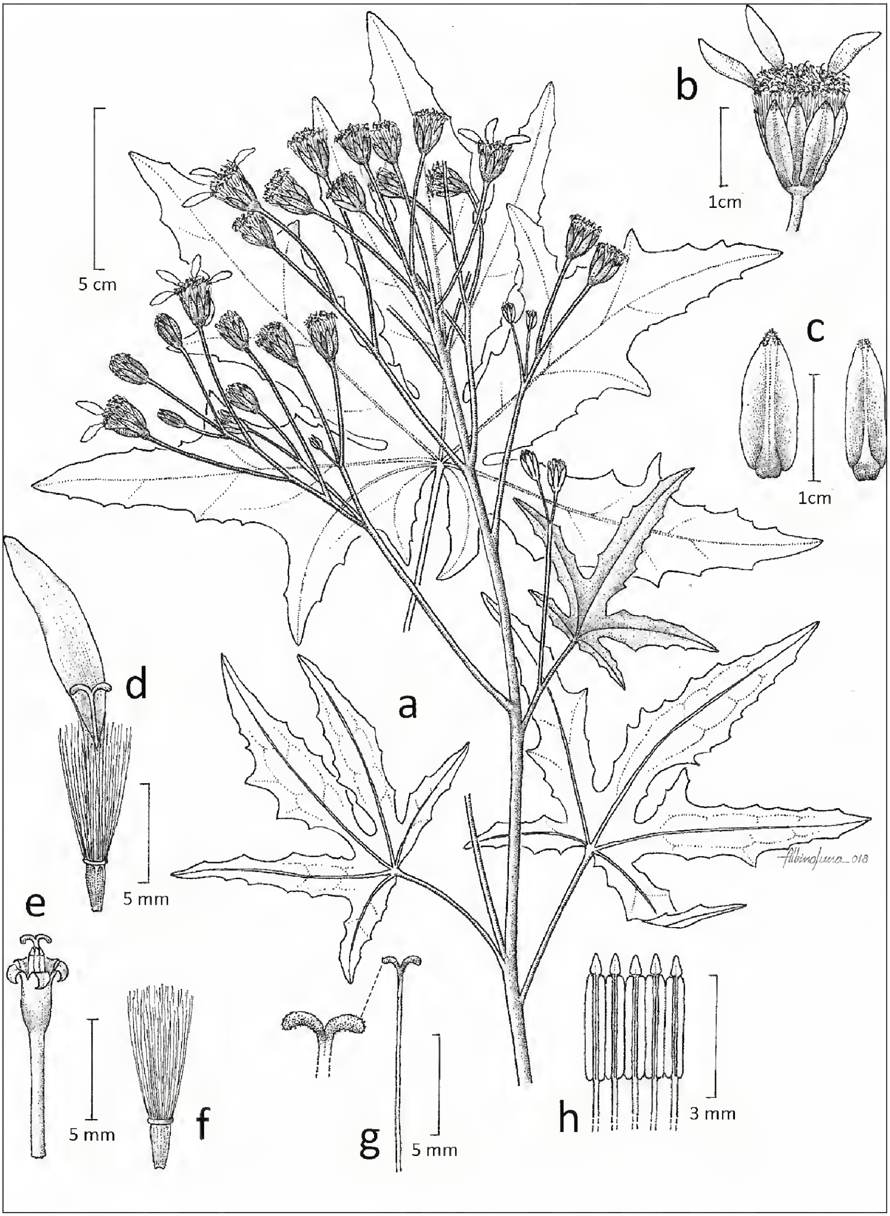
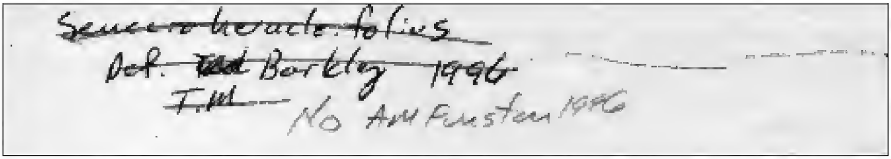


Figura 1. *Roldana elizondoarum*. a. Rama con hojas e inflorescencias. b. Cabezuela. c. Brácteas involucrales. d. Flor del radio. e. Corola de la flor del disco. f. Aquenio. g. Estilo. h. Anteras. Ilustrado por Albino Luna.

Caracteres	**Roldana heracleifolia**	**Roldana elizondoarum**
Porte de la planta	1 a 3 m	hasta 0.8 m
Hojas		
peciolos	alados	sin alas
venación y división	pinnada	palmada
segmentos primarios	(5)7 a 11	5
profundidad de la incisión hacia el centro de la hoja	hasta ¾ de distancia	casi hasta el centro
Involucro de la cabezuela	con calículo	por lo general sin calículo
Flores del radio	5 a 7	8
Flores del disco	12 a 20	ca. 35
Aquenios	pubescentes	glabros
Distribución geográfica conocida	Zacatecas y Jalisco al sur de Querétaro	noreste de Querétaro
Afinidades ecológicas	planta calcífuga, favorecida por intenso disturbio	planta calcífila, habitante de bosque

Cuadro 1. Principales características diferenciales entre *Roldana heracleifolia* y *R. elizondoarum.*

En el año 1996 el herbario del Centro Regional del Bajío del Instituto de Ecología, A.C. recibió la visita del Dr. Theodore M. Barkley, quien venía acompañado de su entonces estudiante Adrienne Michele Funston. Ambos revisaron el material de Compositae-Senecioneae y determinaron los nombres de numerosos ejemplares que hasta esa fecha no habían sido identificados. Los dos examinaron el espécimen *Carranza 2610*; inicialmente Barkley le asignó el nombre *Senecio heracleifolius*, pero Funston no estuvo de acuerdo con tal anotación (ver la Figura 2), con lo cual planteó una ubicación taxonómica diferente, posiblemente nueva.



~~Senecio heracleifolius~~
~~Det. Ted Barkley 1996~~
~~T.M.~~ NO AM Funston 1996

Figura 2. Anotaciones realizadas en el año 1996 por T.M. Barkley y por A.M. Funston sobre el papel del ejemplar *E. Carranza 2610.*

AGRADECIMIENTOS

Se agradece a Martha Rzedowski el apoyo en la composición tipográfica del artículo. El dibujo es obra de Albino Luna.

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FIRST REPORT OF RUMEX CRISTATUS (POLYGONACEAE) FOR NEW YORK STATE

DANIEL ATHA
Center for Conservation Strategy
New York Botanical Garden
Bronx, New York 10458
datha@nybg.org

ABSTRACT

Rumex cristatus is documented from New York for the first time. The species is known from Bronx and New York counties in New York and from Union Co., New Jersey.

In recent years, there has been an increase in populations and abundance of a distinctive *Rumex* species in New York City that did not easily fit any species described for the state. The plants were tentatively identified as *R. patientia* L. (Atha et al. 2016). Photographs taken in the Bronx in June 2018 and uploaded to the biodiversity program, iNaturalist were identified by Walter Plieninger (in Germany) as *R. cristatus* DC. Herbarium specimens were prepared and plants photographed in several locations.

Rumex cristatus (Greek dock) is a robust perennial native to southeastern Europe (Balkan Peninsula, the Aegean region, Cyprus, and Sicily) and naturalized in southern Europe and the USA (Mosyakin 2005; Akeroyd & Webb 1991; Akeroyd 2014). It is reported from Illinois, Kansas, and Missouri in the USA (Mosyakin 2005; USDA, NRCS 2018) but not previously reported for New York (Werier 2017).

Voucher specimens. USA. New York. Bronx Co.: New York City, along Mosholu Parkway at Marion Avenue, 13 Jun 2005, *Nee 53311* (NY); 3600 Paul Avenue, along wall between street and railroad yard, ca 38 m elev., 5 Jun 2018, *Atha 16007* (NY); New York Botanical Garden, W of the Bronx River and N of Waring Avenue, ca 15 m elev, 29 May 2009, *Atha 7380* (MU, NY). **New Jersey**. Union Co.: Elizabeth River Parkway, Pruden Section, 14 Jun 2008, *Glenn 11294* (BKL).

Key to weedy, introduced *Rumex* of New York City

1. Plants dioecious; whole plant (including inflorescence) < 40 cm tall; basal leaves 2–6 × 0.5–3 cm, usually 3-lobed (hastate) .... **Rumex acetosella**
1. Plants monoecious; whole plant (including inflorescence > 40 cm tall; basal leaves 6–50 × 3–15 cm, oblong, ovate or lanceolate.

  2. Basal leaves oblong or ovate, distinctly rugose, leaves usually with red spots or blotches of red color, especially along the midrib and petiole bases; mature tepal margins with narrow, elongate teeth .... **Rumex obtusifolius**
  2. Basal leaves oblong to lanceolate, not distinctly rugose, green and only marked with red at senescence; mature tepal margins entire, erose or deltate-toothed.

    3. Basal leaves oblong, the margins strongly crisped; mature tepals 3–4 mm wide, the margins entire; tubercules usually 3 .... **Rumex crispus**
    3. Basal leaves lanceolate, the margins flat or weakly crisped; mature tepals 4–8 mm wide, the margins entire, erose or toothed; tubercules 1–3.

      4. Mature tepals orbicular, wider than long, the apices rounded to obtuse, the margins entire to erose; tubercules usually 1 .... **Rumex patientia**
      4. Mature tepals ovate, longer than wide, the apices obtuse to acute, the margins toothed, at least some of the teeth 0.5–1 mm long; tubercules usually 3 (unequal), rarely 1 or 2 .... **Rumex cristatus**

Figure 1. *Rumex cristatus* on Randall's Island, New York County. A. Habit. B. Lower leaves. C. Ripening fruit, showing enlarged inner tepals with distinct teeth, D. Tubercules on three tepals. Photos from iNaturalist (https://www.inaturalist.org/observations/13126264), D. Atha, 8 June 2018.

Rumex cristatus are robust and gregarious plants (Fig. 1) with the largest mature tepals of any *Rumex* species reported for North America (Mosyakin 2005). In contrast to *R. patientia*, which has smaller, roughly orbicular tepals with rounded apices, the tepals of *R. cristatus* are ovate with obtuse to acute apices. The tepal margins are distinctly toothed, particularly at the base, in contrast to the entire to erose margins of *R. patientia*. The teeth are roughly triangular, but variable in length, ranging from about 0.2 mm to almost 1 mm long.

Rumex kerneri Borbâs is very similar to *R. cristatus* but the inner tepals have one tubercule (vs 1–3), marginal teeth on the inner tepals shorter than 0.5 mm and papillose abaxial leaf veins (Mosyakin 2005, Plieninger pers. comm). Papillose abaxial veins have not been observed in New York City plants. Robust plants with large leaves having weakly crisped margins and small inner tepals without teeth are present in the City (*Atha 16009*, *Rubin 161*). These plants are probably *R.* × *confusus* Simonk., the hybrid between *R. patientia* and *R. crispus* (Werier 2017).

The oldest specimen of *Rumex cristatus* from the region found at NY and BKL was collected by Michael Nee in Bronx County in 2005. The species probably is now more widespread than the herbarium specimens cited here indicate.

The discovery of a new xenophyte for the region from a photograph identified on iNaturalist demonstrates the value of the iNaturalist program for the identification and discovery of biological novelties, particularly in large, cosmopolitan genera without active specialists making general identifications on a wide-scale.

ACKNOWLEDGEMENTS

I am grateful to Meryl Rubin for databasing, labeling, and distributing the specimens and to Walter Plieninger for first identifying *Rumex cristatus* in New York and for his helpful comments on *Rumex* in general. I thank Chris Girgenti, Natural Areas Manager of the Randall's Island Park Alliance and Susan Hewitt for assistance in the field. Appreciation is extended to the New York City Department of Parks and Recreation for their ongoing collaboration on the flora of New York City.

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AN UPDATED LIST OF PTERIDOPHYTA AND LYCOPHYTA TYPE MATERIAL DEPOSITED AT THE NATIONAL HERBARIUM OF COSTA RICA (CR)

SILVIA LOBO C.
Herbario Nacional (CR)
Av. Central and 2, 17th Street
San José, Costa Rica
slobo@museocostarica.go.cr

ABSTRACT

This study presents information about the type specimens of Pteridophyta and Lycophyta housed at the National Herbarium of Costa Rica (including ex INB). In total, Pteridophyta and Lycophyta type material encompasses 422 species and infraspecific taxa. This represents 257 species and 960 specimens more than the last assessment. 137 holotypes, 239 isotypes (s.l.), 22 syntypes, and 766 paratypes (s.l.) are present. Foreign type material comprises 10% of the collection.

The National Herbarium of Costa Rica (CR) is one of the oldest and largest plant collection in Central America and Mesoamerica, with a history of over 130 years in the documentation and study of the country's flora. These activities have resulted in the herbarium containing 90% of known plant species nationwide. The National Institute of Biodiversity (INBio) transferred its herbarium to CR in 2015, nearly doubling the number of bryophyta, lichens, fungi, and plant specimens. The CR type collection also was greatly enlarged by this addition.

In Costa Rica, two other institutions house plant type specimens. The Herbarium of the Costa Rican University (USJ) houses Pteridophyta and Lycophyta types of approximately 8 species. The emphasis of the Lankester Botanical Garden (JBL) is on the orchid family.

The only previous attempt to list cryptogamic type specimens at CR was by Ruiz-Boyer and González-Ball (2002), who documented 283 type specimens of 165 species and infraspecific taxa. The present report presents an updated list of the type specimens of Pteridophyta and Lycophyta presently housed at CR.

This study is based on the author´s specimen-by-specimen examination of the CR and ex INB collection from 2015 to 2018. Each type specimen was examined after checking their labels against original descriptions and/or additional bibliographical material and online databases (specially Tropicos (www.tropicos.org) and JSTOR (www.jstor.org). An active search for specimens stored as non-type material was also undertaken. After screening and comparison, the status of the type specimen was confirmed, registered in the CR database, and scanned and stored in the type collection. The original CR type specimens information and image can be seen in http://ecobiosis.museocostarica.go.cr, and ex INB type specimens can be consulted in http://www.specify7.museocostarica.go.cr:8080/specify-solr/. For this paper, nomenclature of genera follows PPG 1 (2016).

RESULTS

The fern and lycophyte type collection at CR contains 1239 type specimens, representing 422 species and infraspecific taxa (Table 1). Six main categories of types are represented (Fig. 1). No lectotypes or neotypes exist. The vast majority of the CR type material is from Costa Rica (90%); the rest is mainly from Latin American countries (Fig. 2).

The transfer of the former INB collection added 254 type specimens to CR: 58 holotypes, 27 isotypes, 167 paratypes and 3 fototypes, and 12 new species of cryptogams to the type collection. But it also increased the different type categories for a single species: 20 species are now represented by both a holotype and an isotype and 37 species by a holotype, an isotype, and paratypes. Previously there were just 16 cases in CR.

Principal authors of the type species represented in CR are Konrad H. Christ and A. Rojas, who together have described the 48% of the species. Christ was a Swiss botanist who specialized in pteridology (Gómez 1977) –– he is the main author of the fern species of Costa Rica of the late and early Twentieth Century. Alexander Rojas (A. Rojas) is a Costa Rican pteridologist who has published many taxonomic studies of the country's ferns and lycophytes since the 1990s.

An interesting finding is that in the description of 24 new taxa, 13 specimens were used repeatedly (Table 2).

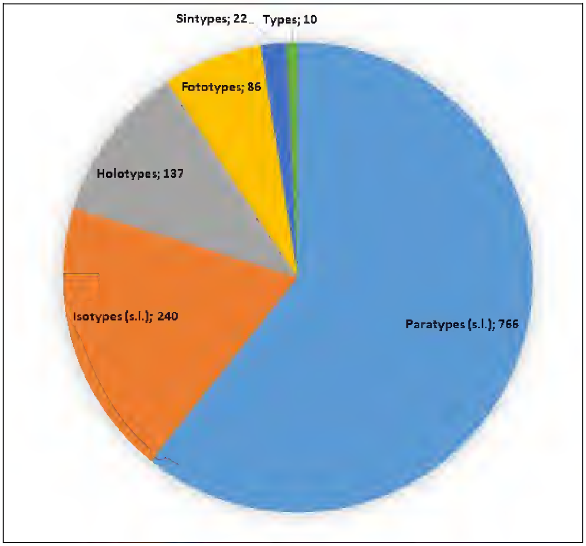

Figure 1. Number of specimens in each type category.

Table 1. List of fern and lycophyte type specimens deposited at the National Herbarium of Costa Rica (CR). Abbreviations are: H= Holotype, I= Isotype, L= Lectotype, IL= Isolectotype, LP= Lectoparatype, S= Syntype, IS= Isosyntype, P= Paratype, T= Type, F= Phototype. Species included in Ruiz-Boyer and González-Ball (2002) are marked with *.

Family	Original name	Origin	Type
Pteridaceae	*Acrostichum acutum* Fée	Brasil	F
Dryopteridaceae	*Acrostichum bernoullii* Kuhn ex Christ	Guatemala	P
Dryopteridaceae	*Acrostichum conforme* var. *alpinum* J. Boomer ex Christ	Costa Rica	IL
Dryopteridaceae	*Acrostichum foeniculaceum* Hook. & Grev.	Ecuador	F
Dryopteridaceae	*Acrostichum lloense* Hook.	Ecuador	F

Dryopteridaceae	*Acrostichum moorei* E. Britton	Bolivia	F
Pteridaceae	*Acrostichum omphalodes* Fée	Brasil	F
Dryopteridaceae	*Acrostichum peltatum* var. *potentillifolium* Christ *	Costa Rica	H, I
Lomariopsidaceae	*Acrostichum pittieri* Christ	Costa Rica	IL, LP
Dryopteridaceae	*Acrostichum tripartitum* Hook. & Grev.	Ecuador	F
Pteridaceae	*Adiantum acrolobum* A. Rojas	Costa Rica	H
Pteridaceae	*Adiantum caribense* A. Rojas	Costa Rica	H
Pteridaceae	*Adiantum subtrapezoideum* Christ *	Costa Rica	I
Pteridaceae	*Adiantum tetraphyllum* var. *costaricense* Christ	Costa Rica	I
Pteridaceae	*Adiantum* × *janzenianum* A. Rojas & C. Herrera	Costa Rica	H, I, P
Cyatheaceae	*Alsophila acutidens* Christ	Costa Rica	S
Cyatheaceae	*Alsophila decussata* Christ *	Costa Rica	I
Cyatheaceae	*Alsophila furcata* Christ *	Costa Rica	I
Cyatheaceae	*Alsophila ichtyolepis* Christ *	Costa Rica	IL
Cyatheaceae	*Alsophila leucolepis* var. *pubescens* Christ *	Costa Rica	IS
Cyatheaceae	*Alsophila nesiotica* Maxon	Costa Rica	I
Cyatheaceae	*Alsophila notabilis* Maxon	Costa Rica	P
Cyatheaceae	*Alsophila pinnula* Christ *	Costa Rica	I
Cyatheaceae	*Alsophila polystichoides* Christ *	Costa Rica	I
Cyatheaceae	*Alsophila subaspera* Christ *	Costa Rica	IL, LP
Cyatheaceae	*Alsophila tenerifrons* Christ	Costa Rica	IL
Cyatheaceae	*Alsophila trichiata* Maxon	Panamá	P
Anemiaceae	*Anemia* × *didicusana* L.D. Gómez	Costa Rica	H
Thelypteridaceae	*Aspidium biolleyi* Christ *	Costa Rica	I
Dryopteridaceae	*Aspidium bullatum* Christ *	Costa Rica	I
Tectariaceae	*Aspidium caudatum* var. *contractum* Christ *	Costa Rica	IL
Tectariaceae	*Aspidium cicutarium* var. *angustius* Christ *	Costa Rica	I
Dryopteridaceae	*Aspidium effusum* var. *muticum* Christ *	Costa Rica	I
Tectariaceae	*Aspidium eurylobum* Christ *	Costa Rica	IL, LP
Dryopteridaceae	*Aspidium karstenianum* var. *navarrense* Christ *	Costa Rica	I
Tectariaceae	*Aspidium macrophyllum* var. *biolleyanum* Christ *	Costa Rica	I
Tectariaceae	*Aspidium macrophyllum* var. *pittieri* Christ *	Costa Rica	IS
Tectariaceae	*Aspidium myriosorum* Christ	Costa Rica	IS
Tectariaceae	*Aspidium subebeneum* Christ *	Costa Rica	I
Dryopteridaceae	*Aspidium tonduzii* Christ	Costa Rica	I

Dryopteridaceae	*Aspidium trejoi* Christ	Costa Rica	S
Aspleniaceae	*Asplenium alfredii* Rosenst.	Costa Rica	I
Aspleniaceae	*Asplenium auriculatum* var. *aequilaterale* Christ	Costa Rica	IL
Aspleniaceae	*Asplenium barclayanum* C.D. Adams	Costa Rica	P
Aspleniaceae	*Asplenium cuspidatum* var. *triculum* Lellinger *	Costa Rica	I, F
Aspleniaceae	*Asplenium dareoides* Desv.	South América	F
Aspleniaceae	*Asplenium delicatulum* var. *cocosense* A. Rojas & Trusty	Costa Rica	H, P
Aspleniaceae	*Asplenium excelsum* Lellinger *	Panamá	P, F
Aspleniaceae	Asplenium gomezianum Lellinger *	Costa Rica	P, F
Aspleniaceae	*Asplenium induratum* Hook. *	Costa Rica	IL, LP
Aspleniaceae	*Asplenium maxonii* Lellinger *	Panamá	P, F
Aspleniaceae	*Asplenium onustum* Christ	Costa Rica	I
Aspleniaceae	*Asplenium radicans* var. *costaricense* Christ	Costa Rica	I
Aspleniaceae	*Asplenium sodiroi* Christ	Costa Rica	P
Aspleniaceae	*Asplenium trichomanes* var. *viridissimum* Christ *	Costa Rica	T
Athyriaceae	*Athyrium commixtum* Koidz.	China?	F
Athyriaceae	*Athyrium reductum* Christ	Costa Rica	IL
Dicksoniaceae	*Balantium blumei* Kunze	Java	F
Blechnaceae	*Blechnum flaccisquama* A. Rojas *	Costa Rica	H, I, P
Blechnaceae	*Blechnum fuscosquamosum* A. Rojas	Costa Rica	H, I, P
Blechnaceae	*Blechnum lellingerianum* L.D. Gómez	Costa Rica	H, I, P
Blechnaceae	*Blechnum microlomaria* L.D. Gómez *	Costa Rica	H, I
Blechnaceae	*Blechnum moranianum* A. Rojas	Costa Rica	H, P
Ophioglossaceae	*Botrychium ternatum* var. *daedaleum* Christ *	Costa Rica	I
Polypodiaceae	*Campyloneurum gracile* A. Rojas	Costa Rica	H, P
Polypodiaceae	*Campyloneurum irregulare* Lellinger *	Ecuador	P
Polypodiaceae	*Campyloneurum leoniae* A. Rojas	Costa Rica	H
Polypodiaceae	*Ceradenia tristis* A.R. Sm.	Costa Rica	I, P
Polypodiaceae	*Ceradenia aulaeifolia* L. E. Bishop ex A.R. Sm.	Costa Rica	I, P
Polypodiaceae	*Ceradenia phloiocharis* L. E. Bishop *	Panamá	P
Pteridaceae	*Cheilanthes glandulifera* Liebm.	México	F
Pteridaceae	*Cheilanthes paleacea* M. Martens & Galeotti	México	F
Cyatheaceae	*Chnoophora glauca* Blume	Java	F
Cyatheaceae	*Cnemidaria chocoensis* Stolze *	Colombia	I, P

Dryopteridaceae	*Ctenitis bidecorata* Lellinger *	Costa Rica	P, F
Dryopteridaceae	*Ctenitis costaricensis* R.C. Moran *	Costa Rica	H, I
Dryopteridaceae	*Ctenitis gomezii* R. C. Moran	Costa Rica	H
Dryopteridaceae	*Ctenitis skutchii* Lellinger *	Costa Rica	P, F
Dryopteridaceae	*Ctenitis sotoana* A. Rojas	Costa Rica	H, P
Cyatheaceae	*Cyathea albomarginata* R.C. Moran *	Costa Rica	I, P
Cyatheaceae	*Cyathea alfonsoana* L.D. Gómez *	Costa Rica	H, I, P
Cyatheaceae	*Cyathea aphlebioides* Christ *	Costa Rica	I
Cyatheaceae	*Cyathea arida* Christ *	Costa Rica	IS
Cyatheaceae	*Cyathea aureonitens* Christ *	Costa Rica	IL
Cyatheaceae	*Cyathea cervantesiana* A. Rojas	Costa Rica	H
Cyatheaceae	*Cyathea javanica* Blume	Java	F
Cyatheaceae	*Cyathea mucilagina* R.C. Moran *	Costa Rica	I, P
Cyatheaceae	*Cyathea povedae* A. Rojas	Costa Rica	H, P
Cyatheaceae	*Cyathea punctifera* Christ *	Costa Rica	I
Cyatheaceae	*Cyathea werckleana* Christ	Costa Rica	IL
Cyatheaceae	*Cyathea* × *holdridgeana* Nisman & L.D. Gómez *	Costa Rica	H
Cyatheaceae	*Cyathea* × *moralesiana* A. Rojas	Costa Rica	H
Cyatheaceae	*Cyathea* × *smithiana* A. Rojas	Costa Rica	H, P
Marattiaceae	*Danaea tuomistoana* A. Rojas	Costa Rica	H, I
Dennstaedtiaceae	*Dennstaedtia gracilis* A. Rojas & Tejero	México	I, P
Dennstaedtiaceae	*Dennstaedtia grandifrons* Christ	Costa Rica	T
Dennstaedtiaceae	*Dennstaedtia obtusifolia* var. *protrusa* Christ *	Costa Rica	I
Dennstaedtiaceae	*Dennstaedtia spinosa* Mickel	Costa Rica	I
Dicksoniaceae	*Dicksonia decomposita* Christ	Costa Rica	S
Dicksoniaceae	*Dicksonia lobulata* Christ *	Costa Rica	I
Dicksoniaceae	*Dicksonia obtusifolia* var. *protrusa* Christ	Costa Rica	I
Pteridaceae	*Didymochlaena lunulata* var. *microphylla* J. Bommer ex Christ *	Costa Rica	I
Athyriaceae	*Diplazium arayae* A. Rojas	Costa Rica	H
Athyriaceae	*Diplazium ingens* Christ	Costa Rica	IL, LP
Athyriaceae	*Diplazium matamense* A. Rojas *	Costa Rica	H, I
Athyriaceae	*Diplazium multigemmatum* Lellinger *	Costa Rica	P, F
Athyriaceae	*Diplazium navarrense* Lellinger *	Costa Rica	F
Athyriaceae	Diplazium obscurum Christ	Costa Rica	LP
Athyriaceae	*Diplazium pactile* Lellinger *	Ecuador	F
Athyriaceae	*Diplazium sanctae-rosae* Christ *	Costa Rica	IL
Athyriaceae	*Diplazium skutchii* Lellinger *	Costa Rica	P, F

Athyriaceae	*Diplazium striatastrum* Lellinger *	Costa Rica	P, F
Athyriaceae	*Diplazium subsilvaticum* Christ	Costa Rica	IL, LP
Athyriaceae	*Diplazium urticifolium* Christ *	Costa Rica	I
Athyriaceae	*Diplazium urticifolium* var. *mesoamericanum* A. Rojas	México	H
Dryopteridaceae	*Dryopteris atrovirens* C. Chr.	Costa Rica	S
Dryopteridaceae	*Dryopteris boqueronensis* Hieron.	Colombia	F
Dryopteridaceae	*Dryopteris curta* Christ	Costa Rica	IL
Dryopteridaceae	*Dryopteris engelii* Hieron.	Venezuela	F
Dryopteridaceae	*Dryopteris ensiformis* C. Chr. *	Costa Rica	I
Dryopteridaceae	*Dryopteris flaccisquama* A. Rojas	Costa Rica	H, P
Dryopteridaceae	*Dryopteris lepidula* Hieron.	Colombia	F
Dryopteridaceae	*Dryopteris limonensis* Christ	Costa Rica	I
Dryopteridaceae	*Dryopteris lingulata* C. Chr.	Costa Rica	I
Dryopteridaceae	*Dryopteris mexiae* Copel. ex C. Chr.	Brasil	T
Dryopteridaceae	*Dryopteris millei* C. Chr.	Ecuador	F
Dryopteridaceae	*Dryopteris muzensis* Hieron.	Colombia	F
Dryopteridaceae	*Dryopteris santae-catharinae* Rosenst.	Brasil	F
Dryopteridaceae	*Dryopteris strigifera* Hieron.	Colombia	F
Dryopteridaceae	*Dryopteris subattenuata* Rosenst.	New Guinea	F
Dryopteridaceae	*Dryopteris tetragona* var. *costaricensis* Rosenst.	Costa Rica	S
Dryopteridaceae	*Dryopteris vattuonei* Hicken	Argentina	F
Dryopteridaceae	*Elaphoglossum adrianae* A. Rojas	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum alvaradoanum* A. Rojas	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum auripilum* var. *longipilosum* L. Atehortúa	Costa Rica	P
Dryopteridaceae	*Elaphoglossum baquianorum* A. Rojas	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum barbae* Rosenst.	Costa Rica	T
Dryopteridaceae	*Elaphoglossum barnebyanum* A. Rojas *	Costa Rica	H, I
Dryopteridaceae	*Elaphoglossum bittneri* A. Rojas	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum bradeorum* Christ	Costa Rica	I
Dryopteridaceae	*Elaphoglossum brenesii* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum caricifolium* Mickel	Panamá	P
Dryopteridaceae	*Elaphoglossum caridadiae* A. Rojas	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum caroliae* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum cedralense* A. Rojas	Costa Rica	H
Dryopteridaceae	*Elaphoglossum christianeae* Mickel	Panamá	P

Dryopteridaceae	*Elaphoglossum ciliatosquamum* A. Rojas *	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum cocosense* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum cordigerum* Christ	Costa Rica	IL
Dryopteridaceae	*Elaphoglossum coriifolium* Mickel	Panamá	P
Dryopteridaceae	*Elaphoglossum correae* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum costaricense* Christ	Costa Rica	S
Dryopteridaceae	*Elaphoglossum coto-brusense* A. Rojas *	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum cotoi* A. Rojas	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum davidsei* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum delgadilloanum* A. Rojas	Costa Rica	P
Dryopteridaceae	*Elaphoglossum doanense* L.D. Gómez *	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum ellipticifolium* A. Rojas	El Salvador	P
Dryopteridaceae	*Elaphoglossum eludens* L.D. Gómez *	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum fournierianum* L.D. Gómez	Costa Rica	P, F
Dryopteridaceae	*Elaphoglossum fuliginosum* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum gamboanum* A. Rojas *	Costa Rica	H, I
Dryopteridaceae	*Elaphoglossum gerardianum* L.D .Gómez	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum gloeorrhizum* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum gomezianum* A. Rojas	Panamá	I, P, F
Dryopteridaceae	*Elaphoglossum grayumii* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum hammelianum* A. Rojas	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum herrerae* A. Rojas *	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum heterochroum* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum hyalinum* Christ *	Costa Rica	I
Dryopteridaceae	*Elaphoglossum incognitum* A. Rojas	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum jinoteganum* A. Rojas	Nicaragua	H
Dryopteridaceae	*Elaphoglossum killipii* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum lalitae* L.D. Gómez *	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum lanceiforme* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum lankesteri* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum lenticulatum* A. Rojas	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum leporinum* L.D. Gómez *	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum longistipitatum* A. Rojas *	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum luteum* A. Rojas *	Costa Rica	H, I, P

Dryopteridaceae	*Elaphoglossum macrostandleyi* A. Rojas *	Costa Rica	I, P
Dryopteridaceae	*Elaphoglossum maritzae* A. Rojas	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum mickelianum* A. Rojas *	Costa Rica	I, P
Dryopteridaceae	*Elaphoglossum micropogon* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum minutissimum* R.C. Moran & Mickel	Costa Rica	I
Dryopteridaceae	*Elaphoglossum mitorrhizum* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum moralesii* A. Rojas	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum moranii* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum nanum* A. Rojas	Costa Rica	H, I
Dryopteridaceae	*Elaphoglossum nicaraguense* A. Rojas	Nicaragua	I
Dryopteridaceae	*Elaphoglossum nigrosquama* A. Rojas	Costa Rica	H
Dryopteridaceae	*Elaphoglossum ometepense* L.D. Gómez	Nicaragua	I, P
Dryopteridaceae	*Elaphoglossum orosiense* A. Rojas *	Costa Rica	I, P
Dryopteridaceae	*Elaphoglossum pacificum* A. Rojas	Costa Rica	H, I.
Dryopteridaceae	*Elaphoglossum pallidiforme* Mickel	Panamá	P
Dryopteridaceae	*Elaphoglossum pallidosquamum* A. Rojas & P.E. Muñoz	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum pendulum* A. Rojas	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum pseudoerinaceum* A. Rojas	Panamá	P
Dryopteridaceae	*Elaphoglossum reductum* A. Rojas	Costa Rica	I
Dryopteridaceae	*Elaphoglossum reptans* A. Rojas	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum resinosum* A. Rojas	Costa Rica	H
Dryopteridaceae	*Elaphoglossum silencioanum* A. Rojas	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum squamiferum* A. Rojas	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum squamocostatum* A. Rojas	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum standleyi* Mickel	Costa Rica	P
Dryopteridaceae	*Elaphoglossum talamancanum* A. Rojas *	Costa Rica	H, P, F
Dryopteridaceae	*Elaphoglossum tarbacense* A. Rojas	Costa Rica	H
Dryopteridaceae	*Elaphoglossum taylorianum* L.D. Gómez	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum terrestre* A. Rojas	Costa Rica	H, I, P
Dryopteridaceae	*Elaphoglossum valerianum* L.D. Gómez *	Costa Rica	H, P
Dryopteridaceae	*Elaphoglossum variabile* A. Rojas	Costa Rica	H, P
Polypodiaceae	*Enterosora amplifolia* A. Rojas	Costa Rica	H, I
Polypodiaceae	*Enterosora lobulata* A. Rojas	Costa Rica	H, I
Pteridaceae	*Eriosonia* x *rollaliciana* L.D. Gómez	Costa Rica	H, I
Pteridaceae	*Gaga germanotta* F.W. Li & Windham	Costa Rica	P

Gleicheniaceae	*Gleichenia brevipubis* Christ *	Costa Rica	IL
Gleicheniaceae	*Gleichenia nitidula* Rosenst.	Costa Rica	I
Gleicheniaceae	*Gleichenia pectinata* var. *sublinearis* Christ	Costa Rica	IS
Gleicheniaceae	*Gleichenia strictissima* Christ *	Costa Rica	I
Polypodiaceae	*Grammitis barbensis* Lellinger *	Costa Rica	I
Polypodiaceae	*Grammitis cornuta* Lellinger *	Costa Rica	F
Polypodiaceae	*Grammitis micula* Lellinger *	Panamá	I, F
Polypodiaceae	*Grammitis pseudomitchellae* Lellinger *	Costa Rica	F
Pteridaceae	*Gymnogramma chaerophylla* var. *cryptogrammoides* J. Bommer ex Christ *	Costa Rica	I
Pteridaceae	*Gymnogramma congesta* Christ *	Costa Rica	IL
Pteridaceae	*Gymnogramma haematodes* Christ *	Costa Rica	S, IS
Pteridaceae	*Gymnogramma kupperi* I. Losch	Costa Rica	F
Pteridaceae	*Gymnogramma mayoris* Rosenst.	Colombia	F
Cyatheaceae	*Hemitelia choricarpa* Maxon	Costa Rica	I
Cyatheaceae	*Hemitelia mutica* Christ *	Costa Rica	IL
Cyatheaceae	*Hemitelia pittieri* Maxon	Costa Rica	I
Cyatheaceae	*Hemitelia rudis* Maxon	Panamá	I
Cyatheaceae	*Hemitelia subglabra* Underw. ex Maxon	Costa Rica	S
Cyatheaceae	*Hemitelia suprastrigosa* Christ *	Costa Rica	I
Lycopodiaceae	*Huperzia oellgaardii* A. Rojas	Costa Rica	H, P
Cyatheaceae	*Hymenophyllopsis hymenophylloides* L.D. Gómez	Guyana	P
Hymenophyllaceae	*Hymenophyllum adiantoides* Bosch.	Perú	F
Hymenophyllaceae	*Hymenophyllum caulopteron* Fée	Brasil	F
Hymenophyllaceae	*Hymenophyllum cocosense* A. Rojas *	Costa Rica	H, I, P
Hymenophyllaceae	*Hymenophyllum crassipetiolatum* Stolze *	Guatemala	F
Hymenophyllaceae	*Hymenophyllum densipilosum* A. Rojas	Costa Rica	H, P
Hymenophyllaceae	*Hymenophyllum dimorphum* Christ *	Costa Rica	I
Hymenophyllaceae	*Hymenophyllum durandii* Christ *	Costa Rica	I
Hymenophyllaceae	*Hymenophyllum fucoides* var. *integrum* Kuhn	Costa Rica	S
Hymenophyllaceae	*Hymenophyllum hemipteron* Rosenst.	Costa Rica	F
Hymenophyllaceae	*Hymenophyllum intercalatum* Christ *	Costa Rica	I
Hymenophyllaceae	*Hymenophyllum mortonianum* Lellinger *	Colombia	I, F
Hymenophyllaceae	*Hymenophyllum multicristatum* A. Rojas	Costa Rica	H, P
Hymenophyllaceae	*Hymenophyllum pycnocarpum* Lellinger	Java	F
Hymenophyllaceae	*Hymenophyllum saenzianum* L.D. Gómez	Costa Rica	I
Hymenophyllaceae	*Hymenophyllum semiglabrum* Rosenst.	Costa Rica	F
Hymenophyllaceae	*Hymenophyllum siliquosum* Christ *	Costa Rica	IL
Hymenophyllaceae	*Hymenophyllum talamancanum* A. Rojas	Costa Rica	H, I

Dennstaedtiaceae	*Hypolepis grandis* Lellinger *	Costa Rica	F
Dennstaedtiaceae	*Hypolepis lellingeri* A. Rojas	Costa Rica	H, I, P
Dennstaedtiaceae	*Hypolepis moraniana* A. Rojas	Costa Rica	H, P
Dennstaedtiaceae	*Hypolepis repens* var. *colorata* Christ	Costa Rica	S
Isoetaceae	*Isoetes cleefii* H.P. Fuchs	Colombia	I
Isoetaceae	*Isoetes echinospora* Durieu	France	H
Isoetaceae	*Isoetes panamensis* Maxon & Morton *	Panamá	I
Isoetaceae	*Isoetes savannarum* L.D. Gómez *	Costa Rica	H, I
Isoetaceae	*Isoetes savatieri* Franch.	France	T
Isoetaceae	*Isoetes tryoniana* L.D. Gómez	Costa Rica	I
Pteridaceae	*Jamesonia hispidula* Kunze	Venezuela	F
Pteridaceae	*Jamesonia scammaniae* A.F. Tryon	Costa Rica	P
Polypodiaceae	*Lellingeria brenesii* A. Rojas	Costa Rica	H, P
Polypodiaceae	*Lellingeria guanacastensis* A. Rojas	Costa Rica	H, I, P
Polypodiaceae	*Lellingeria pinnata* A. Rojas	Costa Rica	H, I, P
Lindsaeaceae	*Lindsaea angustipinna* A. Rojas & Tejero	Costa Rica	H, P
Lindsaeaceae	*Lindsaea fuscopetiolata* A. Rojas & Tejero	Costa Rica	H, P
Lindsaeaceae	*Lindsaea mesoamericana* A. Rojas & Tejero	México	P
Blechnaceae	*Lomaria sessilifolia* Klotzsch ex Christ	Costa Rica	S
Lomariopsidaceae	*Lomariopsis* × *farrarii* R.C. Moran & J.E. Watkins	Costa Rica	H, I
Dennstaedtiaceae	*Lonchitis lindeniana* Hook.	Venezuela	F
Dicksoniaceae	*Lophosoria quesadae* A. Rojas *	Costa Rica	H, I, P
Lycopodiaceae	*Lycopodium cernuum* fo. *macrostachyum* Christ *	Costa Rica	I
Lycopodiaceae	*Lycopodium clavatum* var. *pseudocontiguum* Christ *	Costa Rica	I
Lycopodiaceae	*Lycopodium cuneifolium* Hieron.	Costa Rica	F
Lycopodiaceae	*Lycopodium hippurideum* Christ *	Costa Rica	I
Lycopodiaceae	*Lycopodium pensum* Lellinger & Mickel *	Costa Rica	P, F
Lycopodiaceae	*Lycopodium pithyoides* Schltdl. & Cham.	México	F
Lycopodiaceae	*Lycopodium reflexum* var. *brevissimum* Christ *	Costa Rica	I
Lycopodiaceae	*Lycopodium tubulosum* Maxon	Costa Rica	P
Lycopodiaceae	*Lycopodium underwoodianum* Maxon *	Costa Rica	I
Lygodiaceae	*Lygodium* × *lancetillanum* L.D. Gómez	Honduras	H
Dryopteridaceae	*Megalastrum apicale* R.C.Moran & J. Prado	Costa Rica	P
Dryopteridaceae	*Megalastrum costipubens* R.C. Moran & J. Prado	Costa Rica	H, P

Dryopteridaceae	*Megalastrum ctenitoides* A. Rojas	Costa Rica	H, I
Dryopteridaceae	*Megalastrum dentatum* A. Rojas	Costa Rica	H, P
Dryopteridaceae	*Megalastrum glabrum* R.C. Moran & J. Prado	Costa Rica	P
Dryopteridaceae	*Megalastrum intermedium* R.C. Moran & J. Prado	Costa Rica	H, P
Dryopteridaceae	*Megalastrum longiglandulosum* R.C. Moran & J. Prado	Costa Rica	I
Dryopteridaceae	*Megalastrum longipilosum* A. Rojas	Costa Rica	H, I, P
Dryopteridaceae	*Megalastrum longipilosum* var. *glabrescens* A. Rojas	Costa Rica	H, I, P
Dryopteridaceae	*Megalastrum longipilosum* var. *glandulosum* A. Rojas	Costa Rica	H, P
Dryopteridaceae	*Megalastrum squamosum* A. Rojas *	Costa Rica	H, I, P
Polypodiaceae	*Melpomene alan-smithii* A. Rojas	Costa Rica	H, I, P
Polypodiaceae	*Melpomene personata* Lehnert	Bolivia	P
Polypodiaceae	*Microgramma × moraviana* L.D. Gómez *	Costa Rica	H
Dryopteridaceae	*Microstaphyla columbiana* Maxon	Colombia	I
Marattiaceae	*Myriotheca sorbifolia* Bory	África	F
Nephrolepidaceae	*Nephrolepis obtusiloba* A. Rojas	Costa Rica	I
Polypodiaceae	*Niphidium oblanceolatum* A. Rojas	Costa Rica	I, P
Oleandraceae	*Oleandra costaricensis* Maxon *	Costa Rica	I, S
Oleandraceae	*Oleandra decurrens* Maxon *	Costa Rica	I
Oleandraceae	*Oleandra zapatana* Lellinger *	Colombia	F
Ophioglossaceae	*Ophioglossum petiolatum* Hook.	Antilles	F
Dryopteridaceae	*Osmunda peltata* Sw.	Jamaica	F
Dryopteridaceae	*Peltapteris peruviana* L.D. Gómez	Perú	T, F
Dryopteridaceae	*Phegopteris subdryopteris* Christ *	Costa Rica	I
Lycopodiaceae	*Phlegmariurus gracilis* A. Rojas & R. Calderón	Costa Rica	H, P
Lycopodiaceae	*Phlegmariurus nanus* A. Rojas & R. Calderón	Costa Rica	P
Pteridaceae	*Pityrogramma dukei* Lellinger *	Colombia	F
Plagiogyriaceae	*Plagiogyria anisodonta* Copel. *	Costa Rica	I
Polypodiaceae	*Pleurogramme gyroflexa* Christ *	Costa Rica	I
Dryopteridaceae	*Polybotrya acuminata* var. *villosa* Christ	Costa Rica	T
Dryopteridaceae	*Polybotrya aucuparia* Christ	Costa Rica	F
Dryopteridaceae	*Polybotrya bipinnata* A. Rojas	Costa Rica	P
Dryopteridaceae	*Polybotrya gomezii* R.C. Moran *	Costa Rica	H
Dryopteridaceae	*Polybotrya lourteigiana* Lellinger *	Colombia	F
Dryopteridaceae	*Polybotrya pittieri* Lellinger *	Colombia	F
Dryopteridaceae	*Polybotrya villosula* Christ *	Costa Rica	T

Polypodiaceae	*Polypodium alsophilicola* Christ	Costa Rica	I
Polypodiaceae	*Polypodium blepharodes* Maxon	Costa Rica	P
Dryopteridaceae	*Polypodium cyclocolpon* Christ *	Costa Rica	I
Polypodiaceae	*Polypodium enterosoroides* Christ *	Costa Rica	I
Polypodiaceae	*Polypodium extensum* G. Forst	Australia	F
Polypodiaceae	*Polypodium flagellare* Christ *	Costa Rica	I
Polypodiaceae	*Polypodium fraxinifolium* subsp. *articulatum* Christ *	Costa Rica	IL
Polypodiaceae	*Polypodium furfuraceum* fo. *pinnatisectum* Brade	Costa Rica	T
Polypodiaceae	*Polypodium hyalinum* Maxon *	Costa Rica	I
Polypodiaceae	*Polypodium lanceolatum* var. *complanatum* Weath. *	Costa Rica	I, P
Polipodiaceae	*Polypodium limulum* Christ *	Costa Rica	IL, LP
Polypodiaceae	*Polypodium loriceum* var. *oligoneurum* Christ	Costa Rica	I
Polypodiaceae	*Polypodium moniliforme* var. *minus* Christ *	Costa Rica	IS
Polypodiaceae	*Polypodium montigenum* Maxon	Costa Rica	P
Polypodiaceae	*Polypodium myriolepis* Christ *	Costa Rica	I
Polypodiaceae	*Polypodium pectinatum* var. *hispidum* Christ *	Costa Rica	IL
Polypodiaceae	*Polypodium percussum* var. *squamosum* Christ	Costa Rica	I
Polypodiaceae	*Polypodium pittieri* Christ *	Costa Rica	I
Polypodiaceae	*Polypodium plebeium* var. *palmense* Christ	Costa Rica	S
Polypodiaceae	*Polypodium plectolepidioides* Rosenst. *	Costa Rica	I
Polypodiaceae	*Polypodium plesiosorum* var. *rubicundum* Tejero	Costa Rica	I
Polypodiaceae	*Polypodium polypodioides* var. *aciculare* Weath. *	Costa Rica	I
Polypodiaceae	*Polypodium rodriguezianum* L.D. Gómez *	Costa Rica	I
Grammitidaceae	*Polypodium sericeolanatum* Hook.	Ecuador	F
Polypodiaceae	*Polypodium subviride* Lellinger *	Panamá	F
Polypodiaceae	*Polypodium tablazianum* Rosenst.	Costa Rica	IL
Polypodiaceae	*Polypodium tico* A. Rojas *	Costa Rica	H, I, P
Grammitidaceae	*Polypodium turrialbae* Christ *	Costa Rica	IL
Dryopteridaceae	*Polystichum talamancanum* Barrington	Costa Rica	I, P
Pteridaceae	*Psilogramme glaberrima* Maxon *	Costa Rica	I
Pteridaceae	*Psilogramme jimenezii* Maxon *	Costa Rica	I
Pteridaceae	*Psilogramme villosula* Maxon *	Costa Rica	I
Pteridaceae	*Pteris herrerae* A. Rojas & M. Palacios	Costa Rica	H
Pteridaceae	*Pteris lactua* Poir.	Guadalupe	F
Pteridaceae	*Pteris longicauda* Christ *	Costa Rica	I

Pteridaceae	*Pteris longipetiolulata* Lellinger *	Colombia	I, F
Pteridaceae	*Pteris mollis* Christ *	Costa Rica	I
Pteridaceae	*Pteris quadriaurita* var. *asperula* Christ *	Costa Rica	I
Pteridaceae	*Pteris quadriaurita* var. *curtidens* Christ *	Costa Rica	I
Dryopteridaceae	*Rhipidopteris standleyi* Maxon	Costa Rica	T
Saccolomataceae	*Saccoloma elegans* var. *spinosum* A. Rojas & Trusty	Costa Rica	H, I, P
Saccolomataceae	*Saccoloma moranii* A. Rojas *	Costa Rica	H, I, P
Blechnaceae	*Salpichlaena thalassica* Grayum & R.C. Moran *	Costa Rica	I, P
Selaginellaceae	*Selaginella costaricensis* Hieron	Costa Rica	S
Selaginellaceae	*Selaginella estrellensis* Hieron.	Costa Rica	P
Selaginellaceae	*Selaginella hoffmannii* Hieron.	Costa Rica	F
Selaginellaceae	*Selaginella osaensis* A. Rojas	Costa Rica	H, I, P
Selaginellaceae	*Selaginella tuberosa* McAlpin & Lellinger *	Costa Rica	I
Blechnaceae	*Stenochlaena kunzeana* Underw.	Cuba	F
Dryopteridaceae	*Stigmatopteris killipiana* Lellinger *	Colombia	F
Isoetaceae	*Stylites andicola* Amstutz	Perú	T
Tectariaceae	*Tectaria acerifolia* R.C. Moran	Panamá	P
Tectariaceae	*Tectaria faberiana* A. Rojas	Costa Rica	H, P
Tectariaceae	*Tectaria neotropica* L.D. Gómez *	Panamá	H, P
Tectariaceae	*Tectaria × chaconiana* A. Rojas	Costa Rica	H, I, P
Polypodiaceae	*Terpsichore acrosora* A. Rojas	Costa Rica	H, I
Polypodiaceae	*Terpsichore cocosensis* A. Rojas *	Costa Rica	H, I, P
Polypodiaceae	*Terpsichore esquiveliana* A. Rojas	Costa Rica	H, I
Polypodiaceae	*Terpsichore glandulifera* A. Rojas	Costa Rica	H, I, P
Polypodiaceae	*Terpsichore smithii* A. Rojas	Costa Rica	H, I
Thelypteridaceae	*Thelypteris alan-smithiana* L.D. Gómez *	Honduras	H
Thelypteridaceae	*Thelypteris barvae* A. R. Sm. *	Costa Rica	I
Thelypteridaceae	*Thelypteris calypso* L.D. Gómez	Costa Rica	H, I, P
Thelypteridaceae	*Thelypteris chocoensis* A.R. Sm. & Lellinger *	Colombia	F
Thelypteridaceae	*Thelypteris crenata* A.R. Sm. & Lellinger	Costa Rica	I, P
Thelypteridaceae	*Thelypteris croatii* A.R. Sm.	Panamá	P
Thelypteridaceae	*Thelypteris darwinii* L.D. Gómez	México	I
Thelypteridaceae	*Thelypteris decussata* var. *costaricensis* A.R. Sm.	Costa Rica	I
Thelypteridaceae	*Thelypteris delasotae* A.R. Sm. & Lellinger *	Costa Rica	P, F

Thelypteridaceae	*Thelypteris gomeziana* A.R. Sm. & Lellinger *	Costa Rica	P, F
Thelypteridaceae	*Thelypteris grayumii* A.R. Sm. *	Costa Rica	I
Thelypteridaceae	*Thelypteris hondurensis* L.D. Gómez *	Honduras	H, I
Thelypteridaceae	*Thelypteris killipii* A.R. Sm. & Lellinger *	Colombia	F
Thelypteridaceae	*Thelypteris mombachensis* Croat	Nicaragua	H
Thelypteridaceae	*Thelypteris ophiorhizoma* A.R. Sm. & Lellinger *	Colombia	I, F
Thelypteridaceae	*Thelypteris oroniensis* L.D. Gómez	Costa Rica	H, I
Thelypteridaceae	*Thelypteris peripaeoides* L.D. Gómez *	Costa Rica	H, P
Thelypteridaceae	*Thelypteris strigillosa* A.R. Sm. & Lellinger *	Colombia	F
Thelypteridaceae	*Thelypteris subscandens* A. R. Sm. *	Costa Rica	I
Thelypteridaceae	*Thelypteris tapantensis* A.R. Sm. & Lellinger *	Costa Rica	I, P, F
Thelypteridaceae	*Thelypteris vernicosa* A.R. Sm. & Lellinger *	Panamá	F
Thelypteridaceae	*Thelypteris villana* L.D. Gómez	Costa Rica	I
Thelypteridaceae	*Thelypteris zurquiana* A.R. Sm. & Lellinger *	Costa Rica	P, F
Hymenophyllaceae	*Trichomanes capillaceum* var. *subclavatum* Christ *	Costa Rica	I
Hymenophyllaceae	*Trichomanes cocos* Christ	Costa Rica	I
Hymenophyllaceae	*Trichomanes collariatum* var. *alvaradoi* A. Rojas	Costa Rica	H, I, P
Hymenophyllaceae	*Trichomanes curtii* Rosenst.	Costa Rica	I
Hymenophyllaceae	*Trichomanes pusillum* var. *macropus* Christ *	Costa Rica	IL
Pteridaceae	*Vaginularia trichoidea* Fée	China?	F
Pteridaceae	*Vittaria bommeri* Christ *	Costa Rica	S
Pteridaceae	*Vittaria costaricensis* Lellinger *	Costa Rica	F

Table 2. List of the 13 specimens used in the descriptions of different taxa.

Specimen	Taxa 1	Taxa 2
H. Pittier 10981	*Alsophila leucolepis* var. *pubescens*	*Alsophila acutidens*
A. Tonduz 11784	*Dennstaedtia obtusifolia* var. *protrusa*	*Dicksonia obtusifolia* var. *protrusa*
W. Burger 5421	*Megalastrum longiglandulosum*	*Megalastrum longipilosum* var. *glandulosum*
H. Pittier 10993	*Ctenitis skutchii*	*Megalastrum intermedium*
L. Gómez-Pignataro 3347	*Elaphoglossum alvaradoanum*	*Elaphoglossum auripulum* var. *longipilosum*
I. Chacón 1162	*Elaphoglossum brenesii*	*Elaphoglossum heterochroum*
I. Chacón 2291	*Elaphoglossum lenticulatum*	*Elaphoglossum mitorrhizum*
W. Burger 8853 E. Scamman 7962	*Megalastrum costipubens*	*Megalastrum longipilosum* var. *glabrescens*
H. Pittier 13257	*Polypodium montigenum*	*Polypodium plebeium* var. *palmense*
P. Biolley 10688	*Polybotrya acuminata* var. *villosa*	*Polybotrya villosula*
S. Knapp 2109	*Elaphoglossum lanceiforme*	*Elaphoglossum pseudoerinaceum*
M. Valerio 168	*Elaphoglossum talamancanum*	*Elaphoglossum terrestre*

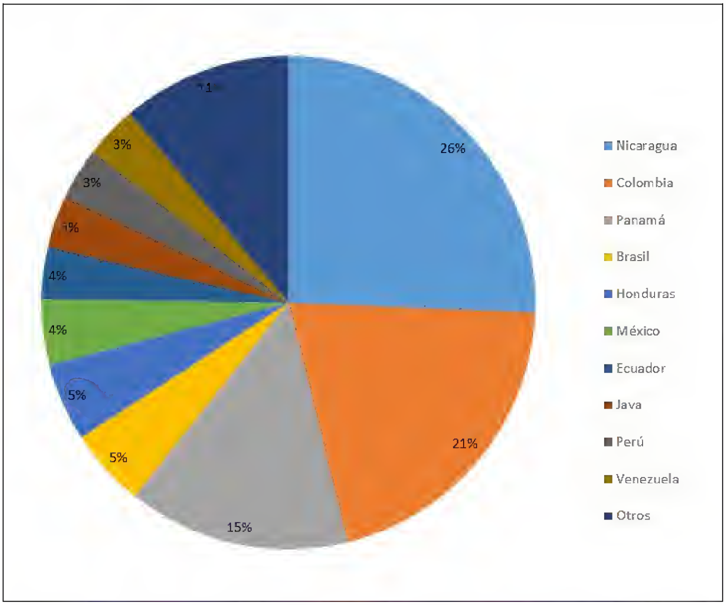

Figure 2. Distribution (%) of the foreign type species of Pteridophyta and Lycophyta in CR.

ACKNOWLEDGEMENTS

I would like to thank María Teresa Vizoso (GDA) for her valuable collaboration in the search, registration, and scanning of a significant number of specimens. I also would like to extend my sincere gratitude to Dr. Robbin Moran (NY) for his critical review of the first draft of the paper.

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Muñoz, C.J. 2018. *Buchnera americana* in Brooks Co., Texas. Phytoneuron 2018-50: 1–4. Published 24 July 2018. ISSN 2153 733X

BUCHNERA AMERICANA IN BROOKS CO., TEXAS

CHRISTOPHER J. MUÑOZ
School of Earth, Environmental and Marine Sciences
Ocean, Coastal and Earth Sciences Program
University of Texas Rio Grande Valley
Edinburg, Texas
Christopher.munoz01@utrgv.edu

ABSTRACT

Buchnera americana is reported for the first time for Brooks Co., Texas, the only known occurrence within an inland county south of the Nueces River. This population was found 60 miles from the coast of the Gulf of Mexico on a migrating sand dune of the South Texas Sand Sheet.

Buchnera americana L. is newly reported for Brooks Co., Texas. This finding is the result of a plant survey conducted within an inland migrating sand dune of the South Texas Sand Sheet (STSS). The population is well-established, with more than 300 individuals (estimated) occurring within the dune and few others in the surrounding vicinity. This represents the only known inland county occurrence of the species south of the Nueces River. Voucher specimens were collected and housed at PAUH (University of Texas Rio Grande Valley Herbarium). County records were determined by referring to TEX-LL Occurrence Records database (Lundell Plant Diversity Portal) as well as regional literature (Richardson 2011; Turner et al. 2003).

Voucher. **Texas**. Brooks Co.: 0.5 mi NW of FM 755, ca. 13 mi SW of the town of Encino, 26.856130° -98.329379°, 236 ft, sandy loam where Goliad Formation is exposed at the surface, area immediately surrounded by active dunes of the South Texas Sand Sheet (STSS), decreasing concentration gradient of individuals farther from exposed substrate of the Goliad Formation, with *Froelichia drummondii*, *Prosopis glandulosa*, *Croton coryi*, *Stillingia sylvatica*, *Cnidoscolus texanus*, *Dalea obovata*, *Yucca constricta*, *Zanthoxylum hirsutum*, *Galactia canescens*, and various grass species, 3 Jun 2018, *Muñoz s.n.* (PAUH).

Buchnera americana is a hemiparasite with little host specificity (Natureserve 2018). Individuals of the Brooks Co. population apparently were growing mostly in the absence of characteristic host plants –– common hosts are white oak, eastern white pine, green ash, and cottonwood (Musselman & Mann 1977). Populations of *B. americana* have an affinity for sandy substrates and are typically confined to coastal dunes along the southern portion of its range in Texas (Richardson 2011).

The migrating dune where the Brooks County population is located represents an anomaly in terms of its distance away from the coastline (60 miles) and was identified as a unique physiographic feature via satellite imagery. A similar migrating sand dune can be seen 22 miles west of the Brooks Co. locality via satellite imagery.

Figure 1. Apical inflorescences of *Buchnera americana,* Brooks Co., Texas.

Figure 2. *Buchnera americana* individuals at various stages of maturity, Brooks Co., Texas.

Figure 3. *Buchnera americana,* Brooks Co. locality with standard-size botanical press for scale.

Figure 4. Aeolian dunes of the South Texas Sand Sheet surrounding the *Buchnera americana* locality.

ACKNOWLEDGEMENTS

The author thanks Juan González and Guy Nesom for reviewing this paper.

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HOW I WROTE THE FLORA OF THE NORTHEAST: A MANUAL OF THE VASCULAR FLORA OF NEW ENGLAND AND ADJACENT NEW YORK

DENNIS W. MAGEE
762 Townsend Road
Groton, Massachusetts 01450

I was born and raised in rural Massachusetts and spent many hours throughout my youth as a hunter, trapper, and fisherman. It was only fitting that I would develop an intense interest and knowledge of natural history. In those early years I acquired a particular fondness for wild plants and for the places where they grow. Early in my career as an environmental consultant I spent many hours identifying wetlands and delineating their boundaries. This led to the writing of my first book "Freshwater Wetlands: A Guide to Common Indicator Plants of the Northeast" (1981). Over time my floristic interests expanded, leading me into the interior as well as the coastlines of New England, where I became intimately acquainted with the floras of a wide variety of habitats throughout this region as well as the Midwest and the mid-Atlantic states. Early in my professional life, the possibility of writing a regional flora seemed unlikely. Four of them already existed, and they effectively treated the vascular flora of greater New England, so the likelihood of me producing something novel seemed low.

It wasn't until I met Mr. Harry Ahles in the early 1970's as a grad student at the University of Massachusetts, Amherst, and studied under his tutelage that I began to realize the value and need to produce a modern flora for the region, one that would incorporate the latest taxonomic and nomenclatural standards into a descriptive text and blend these with easy to use keys, illustrations, and county-level distribution maps. This combination of objectives offered compelling justification for writing a new regional flora for greater New England, since none that had been written provided such features in combination.

The Influence of Harry Ahles

Mr. Ahles, or Harry as I knew him, was an exceptionally talented field botanist. As Dr. Arthur Cronquist once described him "He was simply one of the best plantsmen I've ever met". And, indeed, he was. Harry had a profound memory and an exceptionally keen eye for depicting subtle morphological details useful for separating closely related plant species. He had no college training and started work in his late teens as a groundsman at the New York Botanical Garden. Over the decades he studied and came to know the floras of eastern North America from the Carolinas to the Florida Keys and northward from Illinois to eastern Canada. He had worked with Dr. Jones to produce the flora of Illinois and with Drs. Radford and Bell to produce the Flora of the Carolinas. He came to the UMass Amherst Botany Department in the late 1960's. When I once asked him how many species he thought he knew on sight, he estimated over 7,000.

Harry had many colleagues and acquaintances but few friends. During the 11 years I mentored and worked with him, we became close friends. I helped him build his log cabin on Horse Mountain in Hatfield, Massachusetts. I stayed at his cabin on weekends and, after breakfast at a local diner, would spend the day with him collecting plants for the UMass Amherst Herbarium. What I learned most from Harry was not so much field identification skills but more how to think about classification and how to construct useful keys. Notwithstanding his eye for subtle details, Harry was not a splitter, quite the opposite. In fact, he disdained taxonomists with the mindset of naming new species using criteria that don't stand up.

Although the interior of his cabin looked messy and chaotic, he always knew where everything was and had a very well-organized mindset. Field botany was his whole life, and he usually worked 90 to 100 hours a week. In his youth he had a close relationship with a young woman that went sour and ever since then he swore off serious relationships with women and threw himself into his work. He could be very opinionated and stubborn as a mule, and I never dared to argue with him for fear of losing the friendship. But a more loyal friend one could not have; when I was newly married and building my house, he offered to lend me every dollar he had on no more than my word to repay him. Each year he had a tradition of baking Christmas cookies -- several dozen batches of 50 or so each that he gave out randomly. He passed away in March, 1981, at the age of 57, from complications arising from surgery to remove a tumor from his lung. His untimely passing was a great personal loss to me as well as to the botanical community.

How I Proceeded

My opportunity to actually write the Flora came following Harry's passing. As a faculty member in the UMass Amherst Botany Department, he taught courses in field botany in addition to his role as herbarium curator. As part of his curatorial duties he established and maintained a large file of distribution records for the 3,800 or so species of plants in New England and adjacent New York. He also wrote keys for his use in teaching. As a faculty member he was also under some pressure to publish, and he represented his work on the keys as part of a flora for New England that he was working on. He told me on several occasions that he intended to publish a book strictly of keys. I often wondered whether he would have ever completed it because I observed him involved with his herbarium duties for 80 to 90 hours a week. During the last several years of his life he wasn't, to my knowledge, actively working on completing the keys.

Shortly after Mr. Ahles' death, I petitioned the Botany Department for permission to take the information he had assembled and write a flora for New England and the adjacent New York counties; I also needed permission from his sister, Marjorie Armstrong. There were others also interested in gaining access to Harry's files, including staff at Harvard University, who were interested mainly in his distribution data. Based on my long association with Harry, during which I spent much time with him in the field, the Botany Department and Harry's sister selected me to undertake the work. The challenge would be how to carve out a significant amount of time for this new endeavor in a schedule that was already full with a career in environmental consulting and a family. The task turned out to be several orders of magnitude more difficult and time-consuming than I'd imagined.

But I was strongly committed to the project, to see it through to completion regardless of the time it would take. I realized that circumstances afforded me a unique opportunity to make a significant, long-term contribution to field botany by writing a new regional flora. I was particularly interested in writing good keys. In the past, whenever I was on a serious mission to inventory plants I needed to bring along a half dozen or so field guides and manuals. Some resources had good keys for some groups of plants and others for other genera and species; principal authors often used various specialists to treat certain groups and so the treatments throughout such a manual were often uneven, some good and some not so good. I wanted to write a manual having treatments for all the plants in our region that would be useable for much of the year and that would be user-friendly. Also, Harry had done a lot of work on keys and distributions and I wanted to make best use of what he had produced, which would otherwise be lost to science.

To produce a finished flora from the partially completed keys and the distribution data turned out to be an enormous effort that required 20-25 hours per week over a period of 17 years. To honor my other commitments, I arose week days at 2:45 AM and put in 3 ½-4 hours each day before work. I also worked many weekends at the UMass Herbarium, and also put in a lot of time over holidays and vacations. I thought that a complete regional flora required excellent keys, family and genus descriptions, species accounts, diagnostic illustrations, and county-level range maps. I greatly admired the "Flora of the Carolinas" that Harry had co-authored and wanted to use the same format and design for this work I have always thought that photographs are useless in showing important diagnostic features while adding greatly to the production cost of a book, and so I've never used any. A major advantage in writing a flora is being in control of its content and design. I decided to call the book "Flora of the Northeast: A Manual of the Vascular Flora of New England and Adjacent New York."

I am describing my work on the Flora because I've come to regard it as a major portion of my life's work and also because I'm not aware of anyone who has given a full account of such an undertaking. I also thought it might be helpful to give others at least one man's perspective on how one goes about preparing a major regional flora. I can honestly say that I spared nothing as to level of effort, thoroughness, and what personal finances I could afford to produce the best possible flora for our region. In hindsight, I would not have done anything any differently.

Plant Distributions

The first task in writing a flora is to compile a list of all species having records of occurrence in the region to be covered by the flora. Fortunately, this information mostly resided in the 12-ring binder set of notebooks that Harry kept in the UMass Herbarium. All the data were at the county level for our Flora region. Just prior to his death, he had taken a one and one half year leave of absence from the Department to visit all the major herbaria in New England and eastern New York to update his file. He would work 80 to 90 hours a week taking off only one day but accomplished his goal. After Harry's death I did an extensive literature review to capture any records subsequent to his work. Harry's information was also used by the Massachusetts Natural Heritage Program in preparing an updated checklist for part of our area (published in 1999). They visited major herbaria to document collections made since 1981, and in comparing their more recent work with Harry's distribution data, a high level of congruence was found. As an added measure I obtained the list of plant names for our region from Dr. John Kartesz from the Biota of North America Program and added any data that were missing to my file.

After this process I felt I had a solid basis for the plant species I needed to include in the Flora, which came to around 3,600 species. For every species with more than three occurrences in the region covered by the Flora, I prepared a range map. For those with fewer occurrences I noted the data in the species account. To do this I mass produced maps showing state and county boundaries for New England and adjacent New York, and then placed a dot in each county having an occurrence record from my file. In all I prepared over 2,400 county-level distribution maps for the Flora. Owing to time constraints I wasn't able to make another circuit to revisit all the herbaria.

Keys and Descriptions

I feel that the most important part of any flora is its keys, and I spent an inordinate amount of time on these. I shared Harry's views of wanting keys that were accurate yet user friendly and useful for as much of the year as possible. And so, I used vegetative structures as much as practicable in addition to flowering and fruiting structures. For woody plants I included a key to genera in winter condition and descriptions of twig, bud, and other features useful for winter identification that I placed in the genus accounts. Overall, I spent around 12 of the 17 years required to complete the work on the keys and descriptions.

In writing the keys I always prepared the species keys of a genus first and then a key to the genera in the family. Harry had completed keys for many of the genera, had partly completed others, and for some genera had no keys. And so, I used the information he had completed as a data source, and also consulted other floras and monographs. I used these sources to compile a list of plant characteristics that had been found to be useful in distinguishing one species from another. I then constructed a matrix of characteristics and species and filled in the matrix cells with information from the literature on each species; such information included measurements and similar empirical data. I then went to the UMass Herbarium and pulled out a folder of usually one to two dozen sheets for each species. I then examined each sheet, took my own measurements and other observations, and added these to the matrix cells. Over the course of this research I examined tens of thousands of herbarium sheets.

Over the many years that botanists have been studying the temperate flora, all the important diagnostic features that distinguish a species from others had pretty much been discovered. What was different among the various floras was the hierarchy used by various writers to arrange the data and design the keys. By the time I had gone through the literature and plant specimens for all the species in a genus and had completed my matrices, I had a clear idea on how to design a key that I felt accomplished my objectives. In writing the keys to the genera I pretty much used the same process. Throughout the 12 or so years I worked on the keys, I was spending a lot of time in the field inventorying vegetation as part of my work as an environmental consultant. Throughout this time, I and my staff of three botanists at Normandeau Associates, Environmental Consultants (Bedford N.H.) field-tested the keys I had completed up to that time, and I modified my keys whenever needed. Since Harry and I came to view field botany and keys pretty much the same, the keys I ended up constructing were often similar to his. Wherever the data supported his conclusions, I tried to make use of them in my keys to preserve his understanding and make it part of the Flora. In constructing the keys, I made every effort to use everything of value from Harry's manuscript. I have placed a copy of his original manuscript in the archives of the University of Massachusetts Amherst Library for posterity.

By the time I had finished the keys for around 3,600 species and 1,000 genera, I felt I was well on my way toward accomplishing my objective of creating a single manual with uniformly good treatment of all the groups. The final major task in this part of the project was to prepare the general keys section for the beginning of the Flora. In anticipation of this task I prepared a master matrix for genera with more than one to few species; I ended up with around two-thirds of the genera in this matrix (over 600 genera). The matrix had around four dozen characteristics of potential value in distinguishing each genus from the others. Because the information was voluminous and the cells were small, I developed a system of codes and abbreviations that I used to populate the matrix. The matrix proved indispensible in writing the general keys. Harry had also completed a draft of this general key, much of which I was able to use. Because this matrix contained a lot of good empirical data of potential value to others, on the strong recommendation of Dr. George Wilder of the Naples Botanical Garden (Florida) I ended up including it, along with all the codes in the appendix to the Flora. In last analysis, the keys and descriptions that ultimately comprised the Flora are my own creations based on analysis and synthesis of information gleaned from the herbarium material, the literature, and Harry's partial manuscript.

In his 15 or so years as curator of the UMass Herbarium, Harry spent the majority of his time building up the specimen collection. He also collected specimens for exchange with other institutions and maintained a large exchange program with herbaria throughout the USA and the world. And so, for the Flora region there was abundant material for me to examine to prepare the keys and descriptions. If a species was rare in the Northeast it was generally well represented in specimen folders from other areas of the USA or abroad. I am fortunate to have had access to such a large, well supplied herbarium throughout my preparation of the Flora. The Botany Department and Herbarium staff afforded me unlimited access; I had my own key to the science building and the herbarium. I would go to the herbarium when I needed to, take home dozens of folders of specimens at a time and return them when I had finished a group. I typically spent around 10 hours each visit. The herbarium was always well organized and well maintained by Dr. Karen Searcy, the Herbarium Curator who took over after Harry. Without this level of cooperation and encouragement, I could never have undertaken the project.

During the years I worked on the keys I traveled a fair amount of the time to various project sites in the course of my work as an environmental consultant, mostly to do field studies. I was generally able to get my own room in a motel or a cabin. I would load the back of the field vehicle with herbarium folders and take them to my temporary accommodation of up to a week or two. This way I was able to maintain my schedule of arising at 2:45AM and putting in four hours or so per day on my work on the keys. All I needed was my dissecting needles and my 10 power hand lens. If I thought observations of fresh material were needed I brought as much from our field studies as needed back to my room. If my trips out of town involved air travel, I brought my notes, matrices, and literature sources with me and worked on the plane and mornings in my hotel room. Overall, I was never away from the project and lost little if any time due to travel for my profession.

After I had completed a key to a given genus I used my notes, matrices, and the literature to prepare a technical description for the genus while everything was fresh in my mind. I also prepared accounts for each of the species to include information generally found in a floristic treatment except the technical description. To do this would have added years to the work and considerable volume to a book that was already going to be very large. Instead, I added brief notes of the sort that a field botanist, wetland scientist, or naturalist would find useful and interesting. For synonymies I relied on the data provided in the Biota of North America Program. More original research would have involved extensive literature review to document my decision on the name I used for the plant. This would have added years to the project, and since John Kartesz had made it his primary work to maintain a list of updated names, I relied on the information he provided. After completing the descriptions and accounts for all the genera in a family, I prepared the family description.

Illustrations

I decided on the illustrations I would include in the Flora as I was writing the keys to species and genera. As I was working on a key I would identify the concepts and features that I thought needed clarification and note these. After I had accumulated a couple dozen or so I made a special trip to the herbarium to select specimen sheets that I thought best showed what I wanted to clarify. I then brought these to my illustrator, Abigail Rorer, and sat with her for hours at a time, going over my notes and each sheet. She then made her own notes and by the end of the session had a clear understanding of what she needed to produce. As soon as I got the finished product I appended the species name and prepared the text that I wanted to accompany each drawing. Throughout the process of working with Abigail, I was able to convey any specific features I thought should be highlighted in a particular drawing and she was able to do this with heavier lines, shading, and other graphics techniques. This is a distinct advantage over photographs, which often come out too dark or light and generally don't show clearly the important features. Photographs are useful in conveying overall appearance of a plant but generally fail to display necessary diagnostic details. Overall, nearly 1,000 original drawings were prepared by Abigail for the Flora, working steadily for four years, and all are of top quality.

Other Tasks

Although the vast majority of the time and effort put into this Flora was spent on the keys and descriptions, distributions, and illustrations, there are other parts to a floristic manual that need to be included. A couple of more years needed to be spent on the preface, acknowledgements, glossary, index, summary of taxa, and assorted other lesser tasks; for these lesser tasks I adopted conventions used by other authors that have become more or less standard, formatting my own information to the standard. One task that was not part of the preparation of the Flora that I much disliked was fund-raising. For many publishers, authors are expected to solicit funding for their project, and I had to take time out from my work on the manuscript to write letters, send samples of the work, make phone calls, and attend meetings. Fortunately, I didn't need to be involved in this process in earnest until the project was about three-quarters completed.

Funding and Production

Over and above the enormous amount of time required to write a flora, the monetary cost of producing a high-quality manual was way beyond what I had expected. I myself paid out around $10,000 for the illustrations (1000 drawings at $10/apiece), and this was a real bargain in view of their high quality. Abigail Rorer, an exceptionally talented illustrator, has since earned international acclaim, and costs to secure her work today would be prohibitive. The Ahles estate paid out about as much in word processing and assorted other costs. My company, Normandeau Associates, dedicated a secretary half time for two and one-half years to produce an electronic manuscript at a cost of around $20,000. In addition, the University of Massachusetts Press, the publisher, required a subsidy in order for production to begin. Fund raising efforts had come to nothing and I was in despair as to whether the book would be published after all the effort and expense put forth. In desperation, I appealed to Normandeau's parent company at the time, Thermo Electron; I had met the President, George Hatsopoulas, a number of times, himself an author of several books on economics. He ended up granting me a contribution of $8,500, which was sufficient to get things moving at the Press.

Timing was everything, and if it had taken me another year or so to bring the project to this point, a large part of the funding would not have been there. In the year following my secretary's half-time work on the manuscript, Normandeau issued a policy whereby department managers could no longer have their own secretaries. Also, about six months after my $8,500 grant from Thermo, that company sold Normandeau and it became employee-owned. Given these circumstances, it is likely that the Flora would not have been published.

Overall, the book was in production for about two years, during which I spent much time meeting with Jack Harrison, the designer, and reviewing galley proofs. I wanted the illustrations to be placed throughout the keys to facilitate keying and the range maps to be as near the species accounts as possible. These requirements presented major problems with layout and typesetting, but Jack did a magnificent job. I also needed to work closely with Jack to be certain each illustration had the correct scale, notations, and arrows to features. These and other production tasks required my constant attention throughout the two years the Flora was being created; in the final stages especially, there were minutiae one could not anticipate. To minimize typographic errors, I conducted countless reviews and there are still a few errors. In addition to the salaries of the production, design, and marketing staff at the Press, actual printing and binding costs for the first printing of 2,500 copies ran around $25,000. I estimate that the entire cost to produce the first print run was in excess of $100,000, or around $40 per book. This doesn't include any of my time, which averaged 20-25 hours per week for 17 years. Some months prior to its debut, the marketing staff at the Press launched an extensive advertising campaign to introduce the book to university book stores and other potential buyers.

Publication

I finally received the call in September 1999 that the book had been shipped from the warehouse to UMass Press, and so my wife and I took the day off and went out to the Press. As I thumbed through it the book looked perfect; text, drawings and maps were crisp and the paper and bindings were of top quality. Design and layout were more than I could have hoped for and gave the book outstanding visual appeal. This book was worth all that I and my predecessor, Harry Ahles, had put into it and I felt proud.

Shortly after its publication the Press marketed it at book shows and in special releases. The book was reviewed in about a dozen professional journals and newsletters, about 10 of which were very positive and the other two were neutral. There were no negative reviews. Within about five years the first printing of 2,500 copies was sold out. The book was being used as a text by several universities and as a reference book by botanists, consultants, and other professionals. I felt pleased with the success of the Flora as reflected in the sales and good reception by the professional and scientific community. I also finally had a single book I could use in the field without needing to bring along a collection of others. I felt more confident using my own keys, which included the best of Harry's insights and the artist's talents than any other keys, and the range maps gave me an immediate sense of the distribution of each species.

A few years later (2007) I produced a second edition of the Flora, with a CD ROM containing a Random Access Key that I prepared from the appendix matrices in the first edition. The CD-ROM included numerous color photographs, because cost was not a consideration as it would have been if they were placed in the book. It took three years to complete the second edition.

Several months prior to his death, as if by premonition, Harry confided to me that he had a deep concern that his knowledge and work would soon pass with him "into the great beyond." And so, I am very pleased to have carried on the botanical legacy of Harry Ahles, a truly great man in the annals of field botany. He will be long remembered by those who knew his work in the field and herbarium as one of the finest field botanists of eastern North America of all time. To reach higher achievements in science, as in other fields, we stand on the shoulders of colleagues and mentors who went before us, blazing new trails and illuminating the way. In writing the Flora, I have followed in the footsteps of a great man, colleague, mentor, and friend.

ACKNOWLEDGEMENTS

The author expresses gratitude to the following individuals for their review of this manuscript prior to its publication and for offering valuable suggestions: Dr. John Kartesz, Director, Biota of North America Program, Chapel Hill, North Carolina; Dr. George Wilder, Herbarium Curator, Naples Botanical Garden, Naples, Florida; Dr. George Neuman, Master Horticulturist and Gardener, Bedford, New Hampshire.

Semple, J.C. 2018. *Solidago veracruzensis,* a new species of goldenrod in *S.* subsect. *Triplinerviae* (Asteraceae: Astereae) from Mexico. Phytoneuron 2018-52: 1–18. Published 13 August 2018. ISSN 2153 733X

SOLIDAGO VERACRUZENSIS, A NEW SPECIES OF GOLDENROD IN *S.* SUBSECT. *TRIPLINERVIAE* (ASTERACEAE: ASTEREAE) FROM MEXICO

JOHN C. SEMPLE
Department of Biology
University of Waterloo
Waterloo, Ontario Canada N2L 3G1
jcsemple@uwaterloo.ca

ABSTRACT

A new species in *Solidago* subsect. *Triplinerviae* is described from collections made primarily in Veracruz, Mexico. In multivariate analyses of *S. altissima, S. juliae, S. pringlei,* and the new species and in an analysis of the varieties of *S. altissima* and the new species, the new species had 100% a posteriori placement of specimens to the species. The new species generally resembles var. *pluricephala* in reduced upper stem leaf size, but with mean number of rays closer to var. *altissima* and mean ray floret lamina width closer to var. *gilvocanescens.* Upper stem leaves are usually serrate and the phyllaries of the new species are broader than those of *S. altissima* and sometimes multi-veined. The following new name is proposed: **Solidago veracruzensis** Semple, **sp. nov.**

Solidago subsect. *Triplinerviae* (Torr. & Gray) Nesom includes 20 species of goldenrods with 4 endemic to Mexico: *S. durangensis* Nesom, *S. gypsophila* Nesom, *S. macvaughii* Nesom, and *S. pringlei* Fern. (Semple 2018 frequently updated). *Solidago altissima* L. has been reported to be present in Coahuila, Nuevo León, Oaxaca, Tamaulipas, and Veracruz, Mexico (UNAM web site 2018; Nesom annotations 1989, 1990; more recent Villaseñor annotations; herbarium specimens from LL, MEXU, and TEX; Thiers continuously updated), but no collections that I have seen from these states are *S. altissima.* They are either *S. pringlei* (*Hinton 20068* TEX; *Hinton 25587* TEX; *White & Chatters 42* LL), *S.* aff. *pringlei* (*Encina & Portillo G. 822* MEXU-2 sheets, robust shoots), *S. missouriensis* Nutt (*Villarreal & Carranza 8366* MEXU); Nesom annotated several other collections from the Sierra la Gavia region of Coahuila as *S. missouriensis,* but he did not annotate this sheet) or much less often *S. velutina* DC. of subsect. *Nemorales* (Mackenzie) Nesom (Semple et al. 2018) from Coahuila and Nuevo León, while collections from Veracruz, southern Tamaulipas, and northcentral Oaxaca are superficially similar to *S. altissima* var. *pluricephala* M.C. Johnston but have upper stem leaves that are more serrate, inflorescences that are often small and lack elongated lower branches, and have phyllaries that are generally wider than those of *S. altissima* and *S. juliae,* slightly wider than those of *S. pringlei* and *S. macvaughii,* and slightly narrower than those of *S. gypsophila.*

Multivariate analyses were performed in order to statistically assess differences between the Veracruz collections plus one each from southern Tamaulipas and north-central Oaxaca and specimens of *Solidago juliae, S. macvaughii, S. pringlei,* and *S. altissima* from throughout the range in Canada and the USA and representing all three races of *S. altissima* (var. *altissima,* var. *gilvocanescens* (Rydb.) Semple, and var. *pluricephala*). No specimens from Mexico were included in the multivariate study of *S. canadensis* and *S. altissima* reported by Semple et al. (2015). Also, no specimens from Veracruz were include the multivariate study of *S. altiplanities* C.&J. Taylor, *S. altissima* var. *gilvocanescens,* S. *chilensis* Meyen, *S. gypsophila, S. juliae* Nesom, *S. leavenworthii* Torr. & A. Gray, *S. microglossa* DC., *S. pringlei,* and *S. tortifolia* Ell. reported by Semple and Lopez Laphitz (2016). Semple et al. (2016) compared *S. durangensis* to specimens of several species of subsect. *Maritimae* (Torr. & Gray) Nesom and subsect. *Triplinerviae* but did not include specimens from Veracruz or any collections of *S. altissima.*

Multivariate Analyses

Multivariate analyses of 33 specimens of *Solidago altissima* var. *altissima,* 32 specimens of *S. altissima* var. *gilvocanescens,* 38 specimens of *S. altissima* var. *pluricephala,* 11 specimens of *S. juliae,* 1 specimen of *S. macvaughii* included a posteriori as unassigned, 12 specimens of *S. pringlei*, and 13 specimens of *S. veracruzensis* were undertaken following the methods described in Semple et al. (2015, 2016). Two analyses were run. First, specimens of *S. altissima*, *S. juliae*, S. *pringlei*, and *S. veracruzensis* were compared with 1 specimen of *S. macvaughii* included a posteriori. Second, specimens of the three varieties of *S. altissima* and *S. veracruzensis* were compared. All 30 traits scored are listed in Table 1.

Table 1. Traits scored for the multivariate analyses of 137 specimens of *Solidago* subsect. *Triplinerviae*.

Abbreviation	**Description of trait scored**
STEMHT	Stem height measured from the stem base to tip (cm)
LLFLN	Lower leaf length measured from the leaf base to tip (mm)
LLFWD	Lower leaf width measured at the widest point (mm)
LLFWTOE	Lower leaf measured from the widest point to the end (mm)
LLFSER	Lower leaf dentation-number of serrations of lower leaf
MLFLN	Mid leaf length measured from the leaf base to tip (mm)
MLFWD	Mid leaf width measured at the widest point (mm)
MLFWTOE	Mid leaf measured from the widest point to the end (mm)
MLFSER	Mid leaf dentation-number of serrations of mid leaf
ULFLN	Upper leaf length measured form the leaf base to tip (mm)
ULFWD	Upper leaf width measured at the widest point (mm)
ULFWTOE	Upper leaf measured from the widest point to the end (mm)
ULFSER	Upper leaf dentation-number of serrations of upper leaf
CAPL	Length of inflorescence (cm)
CAPW	Width of inflorescence (cm)
CAPLBRLN	Length of longest lower inflorescence branches (cm)
INVOLHT	Involucre height at anthesis (mm)
OPHYLL	Outer phyllary length (mm)
IPHYLL	Inner phyllary length (mm)
IPHYLLW	Inner phyllary width (mm)
RAYNUM	Number of ray florets per head
RSTRAPLN	Ray strap length top of the corolla tube to the tip of the strap (mm)
RSTRAPWD	Ray strap width measured at the widest point (mm)
RACHLN	Ray floret ovary/fruit body length at anthesis (mm)
RPAPLN	Ray floret pappus length at anthesis (mm)
DCORLN	Disc floret corolla length from the base to tip of the corolla lobes (mm)
DLOBLN	Disc floret corolla lobe length lobe (mm)
DACHLN	Disc floret ovary/fruit body length at anthesis (mm)
DPAPLN	Disc floret pappus length at anthesis (mm)
DACHPUB	Number of hairs on disc floret ovary/fruit body

Four species analysis

The Pearson correlation matrix yielded r > |0.7| for only mid stem leaf length and upper stem leaf length; the former was not included in the analysis. Midleaf traits and upper leaf width and serrations were included in the analysis. Ray floret ovary/fruit body traits were not included.

In the STEPWISE discriminant analysis of 137 specimens of four species level a priori groups (*Solidago altissima*, *S. juliae*, *S. pringlei*, and *S. veracruzenis*), the following seven traits were selected and are listed in order of decreasing F-to-remove values: mid stem leaf width (15.98), number of ray florets (14.79), inner phyllary length (13.36), disc corolla lobe length (13.28), involucre height (6.55), disc corolla length (6.45), and ray floret lamina length (5.51). Wilks's lambda, Pillai's trace, and Lawley-Hotelling trace tests of the null hypothesis that all groups were the samples of one group had probabilities of p = 0.000 that the null hypothesis was true. The F-matrix for the discriminant analysis is presented in Table 2. F-values based on Mahalanobis distances of the between group centroids indicated the largest separation was between *S. altissima* and *S. pringlei* (18.654); the smallest separations were between *S. juliae* and *S. veracruzensis* (4.043) and between *S. juliae* and *S. pringlei* (4.730).

Table 2. Between groups F-matrix for the four a priori groups in a STEPWISE analysis (df = 16 118).

Group	*altissima*	*juliae*	*pringlei*
juliae	7.088		
pringlei	18.654	4.730	
veracruzensis	5.383	4.043	7.392

Wilks' lambda = 0.1191 df = 16 3 133; Approx. F= 7.6396 df = 48 351 prob = 0.0000

In the Classificatory Discriminant Analysis of 137 specimens of the four species level a priori groups (*Solidago altissima*, *S. juliae*, *S. pringlei*, and *S. veracruzenis*), percents of correct a posterori assignment to the same a priori group ranged from 84-100%. The Classification matrix and Jackknife classification matrix are presented in Table 3. Results are presented in order of decreasing percents of correct placement. Twelve of 12 specimens of the *S. pringlei* a priori group (100%) were assigned a posteriori to the *S. pringlei* group; 11 specimens with 93-100% probability and 1 specimen with 52% probability (40% to *S. juliae*; *Mueller 2062* GH from Nuevo León, this is the isotype of *S. muelleri* Standley a synonym of *S. pringlei*). Twelve of 12 specimens of the *S. veracruzensis* a priori group (100%) were assigned a posteriori to the *S. veracruzensis* group; 8 specimens with 92-100% probability (including the holotype and isotype of the species), 2 specimens with 84% and 82% probabilities, and 2 specimens with 75-76% probability. Ten of the 11 specimens of *S. juliae* (91%) were assigned a posteriori to the *S. juliae* group: 7 specimens with 93-100% probability, 2 specimens with 86% and 80% probability, and 1 specimen with 60% probability (32% to *S. pringlei*). One specimen of the *S. juliae* a priori group was assigned a posteriori to *S. veracruzensis* with 46% probability (29% to *S. altissima* and 25% to *S. juliae*; *Nesom & Nesom 7219* BRIT from Blanco Co., Texas). 86 of 102 specimens of *S. altissima* a priori group (84%) were assigned a posteriori to the *S. altissima* group: 65 specimens with 90-100% probability, 10 specimens with 82-89% probability, 3 specimens with 73-79% probability, 2 specimens with 66% probability, and 3 specimens with 57% probability (43% to *S. veracruzensis*; *Canning s.n.* UBC from Penticton, British Columbia, var. *gilvocanescens*), 56% probability (44% to *S. veracruzensis*; *Morton NA18776b* TRT from Wilmington, North Carolina, var. *pluricephala*), and 53% probability (46% to *S. juliae*; *Semple & B. Semple 6659* WAT from Walworth Co., South Dakota, var. *gilvocanescens*). Sixteen specimens of the *S. altissima* a priori group were assigned a posteriori to other species; 13 to *S. veracruzensis* with 52-94% probability (10 specimens were var. *pluricephala*, 2 were var. *altissima*, and 1 was var. *gilvocanescens*); 2 to *S. juliae* with 99% and 84% probability, and 1 to *S. pringlei* with 36% probability (35% to *S. juliae* and 28% to *S. altissima*). The single specimen of *S. macvaughii* only included a posteriori was assigned to *S. veracruzensis* with 93% probability.

Two dimensional plots of CAN1 versus CAN3 and CAN1 versus CAN2 canonical scores for 137 specimens of *Solidago altissima*, *S. juliae*, *S. mcvaughii* (included a posteriori), *S. pringlei*, and *S. veracruzensis* are presented in Fig. 1. Eigenvalues on the first three axes were 2.565, 0.445, and 0.215.

Table 3. Linear and jackknife classification matrices from the Classificatory Discriminant Analysis of four a priori groups; a posteriori placements to groups in rows.

Group	*altissima*	*juliae*	*pringlei*	*veracruzensis*	% correct
altissima	86	2	1	13	84
juliae	0	10	0	1	91
pringlei	0	0	12	0	100
veracruzensis	0	0	0	12	100
Totals	86	12	13	26	88

Jackknifed classification matrix

Group	*altissima*	*juliae*	*pringlei*	*veracruzensis*	% correct
altissima	85	2	3	12	83
juliae	0	9	1	1	82
pringlei	0	1	11	0	92
veracruzensis	0	0	0	12	100
Totals					

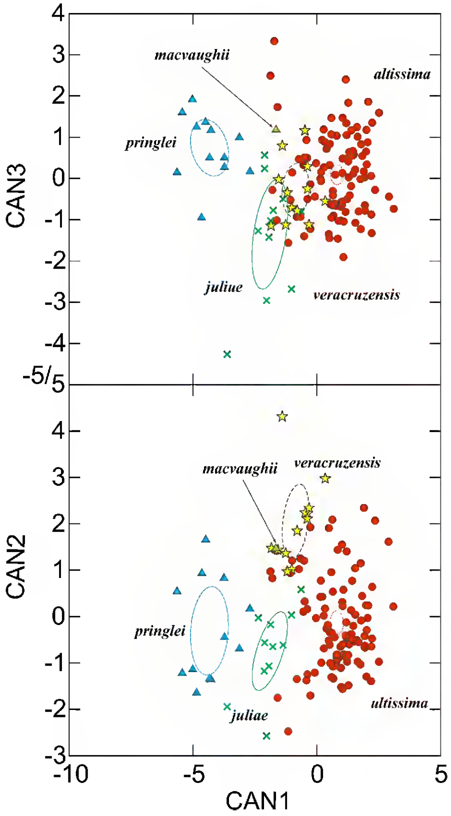

Figure 1. Plot of canonical scores (CAN1 vs CAN3 and CAN1 vs CAN2) for 137 specimens of *Solidago* subsect. *Triplinerviae*: *S. altissima* (red dots), *S. juliae* (green ×s), *S. mcvaughii* (light green triangle), *S. pringlei* (blue triangles), *S. veracruzensis* (yellow stars).

Solidago altissima–S. veracruzensis analysis

The Pearson correlation matrix yielded r > |0.7| for most leaf traits and only upper leaf length, width and number of serrations were included. Involucre height and inner phyllary length were correlated and only the former was included. Also, ray floret ovary traits were not included.

In the STEPWISE discriminant analysis of 116 specimens of four a priori groups (*Solidago altissima* var. *altissima, S. altissima* var. *gilvocanescens, S. altissima* var. *pluricephla*, and *S. veracruzenis*), the following five traits were selected and are listed in order of decreasing F-to-remove values: involucre height (22.77), disc corolla length (9.49), ray floret lamina width (7.87), outer phyllary length (5.74), and disc corolla lobe length (4.46). Wilks's lambda, Pillai's trace, and Lawley-Hotelling trace tests of the null hypothesis that all groups were the samples of one group had probabilities of p = 0.000 that the null hypothesis was true. The F-matrix for the discriminant analysis is presented in Table 4. F-values based on Mahalanobis distances of the between group centroids indicated the largest separations were between *S. altissima var. gilvocanescens* and *S. altissima var. pluricephala* (21.207) and *S. altissima var. gilvocanescens* and *S. veracruzensis* (18.648); the smallest separation was between *S. altissima var. altissima* and *S. altissima var. pluricephala* (3.408).

Table 4. Between groups F-matrix for the four a priori groups in a STEPWISE analysis (df = 5 108).

Group	***altissima***	***gilvocanescens***	***pluricephala***
gilvocanescens	14.944		
pluricephala	3.408	21.207	
veracruzensis	12.537	18.648	12.490

Wilks' lambda = 0.2533 df = 5 3 112; Approx. F= 12.8019 df = 15 298 prob = 0.0000

In the Classificatory Discriminant Analysis of 116 specimens of the four taxa a priori groups (*Solidago altissima* var. *altissima, S. altissima* var. *gilvocanescens, S. altissima* var. *pluricephla*, and *S. veracruzensis*), percents of correct a posterori assignment to the same a priori group ranged from 52-100%. The Classification matrix and Jackknife classification matrix are presented in Table 5. Results are presented in order of decreasing percents of correct placement. Thirteen of 13 specimens of the *S. veracruzensis* a priori group (100%) were assigned a posteriori to the *S. veracruzensis* group; 5 specimens with 98-100% probability, 3 specimens with 83-87% probability, 1 specimen with 74% probability, 2 specimens with 62-63% probability, 1 specimen with 53% probability (20% to var. *gilvocanescens*, 16% to var. *altisssima,* and 11% to var. *pluricephala*; *Solano & Vara 378* TEX from Etla, Oaxaca), and 1 specimen with 33% probability (33% to var. *pluricephala*, 27% to var. *altissima*, and 6% to var. *gilvocanescens*; *Ventura 10651* TEX from Mpio. Xalapa, Veracruz). Twenty-eight of the 32 specimens of the *S. altissima* var. *gilvocanescens* a priori group (88%) were placed a posteriori into the var. *gilvocanescens* group: 12 specimens with 90-100% probability, 4 specimens with 80-85% probability, 4 specimens with 73-79% probability, 3 specimens with 66-69% probability, 1 specimen with 57% probability (24% to var. *altissima*, 13% to var. *pluricephala*, and 6% to *S. veracruzensis*; *Morton & Venn NA15967* TRT from Scott Co., Kansas). Four specimens of the *S. altissima* var. *gilvocanescens* a priori group were placed a posteriori in other taxa: 1 specimen to *S. veracruzensis* with 76% probability (13% to var. *altissima* and 10% to var. *gilvocanescens*; *Canning s.n.* UBC from Penticton, British Columbia), 1 specimen to var. *pluricephala* with 57% probability (43% to var. *gilvocanescens*; *Morton & Venn NA15994* TRT from Lancaster Co., Nebraska), and two specimens to var. *altissima* with 51% probabability (37% to var. gilvocanescens and 13% to var. *pluricephala*; *Morton & Venn NA16303* from Canadian Co., Oklahoma) and 50% probability (35% to var. *gilvocanescens* and 13% to var. *pluricephala*; *Semple 6684* WAT from Eddy Co., North Dakota). Twenty-four or the 38 specimens of the *S. altissima* var. *pluricephala* a priori group (63%) were placed a posteriori into the var. *pluricephala* group: 2 specimens with 82% and 85% probabilities, 7 specimens with 70-79% probability, 7 specimens with 60-68% probability, 6 specimens with 53-59% probability, and 2 specimens with 44% probability (38% to *S. veracruzensis* and 17% to var. *altissima*; *Anon. s.n.* PERTH from Perth Station, Australia) and 38% probability (34% var. *gilvocanescens* and 25% var. *altissima*; *Morton & Venn NA16455* TRT from Hancock Co., Mississippi). Fourteen specimens of *S. altissima* var. *pluricephala* a priori group were placed a posteriori in other taxa: 9 specimens to var. *altissima* with 66% probability (33% to var. *pluricephala*; *Morton NA18778* TRT from Jones Co., North Carolina), 61% probability (33% to var. *gilvocanescens*; *Semple & Chmiewlski 6297* WAT from Marshall Co., Alabama), 55% probability (38% to var. *pluricephala*; *Morton & Venn NA16473* TRT from Butler Co., Alabama), 54% probability (46% to var. *pluricephala*; *Morton & Venn NA1647154* TRT from Escambia Co., Alabama), 51% probability (46% to var. *pluricephala*; *Morton & Venn NA16570* TRT from Sussex Co., Virginia), 50% probability (41% to var. *pluricephala* and 7% to *S. veracruzensis*; *Forster PIF13192* K from Ipswich, Queensland, Australia), 43% probability (40% to var. pluricephala and 17% to var. *gilvocanescens*; *Semple 3887* WAT from Okaloosa Co., Florida), 39% probability (29% to var. *gilvocanescens* and 26% to var. *pluricephala*; *Johnston 12805* TEX from S of Brownsville, Texas), and 38% probability (35% to var. *gilvocanescens* and 26% to var. *pluricephala*; *Cook et al.* C-645 WAT); 3 specimens to *S. veracruzensis* with 85% probability (10% to var. *pluricephala*; *Nesom et al. 7848* WAT from Natchitoches Par., Louisiana), 54% probability (21% to var. *altissima*, 17% to var. *gilvocanescens*, and 8% to var. *pluricephala*; *Morton NA18776b* TRT from Wilmington, North Carolina), and 37% probability (37% to var. *pluricephala* and 25% to var. *altissima*; *Semple & Suripto 10069* WAT from Grimes Co., Texas); and 1 to var. *gilvocanescens* with 59% probability (33% to var. *altissima* and 8% to var. *pluricephala*; *Morton & Venn NA16395* TRT from San Patricio Co., Texas). Seventeen or the 33 specimens of the *S. altissima* var. *altissima* a priori group (52%) were placed a posteriori into the var. *altissima* group: 1 specimen 81% probability, 4 specimens with 70-79% probability, 3 specimens with 61-68% probability, 3 specimens each with 50% probability (49% probability to var. *pluricephala*; *Semple & Heard 8307* WAT from Boone Co., Arkansas; tetraploid 2*n*=36 / *39% to var. pluricephala and 11% to S. veracruzensis*; Adelaide, South Australia, *Uesugi SAUT* no voucher, live collection / and *28% to var. pluricephala and 22% to var. gilvocanescens*; *Morton & Venn NA15993* TRT from York Co., Nebraska). Sixteen specimens of *S. altissima* var. *altissima* a priori group were placed a posteriori into other taxa: 2 specimens to *S. veracruzensis* with 76% probability (10% to var. *altissima* and 9% to var. *pluricephala*; *Morton & Venn NA8550* WAT from N of Tobermory, Ontario) and 41% probability (38% to var. *altissima* and 18% to var. *pluricephala*; *Morton & Venn NA16142* TRT from Randolph Co., West Virginia); 3 specimens to var. *gilvocanescens* with 87% probability (10% to var. *altissima*; *Morton & Venn* NA17660 TRT from S of Pinkham Notch, New Hampshire), 66% probability (17% to var. *altissima* and 11% to *S. veracruzensis*; *Semple & Chmielewski 5251* WAT from Johnson Co., Kansas), and 46% probability (31% to var. *altissima* and 17% to *S. veracruzensis*; *Semple 2908* WAT from Kent Co., Ontario); and 11 specimens to var. *pluricephala* with 72% probability (27% to var. *altissima*; *Cook & Tereszchuk C-339* WAT from Monroe Co., West Virginia), 67% probability (28% to var. *altissima*; *Morton NA18724* TRT from Effingham Co., Illinois), 59% probability (39% to var. *altissima*; Semple & Heard 8285A WAT from Yell Co., Arkansas), 57% probability (42% to var. *altissima*; *Morton & Venn NA15996* TRT from transplant from Pottawattamie Co., Iowa), 53% probability (46% to var. *altissima*; *Cook & Tereszchuk C-211* WAT from Garland Co., Arkansas), 53% probability (44% to var. *altissima*; *Semple & Suripto 9737* WAT from Pitt Co., North Carolina), 53% probability (23% var. *gilvocanescens* and 22% var. *altissima*; *Semple & Brammall 2791* WAT from Bruce Co., Ontario), 48% probability (48% to var. *altissima*; *Morton & Venn NA17643* TRT from Portland, Maine), 46% probability (38% to var. *altissima* and 17% var. *gilvocanescens*; *Semple 10872* WAT from Putnam Co., Georgia), 45% probability (36% to var. *altissima* and 16% to *S. veracruzensis*; *Morton & Venn NA15993* TRT from York Co., Nebraska), and 42% probability (34% to var. *altissima* and 23% var. *gilvocanescens*; Semple & Heard 8284 WAT from Scott Co., Arkansas, tetraploid 2*n* = 36).

Two dimensional plots of CAN1 versus CAN3 and CAN1 versus CAN2 canonical scores for 116 specimens of *Solidago altissima* var. *altissima*, *S. altissima* var. *gilvocanescens*, *S. altissima* var. *pluricephala*, and *S. veracruzensis* are presented in Fig. 2. Eigenvalues on the first three axes were 1.121, 0.641, and 0.134. The placements of the holotype and isotype of *S. veracruzensis* are indicated in Fig. 2.

Table 5. Linear and jackknife classification matrices from the Classificatory Discriminant Analysis of four a priori groups; a posteriori placements to groups in rows.

Group	***altissima***	***gilvocanescens***	***pluricephala***	***veracruzensis***	**% correct**
altissima	17	3	11	2	52
gilvocanescens	2	28	1	1	88
pluricephala	9	1	24	4	63
veracruzensis	0	0	0	13	100
Totals	28	32	36	20	71

Jackknifed classification matrix

Group	***altissima***	***gilvocanescens***	***pluricephala***	***veracruzensis***	**% correct**
altissima	14	3	14	2	42
gilvocanescens	3	26	2	1	81
pluricephala	10	1	23	4	61
veracruzensis	0	0	1	12	92
Totals	27	30	40	19	65

The results indicate that the specimens from Veracruz are statistically distinct from other species in Mexico and from *Solidago altissima* native to Canada and the USA and introduced into other locations around the globe. In both multivariate analyses, 100% of the *S. veracruzensis* specimens were placed a posteriori into that group with generally high probability. In the four species analysis, specimens of *S. pringlei* were most distantly separated from specimens of the other three species, particularly *S. altissima*. The least separation occurred between the group centroids of *S. juliae* and *S. pringlei* and between the group centroids of *S. juliae* and *S. veracruzensis*. Thirteen specimens of *S. altissima* were more similar to *S. veracruzensis* than to other species. In contrast, in the *S. altissima* varieties/*S. veracruzensis* analysis only 7 specimens of *S. altissima* was more similar to *S. veracruzensis* than to any of the three varieties of *S. altissima*. Thus, traits useful in separating *S. pringlei* and *S. juliae* from *S. altissima* and *S. veracruzensis* created a greater chance of specimens of *S. altissima* being assigned to *S. veracruzensis*. A sample size of only 1 meant *S. macvaughii* could not be included in the species level analysis as a separate a priori group. In the a posteriori classificatory analysis, the single specimen of *S. macvaughii* (*McVaugh 23663* MICH; holotype of species) had a 93% probability of being in the *S. veracruzensis* group. Semple (2018) noted that *S. macvaughii* had traits typical of the informal *Tortifoliae* Group of subsect. *Triplinerviae* including persistent twisted wilted and pendent lower stem leaves, although Nesom (1989) had originally placed it near *S. velutina* in subsect. *Nemorales* (Mackenzie) Nesom. Specimens of *S. altissima* do not have such persistent senesced lower stem leaves. Very limited data on lower stem leaves was obtained from the collections of *S. veracruzensis* examined and they are discussed below.

Based on the results of the multivariate analyses, the broader phyllaries that are sometimes multveined, and the allopatric distribution of the *Solidago altissima*-like specimens from Veracruz, a new species of goldenrod endemic to eastern Mexico is proposed.

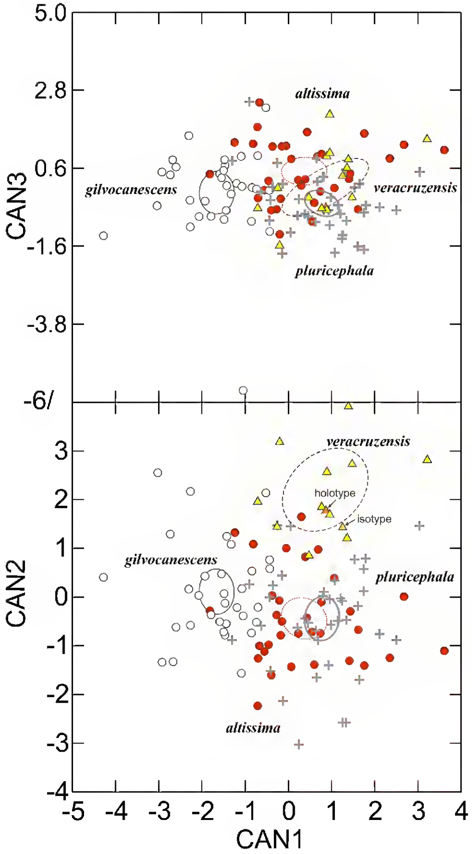

Figure 1. Plot of canonical scores (CAN1 vs CAN3 and CAN1 vs CAN2) for 137 specimens of *Solidago* subsect. *Triplinerviae*: *S. altissima* var. *altissima* (red dots), *S. altissima* var. *gilvocanescens* (white dots with black outline), *S. altissima* var. *pluricephala* (gray +s), *S. veracruzensis* (yellow triangles; holotype orange triangles; isotype, pale orange triangles).

SOLIDAGO VERACRUZENSIS Semple, **sp. nov.** TYPE: **MEXICO**. **Veracruz**. Mpio. Jilotepec: El Esquilón, 7 Oct 1971, *F. Ventura A. 4382* (holotype: MEXU 835466; isotype: TEX). Figures 3-5.

Solidago veracruzensis is similar to *S. altissima* var. *pluricephala* from Texas but differs in having upper stem leaves with some serrations, phyllaries that are slightly broader and longer and sometimes multiveined, and in often having small thyrsiform inflorescences with very short lower branches.

Plants 80–**106**–150 cm, rhizomatous. **Stems** erect, proximally densely short villous-strigose canescent, sometimes becoming glabrate with age due to hair loss, distally densely short villous-strigose canescent. **Leaves**: basal rosette not observed; lower stem leaves were not observed with two exceptions discussed below; mid stem leaves sessile, blades oblanceolate, 55–**72**–115 × 7–**11**–17 mm, tapering to sessile base, apices acute, sparsely to moderately short strigose on adaxial surface, moderately short villous on abaxially surface, moderately to densely so on major veins, margins inrolled with 1–**5**–11 serrations, 0.5-1.5 mm long, ciliate; upper stem leaves sessile, blades narrowly lanceolate to linear lanceolate, 19–**42**–65 × 3–**6.2**–12 mm, much reduced distally, vestiture like mid stem leaves, margins with 0–**3.4**–9 small serrations. **Heads** 40-150+, in narrow thyrsiform or apically secund conical arrays

(Fig. 4) 8–**20**–31 cm tall × 2–4.3–14.5 cm wide, branches 1-14 cm, usually diverging ascending-arching, heads secund on longest branches of large arrays, bracts, linear lanceolate. **Peduncles** 0.2–10 mm, moderately short villoso-hirtellous; bracteoles few, linear-lanceolate. **Involucres** likely cylindrical when fresh, but spreading distally when pressed, 3.1–**4**–5 mm. **Phyllaries** in 3–4 series, broadly to narrowly lanceolate, unequal (outer 1/4 – 1/3 length of inner), margins entire to slightly fimbriate distally, sparsely ciliate, apices acute, fimbriate, often with minute stipitate glands; central vein thicker proximally, rarely multi-veined. **Ray florets** 7–**10.5**–15; laminae yellow 1.3–**1.6**–2 × 0.3–**0.4**–0.8 mm; ovary 0.5–**0.7**–1.1 mm at anthesis, moderately strigillose, pappi 2–**3**–3.7 mm at anthesis, longest not clavate, others narrow, tapering. **Disc florets** yellow, 3–**6**–8; corollas 3–**3.7**–4.2 mm, lobes 0.76–**0.9**–1.13 mm; ovary (narrowly obconic) 0.7–**0.8**–0.9 mm at anthesis, moderately strigillose; pappi 2.6–**3.3**–4 mm, longest not clavate. Mature cypselae: fruit body 1–1.5 mm, pappi ca. 2–3.5 mm, very rare a 1-2 very short outer bristles. **Chromosome number**: unknown. (Means in **bold face**).

Dark sandy soil, red-clay soil, limestone hillside in scrub in canyon, disturbed oak vegetation, along road cuts in pine forest, grassy roadsides and pastures, in cut-over fields along ridge, and in relatively undisturbed grassland remnants. Elevations range from 650-2050 m (2130-6725 ft), averaging 1286 m. *Solidago veracruzensis* grows at generally higher elevations than *S. altissima* var. *pluricephala* in southern Texas and in mountainous areas versus flat outer coastal plain habitats.

Only a few specimens of *Solidago veracruzensis* had lower stem leaves. *Dressler 2309* (MEXU) from southern Tamaulipas had just one senesced proximal lower stem leaf that was pendent, slightly twisted proximally, serrate, and incomplete measuring ca. 33 mm × ca. 6 mm wide (Fig 7A). The mid stem leaves of *Dressler 2309* (MEXU) were similar to those of the type specimens of *S. veracruzensis. Arriga C. 36* (MEXU) from Miahuatlan, Veracruz had several distal lower stem leaves with damaged apices that were 117 mm × 11.5 mm and ca 104 mm × 13 mm and were similar to the large lower mid stem leaves observed on the specimen. *Vibrans 7085* (MEXU:1128470) had some upper lower stem leaves; only one was senesced, not twisted, and it was ascending and damaged. All other collections of *S. veracruzensis* either lacked lower stems or had lower stems without any lower stem leaves attached. Lower stem leaves similar to the senescent, twisted and pendent brown to black lower stem leaves observed on some specimens of *S. juliae*, *S. macvaughii*, and *S. pringlei* and other species of the *Tortifoliae* group were not observed on any collections of *S. veracruzensis.* Specimens of *S. altissima* lack twisted lower leaves.

The mid and upper stem leaves of *S. veracruzensis* generally had moderately inrolled leaf margins with some specimens more pronouncedly so. In rolled leaf margins occur in all species of S. subsect. *Triplinerviae* varying from subtlety so (e.g., *S. canadensis, S. gigantea* Ait., *S. gypsophila*, and *S. juliae*) to obviously so other taxa (e.g., *S. altissima* var. *pluricephala* and *S. chilensis*). Inrolled margins vary from subtle to pronounced in some species (e.g., *S. pringlei*, *S. lepida* DC., and *S. tortifolia* Ell.). Slightly inrolled leaf margins also occur on many specimens of *S.* subsect. *Venosae* (G. Don in Loudon) Nesom, some specimens of *S.* subsect. *Nemorales* and *S.* subsect. *Solidago,* rarely in *S.* subsect._*Humiles* (Rydb.) Semple, and very rarely in *S.* subsect. *Squarrosae* A. Gray and *S.* sect. *Ptarmicoidei* (House) Semple & Gandhi. Thus, inrolled leaf margins is not diagnostic for any one species or group or species, but is occurs in highest frequency in *S.* subsect. *Triplinerviae.*

Only two collections of *Solidago veracruzensis* had broad phyllaries with multiple veins (Fig. 6G), *Solano & Vara 378* (TEX) Mpio. San Juan Guelache Etla, Oaxaca, which is significantly disjunct from the main body of the species's distribution in central Veracruz and *Iltis et al. 860* (TEX) from Acajete, Mpio Xalapa, Veracruz in the center of the distribution of the species. Multi-veined phyllaries occur rarely in species of the *Tortifoliae* Group of subsect. *Triplinerviae*: *S. juliae*, *S. leavenworthii*, and *S. pringlei* in Mexico or the southern USA and *S. chilensis* and *S. microglossa*, native to South America. Multi-veined phyllaries have not been observed in the generally narrow phyllaries of *S. altissima.* Multi-

Figure 3. Holotype of *Solidago veracruzensis* Semple: *Ventura 4382* (MEXU).

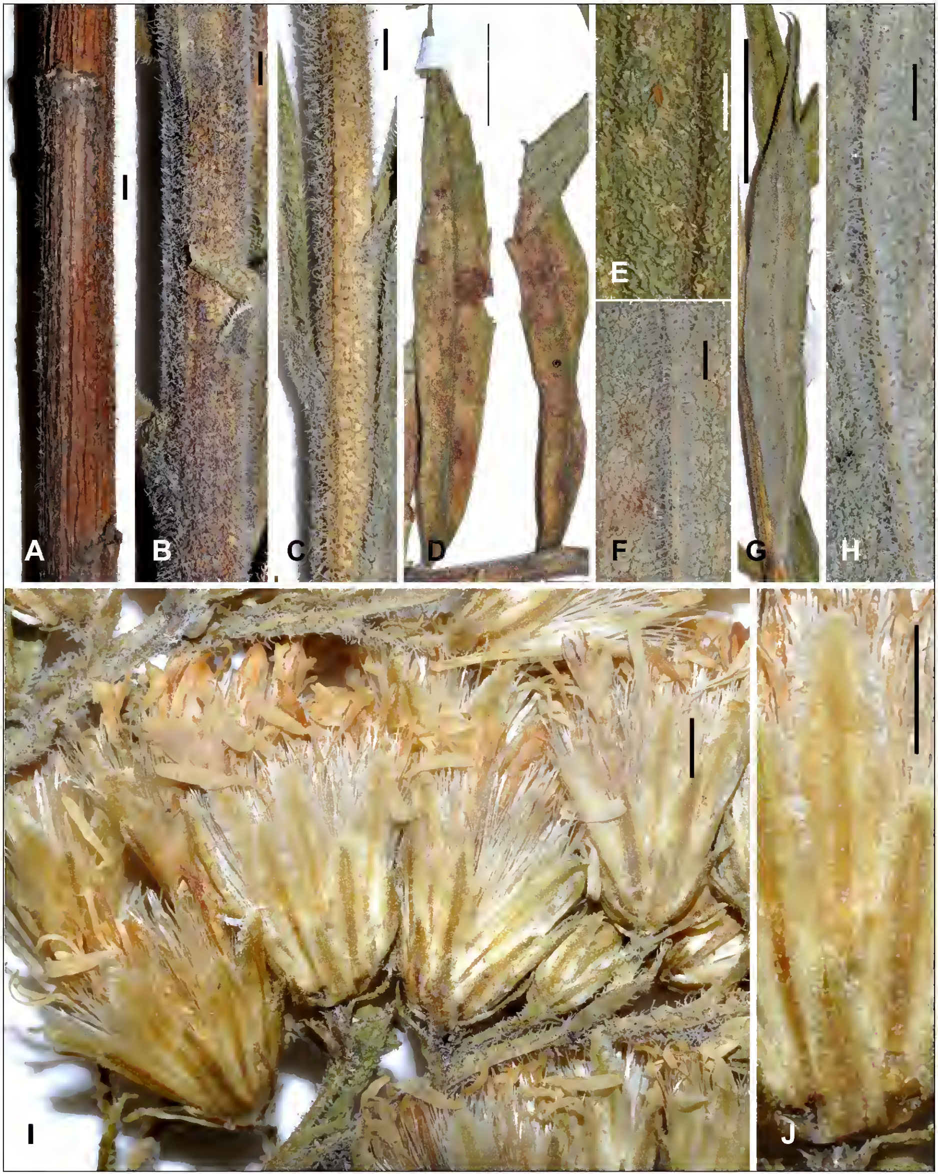

Figure 4. Details of the morphology of the holotype of *Solidago veracruzensis,* Ventura 4382 (MEXU). **A-C.** Lower, mid, and upper stems. **D.** Mid stem leaf. **E-F.** Mid stem leaf adaxial and abaxial surfaces. **G-H.** Upper stem leaf and abaxial midvein. **I.** Heads. **J.** Phyllaries. Scale bars = 1 mm in A-C, E-F, H-I; = 1 cm in D and G.

ISOTYPE: ***Solidago veracruzensis*** Semple, Phytoneuron 2018- . . TYPE. MEXICO. Veracruz. Mpio. Jilotepec, El Esquilón, matorral en cañada, 1230 m, 7 Oct 1971, F. *Ventura A 4382* (Holotype: MEXU:835466, Isotype: TEX).

John C. Semple, **WAT** 27 Jun 2018
University of Waterloo

Multivariate Studies in ***Solidago***
Solidago subsect. *Triplinerviae* 654
Specimen No:
John C Semple 2018
WAT University of Waterloo

UNIVERSITY OF TEXAS HERBARIUM TEX-L
Solidago altissima L.
Det.. Guy Nesom, 19

THE UNIVERSITY OF TEXAS HERBARIUM
Solidago cf. altissima L.
James Henrickson

HERBARIO DE LA ESCUELA NACIONAL DE CIENCIAS BIOLOGICAS
INSTITUTO POLITECNICO NACIONAL MEXICO, D F

PLANTAS MEXICANAS
Solidago

Fam Compositae N v
Loc El Esquilón, municipio de Jilotepec
Estado VERACRUZ Fecha 7.X.1971
Hab matorral en cañada
Alt 1230 m
Col F. Ventura No 4382
Observ arbusto erecto de 1 m de alto, de olor agradable; flores amarillas
Det

Solidago altissima L
var. pluricephala M C. Johnston 654
Det John C. Semple 2018
WAT University of Waterloo

The University of Texas Herbarium
S. canadensis L.
B. L. Turner 1985

University of Texas - Austin (LL, TEX)
00138915

Figure 5. Isotype of *Solidago veracruzensis* Semple: *Ventura 4382* (TEX).

Figure 6. Variation in morphology non-type of *Solidago veracruzensis*. **A**. Lower mid stem leaf, *Ventura 9132* (TEX). **B**. Mid stem leaf, abaxial surface, *Acosta & Dorantes 537* (TEX). **C**. Elongated narrow inflorescence, *Boege 2051* (MEXU). **D**-**F**. Small inflorescences, *Rzedowski 12151* (TEX), *Ventura 9132* (TEX), and *Garcia et al. 1885* (TEX). **G**. Broad multi-veined phyllaries, *Solano & Vara 378* (TEX). **H**. Disc floret, post anthesis, *Acosta & Dorantes 537* (TEX). Scale bars = 1 mm in G-H; = 1 cm in A-F.

Figure 7. Lower stem leaves of *Solidago veracruzensis*. **A.** Wilted proximal lower stem leaf, *Dressler 2309* (MEXU). **B.** Distal lower stem leaves, *Arriga C. 36* (MEXU). Scale bars = 1 cm.

veined phyllaries also occur rarely to frequently in other species of other subsections in *Solidago* and thus the feature is not diagnostic for any one group of goldenrods.

Inflorescence size and shape varies from small club-shaped forms (Figs. 6D-F) to large secund conical forms with long lower branches (Fig. 5) and elongated narrow forms with short lower branches (Fig. 6C). About half of the specimens examined had small to midsize inflorescences with club or narrow second conical inflorescences. This might be a sampling bias favoring shoots that fit on herbarium sheets. The isotype from TEX has the largest inflorescence observed, while the holotype has one of smaller second conical ones observed with short lower inflorescence branches.

The distribution of *Solidago veracruzensis* in eastern Mexico is shown in Fig. 8 along with the distributions of *S. durangensis*, *S. gypsophila*, *S. juliae*, *S. macvaughii* and *S. pringlei.* With one northern disjunct exception in Tamaulipas and one disjunct collections from central Oaxaca, all collections included in the *S. veracruzensis* came from central Veracruz. The range of all species are allopatric, with those of *S. durangensis*, *S. gypsophila* and *S. macvaughii* being very restricted. This is in contrast to the distributions of *S. wrightii* A. Gray of subsect. *Thyrsiflorae* in the western cordillera (Semple et al. 2017, Fig. 13) and *S. velutina* DC. of subsect. *Nemorales* in the eastern cordillera (Semple et al. 2018, Fig. 24). The extensive ranges of distribution of the varieties of *S. altissima* are illustrated by Semple (2018 frequently updated). The range of *S. juliae* extends slightly further north in Texas. Only two of the collections of *S. juliae* illustrated at the UNAM website were thought to be that species. The single collection from Coahuila, *Marsh 922* (MEXU:56696), includes just an upper portion of the stem with inflorescence and appears to be *S. juliae.* The single collection from Chihuahua, *Pringle 1116* (MEXU:T33225), is treated here as *S.* aff. *juliae* because the leaves are more broadly lanceolate than seen in the Texas collections of the species. The collection was annotated as "*S. juliae*" by G.L. Nesom in 1990 and by J.L. Villaseñor in 2003 and originally identified as "*S. canadensis* var. *canescens*" by Pringle in the 1880s, which is a synonym of *S. juliae.* This may just be isolated marginal population divergence; further study is needed. A second collection from Chihuahua, *Cronquist 10228* (MEXU 146256) annotated as "*Solidago juliae*" by G.L. Nesom in 1990 is here treated as *S. velutina* DC based on its lowest stem leaves being the largest on the stem. Semple et al. (2018) noted that some collections of *S. velutina* could be misidentified to species of subsect. *Triplinerviae*, particularly if the lower stem leaves were absent.

Solidago veracruzensis is likely closely related to *S. pringlei* Fern., *S. durangensis*, *S. gypsophila*, and *S. macvaughii* of Mexico based on similar involucre and floral traits. All five species may be derived from a common ancestor via vicariant biogeographic events splitting the ancestral taxon into disjunct populations and habitats. *Solidago veracruzensis* is also likely closely related to *S. altissima* of the USA and Canada based on general similarities in leaf features such as the general lack of persistent, dark, twisted lower stem leaves. A polygenomic multi-loci molecular study of all taxa is needed to really determine relationships among species in *S.* subsect. *Triplinerviae*.

Additional collections of *S. veracruzensis* seen. MEXICO. **Tamaulipas**. Mpio. Aldama: Sierra de Tamaulipas: region of Rancho Las Yucas, ca. 40 km NNW of Aldama, 9 Oct 1957, *Robert L. Dressler 2309* (MEXU 48751, digital image). **Veracruz**. Mpio. Banderilla: Banderilla, 12 Oct 1973, *Acosta & Dorantes 537* (TEX). Mpio. Calcahualco: 11 km al N de Coscomatepec, por la terracería a Escola, 30 Sep 1984, *García, Koch, González, & Hernández 1885* (MEXU 484202). Mpio. Coacoatzintla: Entrada al Rancho La Palma, carretera Jilotepec-Coacoatzintla, 2 Nov 1998, *Lizama M.J. 1227* (MEXU 260258, digital image). Mpio. Juchique de Ferrer: alrededores de Juchique camino Juchique ple de las Hayas, 28 Apr 1976, *Aponte et al. C-240* (TEX). Mpio. Miahuatlán: Miahuatlán, 15 Nov 1979, *Arriga C. 36* (MEXU 564021, digital image); Naolinco, camino a Miahuatlán, 7 Nov 1981, *Ventura A. 19079* (MEXU 338837); above the Cascades at Noalinco, 10 Nov 1983, *Turner & Tapia 15473* (TEX). Mpio. Orizaba: NW of Orizaba, Cerro del Borrego, 14 Dec 1959, *Rzedowski 12151* (TEX). Mpio. Tequila: S of Rizaba along road to Zongolica, 5.0 mi N of Tequila, 9 Oct 1984, *Sundberg & Lavin 3074* (TEX). Mpio. Xalapa: vicinity of Acajete, ca 15 km NW of and above Xalapa on road to Perote, 8 Oct 1978, *Iltis, Castillo C., & Lasseigne 860* (TEX, MEXU 835466); Casa Blanca, 28 Oct 1976, *Ventura 13474* (MEXU, TEX); Jardin Botanico Clavijero, 25 Apr 1978, *Ortega & Calzada 0-789* (TEX); Cerro Macuiltepetl Ladera W, 15 Nov 1979, *Garcia & Palma 80* (MEXU 352141); Colonia Azteca, 9 Apr 1974, *Ventura A. 9864* (TEX); 9 km al E del Castillo, 20 Oct 1971, *Dorantes 400* (TEX, MEXU 219617); near Jalapa, 6 Jul 1908, *Pringle 15605* (LL); Jalapa, 4 Feb 1894, *Smith 1603* (TEX); Marties de Chicago, 16 Oct 1974, *Ventura 10651* (TEX, MEXU); camino al Sumidero, 22 Sep 1976, *Zola B. 761* (MEXU 259921); Cd. Xalapa, 8 Sep 1970, *Ventura A. 2310* (MEXU 350141, TEX); Rancho Guadalupe, 3 km W de Jalapa carretera vieja Jalapa-Coatepec, 8 Sep 1970, *Monroy et al. 33* (MEXU 260258); en las afueras de la ciudad (entre rancherías), hacia el sur, 14 Dec 2000, *Vibrans 7085* (MEXU 1128470); Rancho Guadalupe 3 km W de Jalapa carretera vieja Jalapa Coatepec, 20 Aug 1975, *Calzada & colaboradores 1888* (MEXU 213054, digital image); W of turn off to Lago Farfan, along road to Juchique, 6 Sep 2001, *Bye 28262* (MEXU 1012466, digital image); Jalapa-Consolapan, 1 Sep 1971, *Boege 2051* (MEXU 194191).

A summary of descriptive statistics on morphological traits based on all raw values in the data matrix used in the multivariate analysis of *Solidago altissima*, *S. juliae*, *S. pringlei*, and *S. veracruzensis* is presented in Table 6. Disc floret ovary/fruit body measurements were for florets at flowering; mature cypselae have larger values.

Key to *Solidago veracruzensis* and related species

1. Inner phyllaries averaging (0.5-)0.6–0.8-(10) mm wide.
   2. Smaller veins of leaf under surfaces not raised, sparsely to moderately hairy; central Veracruz, southern Tamaulipas, introduced in central Oaxaca .... **S. veracruzensis**
   2. Smaller veins of leaves under surfaces raised, densely hairy; Coahuila .... **S. gypsophila**
1. Inner phyllaries averaging 0.4–0.6 mm wide.
   3. Inflorescences broadly secund conical and somewhat corymbiform; Durango ...... **S. durangensis**
   3. Inflorescences secund conical to narrowly second conical, not corymbiform.

4. Stems and leaves densely short villous-canescent, mid stem leaves narrowly lanceolate; Texas, northern Coahuila, Chihuahua .... **S. juliae**
4. Stems and leaves sparsely to moderately villous-canescent or more densely so on Great Plains in the US.
   5. 2-**13.5**-(25) florets per head; leaves lanceolate to broadly lanceolate; lower stem leaves not persisting, or if present than not twisted and pendent; US .... **S. altissima**
   5. 10-**20**-33 florets per head; leaves narrowly lanceolate; lower stem leaves if present, twisted, pendent, senescent, achlorophyllous; Mexico.
      6. Mid stem leaves linear-lanceolate, serrations usually few; Coahuila, Nuevo León **S. pringlei**
      6. Mid stem leaves oblanceolate, serrations numerous; Aguascalientes .... **S. macvaughii**

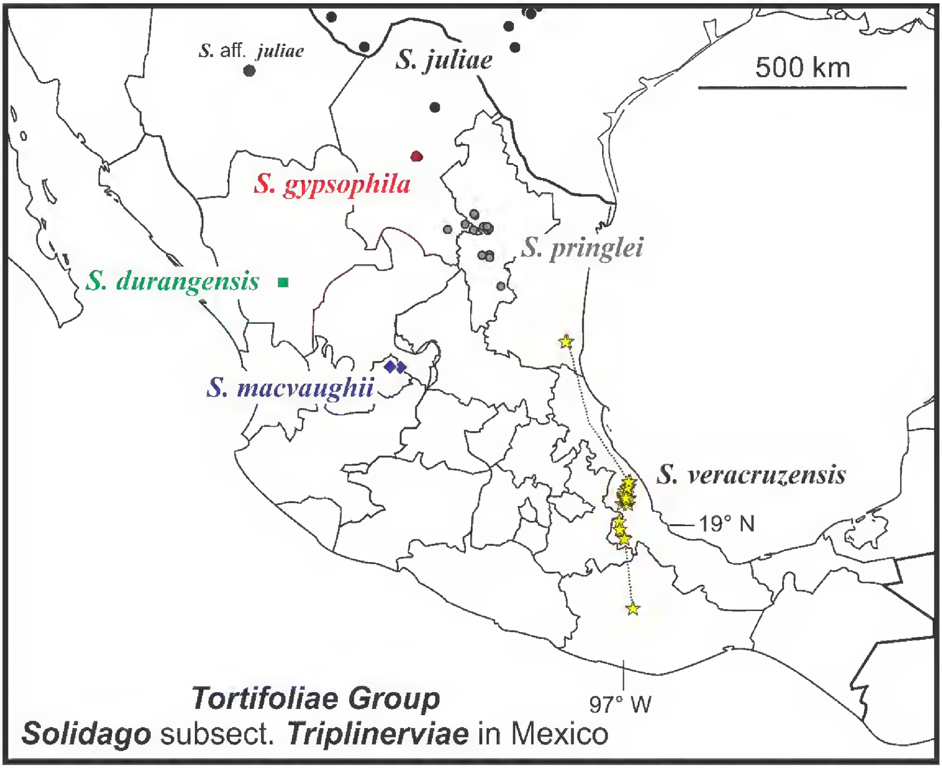

Figure 8. Distribution of species of the *Tortifoliae* Group of *Solidago* subsect. *Triplinerviae* in Mexico. See text for comments on the *S.* aff. *juliae* collection from Chihuahua.

Table 6. Descriptive statistics on raw data on morphological traits of specimens used in the multivariate analyses *S. durangensis, S. gypsophila, S. juliae, S. macvaughii, S. pringlei*, and *S. veracruzensis*: min-**mean**-max. The lowest stem leaves are also generally absent by flowering.

Trait	*S. altissima*	*S. juliae*	*S. pringlei*	*S. veracruzensis*
STEMHT cm	33–**87**–200	60–**95**–180	32–**49**–70	73–**99**–150
LLFLN mm	30–**82.8**–158	74–**108**–127	38–**67.4**–110	103–**110**–117
LLFWD mm	5–**13.5**–35	5.5–**11**–15	4.7–**5.8**–8.5	11.5–**12.3**–13
LLFWTOE mm	16–**40.7**–80	17–**41.4**–60	15–**27**–55	40–**42.5**–45
LLFSER	0–**7**–22	9-**12**-18	0–**4.5**–15	5–**6.5**–8
MLFLN mm	33–**69.3**–133	27–**49.7**–88	14–**34.1**–102	55–**73.3**–115
MLFWD mm *	5–**11.5**–30	4–**7.2**–17	3–**9.5**–30	7.2–**10.6**–17
MLFWTOE mm	14–**36.2**–70	9–**23**–35	12–**27**–45	20–**32.2**–50
MLFSER	0–**6**–17	0–**3.1**–14	0–**4.7**–14	1–**5.6**–11
ULFLN mm	17–**45.7**–102	12–**29.6**–80	16–**41.4**–86	19–**43**–65
ULFWD mm	2–**8.0**–10	2.5–**4.6**–9	1.5–**4.1**–10	3–**6.1**–12
ULFWTOE mm	6–**24.8**–60	6–**14.1**–28	10–**19.8**–40	10–**19.7**–33
ULFSER	0–**3**–11	0–**0.8**–6	0–**2.1**–11	0–**3.6**–10
CAPL cm	5–**18.2**–38	11–**21.7**–37	3.5–**8.9**–14.5	5.5–**12.8**–24
CAPW cm	1.5–**11.8**–35	5.5–**8.3**–11	2–**4.5**–10	2–**7.8**–19
INVOLHT mm *	2–**3.3**–4.8	2.6–**3.4**–4.1	3–**3.5**–4.5	3.1–**4.05**–5.1
OPHYLN mm	0.5–**1.15**–2.3	0.8–**1.3**–2	0.9–**1.4**–2	1–**1.3**–2
IPHYLN mm *	2–**2.6**–4.5	2.3.–**2.8**–3.5	2.6–**3.4**–4.3	3–**3.9**–5
IPHYLW mm	0.4–**0.5**–0.6	0.4–**0.55**–0.7	0.4–**0.6**–0.8	0.6–**0.8**–1
RAYNUM	1–**9.1**–21	6–**10.4**–18	7–**12.6**–20	7–**10.7**–15
RLAMLN mm *	0.9–**1.3**–2.8	0.7–**1.26**–1.8	1.4–**1.8**–2.9	1.3–**1.7**–2.3
RLAMWD mm	0.1–**0.3**–0.7	0.1–**0.34**–0.6	0.2–**0.5**–1	0.3–**0.45**–0.8
DISCNUM *	1–**4.5**–13	2–**5.8**–9	3–**8.5**–13	3–**5.7**–8
DCORLN mm *	2.5–**3.6**–6	2.5–**3.2**–4	2.9–**3.3**–4.1	3–**3.7**–4.2
DLOBLN mm *	0.3–**0.8**–1.1	0.5–**1.1**–2	0.7–**1.0**–1.4	0.5–**0.86**–1.1
DACHLN mm at anthesis	0.3–**0.7**–1	0.5–**0.8**–1.3	0.6–**0.8**–1.2	0.7–**0.8**–1
DPAPLN mm at anthesis	1.5–**3.0**–3.5	2–**2.7**–4	2.1–**2.7**–3.6	2.6–**3.2**–4

* Traits selected by the STEPWISE analysis as useful in separating a priori groups

ACKNOWLEDGEMENTS

This work was supported by Natural Sciences and Engineering Research Council of Canada Discovery Grants to the JCS. Joan Venn is thanked for her curatorial assistance at WAT. The following individuals as students assisted JCS in collecting morphological data on subsect. *Triplinerviae* specimens included in multivariate analyses: Sofia Bzovsky, Katherine Kornobis, Rita Lopez Laphitz, Hammad Rahman, Marian Sorour, and Lan Tong. The curators of BM, F, GH, JKM in TRT, K, LL, MEL, MEXU, MO, NBG, NMC, PERTH, TEX, UBC, WAT in MT (Thiers, continuously updated) are thanked for access to collections of *Solidago* subsect. *Triplinerviae* during visits and the loan of specimens and permission to dissect heads.

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COMPOSITAE OF CENTRAL AMERICA-VII. *DIGITACALIA, DRESSLEROTHAMNUS, PENTACALIA, ZEMISIA,* THEIR MICROCHARACTERS, AND SOME OTHER SENECIONEAE

JOHN F. PRUSKI
Missouri Botanical Garden
4344 Shaw Blvd.
St. Louis, Missouri 63110

ABSTRACT

In Central America tribe Senecioneae are represented by subtribes Senecioninae and Tussilagininae. Here, the southern Central America-centered genus *Dresslerothamnus* (subtribe Senecioninae) is monographed. Five species are recognized, including the new **Dresslerothamnus hammelii** Pruski, **sp. nov.**, from Panama. The Central American species of **Pentacalia** (subtribe Senecioninae) are revised with twelve regional species recognized. Lectotypes are designated for *Senecio calyculatus* Greenm. and *Senecio deppeanus* Hemsl., and an epitype is designated for *Senecio thomasii* Klatt. Former Jamaican endemic *Zemisia* is monographed and the new combination **Zemisia thomasii** (Klatt) Pruski, **comb. nov.**, is made. *Zemisia* is a new generic record for Mexico and Central America. A key to genera centering about *Pentacalia* is given. Mexican-centered *Digitacalia* (subtribe Tussilagininae) is monographed and its distribution expanded into Central America with **Digitacalia stevensii** Pruski, **sp. nov.**, from Honduras and Nicaragua newly described. Microscopic floral details of *Telanthophora steyermarkii* (Greenm.) Pruski are included, supporting its recent placement in Tussilagininae. Seven new combinations for associated South American Senecioninae are these: **Dendrophorbium castaneifolium** (DC.) Pruski, **comb. nov.**, **Dendrophorbium elatum** (Kunth) Pruski, **comb. nov.**, **Dendrophorbium gritense** (Lapp, T. Ruíz & Torrec.) Pruski, **comb. nov.**, **Dendrophorbium huasense** (Cuatr.) Pruski, **comb. nov.**, **Dendrophorbium munchiquense** (S. Díaz & Cuatr.) Pruski, **comb. nov.**, **Dendrophorbium vallecaucanum** (Cuatr.) Pruski, **comb. nov.**, and **Monticalia barbourii** (M.O. Dillon & Sagást.) Pruski, **comb. nov.** SEM micrographs and LM photographs of microcharacters in *Aequatorium, Dendrophorbium, Digitacalia, Dresslerothamnus, Elekmania, Monticalia, Nordenstamia, Ortizacalia, Pentacalia, Pseudogynoxys, Robinsonecio, Scrobicaria, Senecio, Telanthophora,* and *Zemisia* are given, and subtribes Senecioninae and Tussilagininae are distinguished by floral microcharacters.

The cosmopolitan Compositae tribe Senecioneae Cass. contains about 3500 species, about 1% of all Angiosperms, and is the largest tribe of Compositae, the largest family of Angiosperms (Pruski & Robinson 2018). Senecioneae are recognized by having some or all of the following: uniseriate, subequal phyllaries, epaleate clinanthia, 4-nerved ray corolla limbs, truncate style branches, and non-carbonized, terete cypselae with a pappus of many capillary bristles (Cassini 1819a, 1819b, 1821, 1827; Nordenstam 1977, 1978, 2007; Cuatrecasas 1986; Bremer 1994; Nordenstam et al. 2009). Senecioneae often have a secondary chemistry characterized in most genera by presence of toxic pyrrolizidine alkaloids and the sesquiterpene lactone furanoeremophilane, and absence polyacetylenes (Hegnauer 1977; Mabry & Bohlmann 1977; Jeffrey 1979a; Nordenstam 2007; Langel et al. 2011), differing from other Compositae. For nearly a century *Senecio* L., the type of the tribe, often was circumscribed broadly following Bentham and Hooker (1873), who treated several genera of different subtribes (e.g., *Cacalia*) in synonymy of *Senecio*.

Four subtribes are now recognized in Senecioneae, and although cacalioids and senecioids have long been distinguished as informal groups (e.g., Koyama 1967; Pippen 1968; King & Robinson 1977; Nordenstam 1977, 1978), the numbers of recognized subtribes has varied. For example, Jeffrey and Chen (1984) recognized subtribes Senecioninae, Tussilagininae, and Tephroseridinae, with these three subtribes basically mirroring the informal groups of *Senecio* s.l. recognized by Jeffrey et al.

(1977) and Jeffrey (1979a). Nordenstam (1977) and Jeffrey (1992a) recognized only two subtribes: Senecioninae and Blennospermatinae. Bremer (1994) and Barkley et al. (1996) recognized three subtribes, Blennospermatinae (which included *Abrotanella* Cass.), Senecioninae, and Tussilagininae. Most recently, Pelser et al. (2007) and Nordenstam et al. (2009) recognized four subtribes: Abrotanellinae, Othonninae, Senecioninae, and Tussilagininae (including *Blennosperma* Less. and *Tephroseris* (Rchb.) Rchb.). Brachyglottidinae, Chersodominae, and perhaps Doronicinae (the only Senecioneae with polyacetylenes) may also merit recognition (Pelser et al. 2007; Nordenstam et al. 2009). Of the four recognized subtribes, only Senecioninae (senecioids) and Tussilagininae (cacalioids/tussilaginoids) are speciose and common.

Figure 1. Balusterform filament collars in Senecioninae. A. *Senecio vulgaris*, generitype, two superimposed anthers showing collars, ecaudate thecae, a few pollen grains, and terminal appendages. B. *Senecio costaricensis*, close-up of two collars. C. *Scrobicaria ilicifolia*, generitype, the anther on the left is seen in adaxial view and shows the adaxial groove and caudate theca. D. *Pentacalia tonduzii*, collars of two caudate anthers showing (top center) tip of an anther tail. The collars in C and D (*Scrobicaria ilicifolia* and *Pentacalia tonduzii*) are only moderately broadened, but in each the basal cells are obviously enlarged. (A *Pruski & Ortiz 4561*, MO; B *Pruski et al. 3875*, MO; C *Gentry et al. 8931*, MO; D *Alfaro 1546*, MO). [Scale bars: A 0.15 mm, B 0.09 mm, C 0.14 mm, D 0.05 mm].

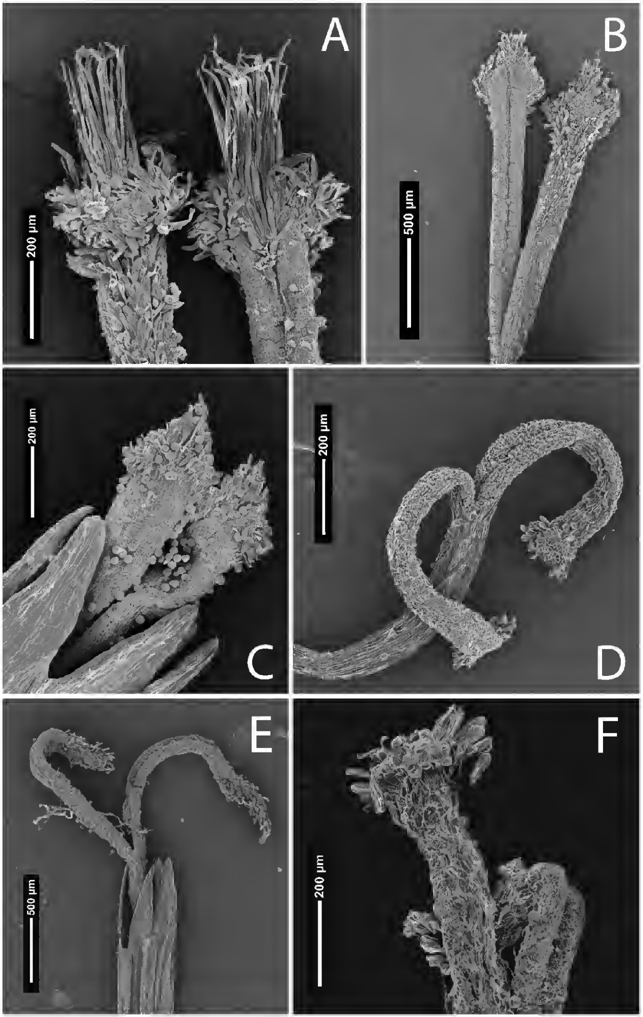


Figure 2. Styles in disk florets of Senecioninae, showing 2-banded stigmatic surfaces, and variously appendiculate (A–C, E) or truncate-exappendiculate (D, F) branch apices. A. *Ortizacalia austin-smithii*, generitype, branches with abaxial-outer (left) and adaxial-inner (right) surfaces showing heteromorphic papillae, apical comae composed of long thin papillae, and distal papillae between stigmatic bands (branch on right). B. *Pentacalia brenesii*, branches with adaxial (left) and abaxial (right) faces showing triangular appendages and isomorphic papillae, no distal adaxial papillae arising between stigmatic bands. C. *Dresslerothamnus angustiradiatus*, generitype, triangular-tipped branch emerging from anther cylinder. D. *Pentacalia phanerandra*, recurved branches showing truncate apices. E. *Pseudogynoxys haenkei*, branches emerging from anther cylinder and showing long-triangular cellar appendages. F. *Senecio callosus*, showing truncate branch apices. (A *Haber & Zuchowski 9847*, MO; B *Herrera & Schik 3830*, MO; C *McPherson 12334*, MO; D *van der Werff 7236*, MO; E *Pruski et al. 4195*, MO; F *Véliz 8327*, MO).

In Tropical American *Senecio*, Jesse Greenman (1901, 1902, 1915, 1916, 1918, 1923, 1926, 1938, 1950), Angel Cabrera (1949, 1950, 1954, 1957, 1985; Cabrera & Zardini 1980), and José Cuatrecasas (1950, 1951, 1953) were influential early workers who mostly followed the broad Benthamian circumscription of the genus. They each delineated sections and species groups within *Senecio* that were subsequently treated as genera. More recently, two large, long-recognized generic alliances marked by suites of unconventional floral microcharacters (i.e., senecioids and cacalioids/tussilaginoids) have come to be recognized as subtribe Senecioninae and Tussilagininae, and many satellite genera have been resurrected or segregated from *Senecio* (viz Rydberg 1924a, 1924b, 1927; Cuatrecasas 1955, 1960 1978, 1981, 1986, 1994; Koyama 1967; Pippen 1968; Robinson & Brettell 1973a, 1973b, 1974; Jeffrey et al. 1977; Nordenstam 1977, 1978, 2006, 2007; Robinson & Cuatrecasas 1977, 1978, 1993, 1994; Robinson 1978, 1989; Barkley 1985a, 1990; Wetter 1983; Jeffrey & Chen 1984; Jeffrey 1986, 1987, 1992a; Vincent & Getliffe 1988, 1992; Pruski 1991, 1996, 1997, 2010, 2012a, 2012b; Bremer 1994; Nordenstam & Pruski 1995; Barkley et al. 1996; Vincent 1996; Janovec & Robinson 1997; Díaz-Piedrahita & Cuatrecasas 1999; Dillon et al. 2001; Dillon 2005; Lundin 2006; Pelser et al. 2007; Nordenstam et al. 2009; Torrecilla & Lapp 2010; Lapp et al. 2015; Pruski & Robinson 2018).

In Central America, Senecioneae are represented basically only by members of subtribes Senecioninae and Tussilagininae, with much restructuring of regional species done or highlighted by José Cuatrecasas, Charles Jeffrey, Ted Barkley, Harold Robinson, and the author. [One species of *Euryops* (subtribe Othonninae) is grown ornamentally in Mesoamerica, but rarely escapes]. Some of the microcharacters used by them (e.g., stigmatic surface characters and shape and cellular features of the filament collar–– sometimes called anther collar or antheropodium, and described by Drury 1966: 36 as "a downward extension of the connective" onto the filament––were used by Cassini, but endothecial tissue characters in Compositae were noted only later (e.g., Kuhn 1908 fig. 37) and mainstreamed much later by Dormer (1962), Robinson and Brettell (1973b), Nordenstam (1978), Wetter (1983), Thiele (1988), and Vincent and Getliffe (1988 fig. 3; viz also the *Dracaena* drawing in Manning 1996 fig. 2). Members of subtribe Senecioninae are characterized by **senecioid microcharacters** of balusterform filament collars dilated basally and with enlarged basal cells (Figs. 1, 35A, 36B, 37A, 50A; "en la forme de balustre" Cassini 1827: 454; Hoffmann 1894 fig. 65M; anglicized in Drury 1973b: 741), typically by 2-banded stigmatic surfaces (Fig. 2), a radial (sometimes transitional with thickenings both radial and polar) endothecial tissue pattern (Figs. 3A, 3C, 35B, 37B, 50B), and $x = 10$ basic chromosome number. Those of subtribe Tussilagininae, on the other hand, are distinguished by **cacalioid microcharacters** of cylindrical filament collars with more or less equal-sized cells throughout (Fig. 4A, 4C, 4E), entire-continuous stigmatic surfaces (Figs. 4F, 9B), and sometimes a polarized endothecial tissue pattern (Fig. 4B), $x = 30$ basic chromosome number, but the correlation of these characters is not absolute.

As noted by Wetter (1983), filament collar characters are the most consistently diagnostic ones distinguishing Senecioninae and Tussilagininae. Further distinguishing characters in Central American plants, however, include 2-banded styles, which are seen only in Senecioninae, and a sometimes polarized endothecial tissue pattern, seen solely in Tussilagininae. Although, Wetter (1983 figs. 4–5) characterized *Telanthophora* styles as cleft, this character was found by Bremer (1994: 488) as "difficult to uphold," and the term has fallen from common usage. Here, *Dresslerothamnus* H. Rob. (Senecioninae), *Pentacalia* Cass. (Senecioninae), *Zemisia* B. Nord. (Senecioninae), and *Digitacalia* Pippen (Tussilagininae) are revised, their respective subtribes characterized mostly by floral microcharacters, with supporting images included. Following the introduction, the taxonomic treatments within are grouped into three segments, with the Mexican and Central American treatments I and II placed first first: I. **Senecioninae**; II. **Tussilagininae**; and III. **New combinations in South American Dendrophorbium and Monticalia (Senecioninae)**. Within each chapter, the taxa treated are arranged alphabetically.

ANATOMICAL AND SEM METHODS

The wet slide mounts were viewed on an Olympus compound microscope and photographed with a Canon A640 camera. SEM mounts were sputter-coated with Au/Pd on a Denton Desk V Cold Sputter Coater operating at 35 mAmps for 120 seconds. The sputtered coated mounts were then micrographed on a JEOL NeoScope CM-5000 scanning electron microscope using 10 kV accelerating voltage, and operating under high vacuum.

I. SENECIONINAE Dumort., Fl. Belg. 65. 1827. **TYPE**: *Senecio* L.

Recognition of subtribes of Senecioneae, as mentioned above, has been slowed due to the influence of Bentham and Hooker's (1873) inclusive concept of *Senecio*. For example, Jeffrey et al. (1977) included members of several subtribes within the genus *Senecio*, but more recently (Jeffrey 1992a) recognized several genera from within his earlier broad concept of *Senecio*. Similarly, Nordenstam (1977, 2007) and Jeffrey (1992a) treated the cacalioid genera within subtribe Senecioninae, but now Tussilagininae (which includes the cacalioid genera) are generally taken as subtribally distinct from Senecioninae (Pelser et al. 2007; Nordenstam et al. 2009; Pruski & Robinson 2018). Nevertheless, some taxa still appear intermediate with others (Nordenstam 1977, 2007; Barkley 1985b), and some characters seem to show continuous variation (Jeffrey et al. 1977; Pelser et al. 2004), complicating generic and subtribal limits. In Central America, however, only the two common well-defined subtribes are native, with Senecioninae recognized by its senecioid microcharacters.

Not only are subtribe Tussilagininae accepted as segregated from Senecioninae, and in Chapter II the Tussilagininae genera *Digitacalia* and *Telanthophora* accepted as segregates of *Senecio*, but the caudate-anthered genera of subtribe Senecioninae revised here––*Dresslerothamnus*, *Pentacalia*, and *Zemisia*––are similarly accepted as distinct, well-diagnosed segregates of onetime monolithic *Senecio*. There has been a pushback of sorts, however, by Pelser et al. (2007 fig. 1H), wherein *Senecio* was again inflated by inclusion of several American ecaudate-anthered genera of "New World *Senecio* clade 1." But, the large New World *Senecio* clade 1 is sister to *Senecio* s. str. (which includes Australian clades 2 and 3, New World clade 2, etc.), rather than nested cladistically within it (Pelser et al. 2007 fig. IG, 1I). Although New World *Senecio* clade 1 has weak support (bootstrap support values of < 50%) and the relationships within are not resolved, the *Aetheolaena* subclade members (e.g., *Aetheolaena* Cass., *Culcitium* Bonpl., monotypic *Lasiocephalus* Willd. ex Schltdl., and monotypic *Iocenes* B. Nord.), for example, appear apt to being grouped into recognizable subunits (genera). Within the genera of the *Aetheolaena* subclade, *Culcitium* has priority and *Aetheolaena* includes all but one species referred formerly to *Lasiocephalus*. These genera have been treated variously by Blake (1937), Nordenstam (1978), and Cuatrecasas (1950, 1978), but do not appear to be congeneric with *Senecio vulgaris* L. The inclusive concept in Pelser et al. (2007) increases character diversity in *Senecio* s. lat., and in turn lessens character predictability. For example, *Culcitium* is recognized by its distinctive habit, as is the monotype *Lasiocephalus ovatus* Schltdl. *Aetheolaena*, presumably distinct from *Culcitium*, is characterized by nutant discoid capitula, and usually penicellate style apices (Nordenstam 1978; Cuatrecasas 1978, as *Lasiocephalus*), but was referred to *Senecio* s. lat. by Pelser et al. (2007). Salomón et al. (2016) called the group *Senecio* sect. *Aetheolaena*, and suggested the distinguishing style characters are "taxonomically uninformative." However, *Aetheolaena* is basically accepted here as circumscribed by Nordenstam (1978). In addition to penicellate style apices, the styles in the odd genus *Aetheolaena* often have adaxial (inner) surface distal papillae emerging between stigmatophores. The style branch characters of *Aetheolaena* roughly parallel the appendiculate styles of *Graphistylis* B. Nord., *Jessea* H. Rob. & Cuatr., and *Ortizacalia* Pruski, each of which are similarly maintained (viz Nordenstam 1978; Pruski & Robinson 2018). Forty years ago, Cuatrecasas (1978) stated that penicellate-tipped styles are "generically significant," Jeffrey (1979a) commented that in tropical America some groups have "well marked" penicellate styles, the first figure in Nordenstam (2007) is of style branches inferring utility of the character, and Pruski (2012b) stated "style branch characters ... generally seem to be" reliable taxonomically.

Neotropical *Dresslerothamnus* H. Rob. and *Pentacalia* Cass., two poorly collected epiphytic vining caudate-anthered segregates of *Senecio*, are treated here, as is caudate-anthered, woody *Zemisia*. Each *Dresslerothamnus* and *Pentacalia* contains species that reach high into the forest canopy, and when flowering are weak-stemmed and strongly dangling-pendent (Fig. 5B). Other species of each genus are fairly branched, scrambling plants (e.g., *Dresslerothamnus hammelii* and *Pentacalia wilburii*) of montane dwarf forests, the flowering stems of these scramblers are consequently more or less arching, rather than long-pendent. Thus, growth form is not a distinguishing character separating *Dresslerothamnus* and *Pentacalia*.

The capitulescence positions (Fig. 5) may vary from species to species, are useful in species-level taxonomies, but are not diagnostic of either *Dresslerothamnus* or *Pentacalia*. Most species of both *Dresslerothamnus* and *Pentacalia* have heterogamous––radiate or disciform––capitula, and although *Pentacalia* sometimes has strictly homogamous (discoid) species, capitula and florets types (Fig. 6) are often not diagnostic generically in Senecioneae. Similarly, the characters of the styles, crested clinanthia, and pappus tip cell shape of both *Dresslerothamnus* and *Pentacalia* overlap in morphology. *Dresslerothamnus* tends to show obtuse to triangular style tips often with a few papillae in an apiculum or tuft, whereas the style tips of *Pentacalia* tend to be mostly truncate or obtuse without a notable central tuft. But, *P. brenesii* (Fig. 2B) has a *Dresslerothamnus*-like style (Fig. 2C), and conversely those of *D. schizotrichus* are *Pentacalia*-like (Fig. 2D). Although most species of the two genera, as well as most Senecioneae, have pointed pappus bristle tips (Fig. 3D), species of each *Dresslerothamnus* and *Pentacalia* may have obtuse-tipped terminal cells, albeit not as pronounced as those seen, for example, in *Monticalia firmipes* (Greenm.) C. Jeffrey (Fig. 3E). *Dresslerothamnus*, *Ortizacalia*, and *Pentacalia* have similar habit and floral characters, and were considered close by Robinson (1978, 1989), Pruski (2012b), and Pruski and Robinson (2018).

Dresslerothamnus is monographed herein, characterized in part by vining habit, heterogamous capitula, 8–10-striate cypselae (Fig. 7) (vs. 5-costate ones in *Pentacalia*, Fig. 8A), and variously-modified multistoried pseudostellate-to-T-shaped trichomes (Figs. 11–12, 17, 20; trichome terminology is that of Robinson 1989). Five species are recognized in *Dresslerothamnus*, four of these in Central America (Costa Rica and Panama; three endemic) and two species present in Colombia with one endemic there. The generitype *D. angustiradiatus* is found from Limon, Costa Rica south to the Bajo Calima region in Valle del Cauca, Colombia. The modified trichomes of *Dresslerothamnus* may resemble those of other tribes (viz species of Old World *Andryala* and *Olearia*, in both Solereder 1908 and Metcalfe and Chalk 1979). But, branched trichomes in other Neotropical Senecioneae––e.g., *Aequatorium*, *Nordenstamia*, and some Monticalias (Figs. 9–10; Nordenstam 1978; Lundin 2006; Lapp et al. 2013 fig. 3B)––do not have the pluricellular stipe as in *Dresslerothamnus*, and trichome type helps distinguish American genera. Robinson (1978, 1989) noted a stylar apiculum in the generitype of *Dresslerothamnus*, but further collections show that an apiculum is less pronounced in other species.

Pentacalia in Central America is treated, with 12 species recognized. The genus is Neotropical and is most speciose in Andean South America, where more than 100 species are known. *Pentacalia* was resurrected from synonymy of *Senecio* by Robinson and Cuatrecasas (1978), and Cuatrecasas (1981) recognized two subgenera. Cuatrecasas (1981) basically took the generitype as intermediate with *Pentacalia* subgen. *Microchaete* Cuatr., influencing him to recognize as congeneric the shrubby elements as a second subgenus. More recently, shrubby, often ericoid *Pentacalia* subgen. *Microchaete* Cuatr. was excluded and recognized at the generic rank as *Monticalia* C. Jeffrey (≡ *Microchaete* Benth. 1845, non Nutt. 1841) (Jeffrey 1992a), which in addition to its shrubby habit is characterized by large carpopodia (Fig. 8B). In each *Pentacalia* and *Monticalia*, several species groups are known (the Monticalias corresponding in part to *Senecio* sects. *Abietoides* Cuatr., *Arbutoides* Cuatr., *Ericoides* Cuatr., *Ledifolium* Cuatr., *Triana* Cuatr., and *Vaccinioides* Cuatr., each typified by species of *Monticalia* and available for infrageneric use there), are perhaps distinct from parent genera, and their generic limits are under continued study by the author. At present, the genera are circumscribed more or less as in Jeffrey (1992a) and Nordenstam (2007). For example, it seems some Monticalias although alternate-leaved are close to opposite-leaved *Scrobicaria* Cass. (Robinson et al. 1997; Pruski 1997). But, in gestalt, opposite-holly-leaved *Scrobicaria* does not resemble *Monticalia*, even though Cuatrecasas (1994) remarked "the opposite leaves ... cannot be considered a reliable basis for separation" and reduced *Scrobicaria* to synonymy of *Pentacalia*. Shortly thereafter, Díaz-Piedrahita and Cuatrecasas (1999) reinstated *Scrobicaria*. Nordenstam (2007) and Pruski and Robinson (2018) treated *Monticalia* and *Scrobicaria* as distinct.

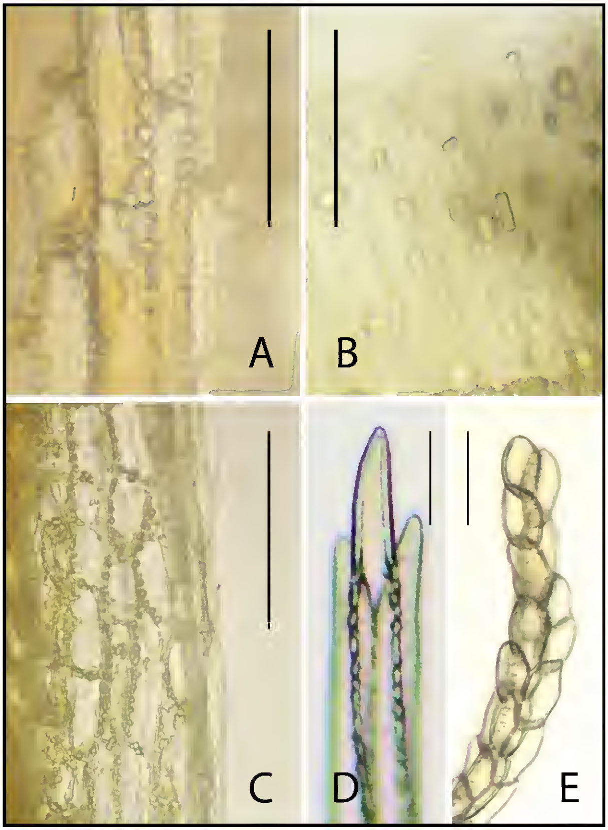


Figure 3. Floral microcharacters in Senecioninae. A. *Dresslerothamnus schizotrichus*, radial (approaching transitional) endothecial tissue. B. *Pentacalia arborea*, generitype, rectangular and hexagonal crystals of immature cypselae epidermis, representative of many Senecioninae. C. *Pentacalia tonduzii*, radial (approaching transitional) endothecial tissue. D. *Pentacalia tonduzii*, pointed tips of a pappus bristle. E. *Monticalia firmipes*, rounded terminal and distal cells of a pappus bristle. (A *Skutch 2502*, MO, holotype; B *King et al.10136*, MO; C–D *Alfaro 1546*, MO; E *Wilbur & Teeri 13937*, MO). [Scale bars: A 25 µm, B 50 µm, C 50 µm, D 30 µm, E 50 µm].

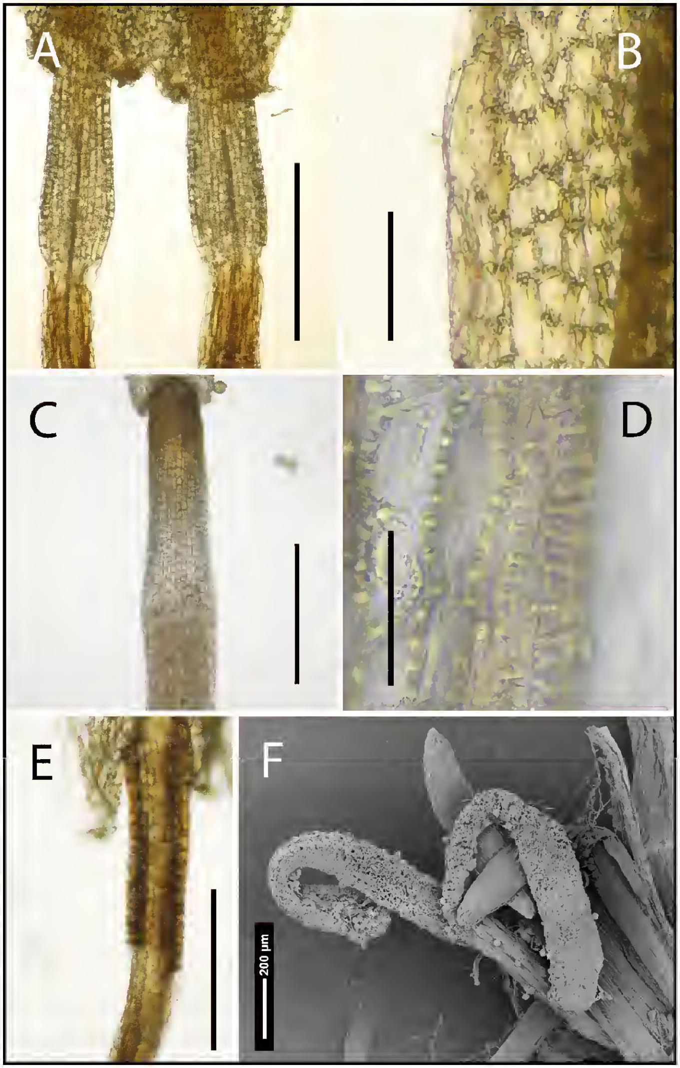


Figure 4. Tussilagininae (cacalioid) floral microcharacters. A. *Digitacalia stevensii*, cylindrical filament collars. B. *Digitacalia stevensii*, polarized endothecial tissue with thickenings on polar walls; C-shaped thickenings were not seen. C. *Robinsonecio gerberifolius*, cylindrical filament collar. D. *Robinsonecio gerberifolius*, radial endothecial tissue, showing (on left) radial cell walls and vertical columns of C-shaped thickening ends, and (on right) several horizontally oriented C-shaped thickenings. E. *Telanthophora steyermarkii*, cylindrical filament collar, adaxial view showing groove. F. *Telanthophora steyermarkii*, recurved disk floret style branches (left-center foreground) with continuous stigmatic surfaces, the anther cylinder is towards the lower right. (A–B *Stevens & Montiel 37259*, MO, holotype; C–D *Pruski & Ortiz 4163*, MO); E–F *Steyermark 49556*, MO, holotype). [Scale bars: A 0.4 mm, B 60 µm, C 0.25 mm, D 30 µm, E 0.2 mm].

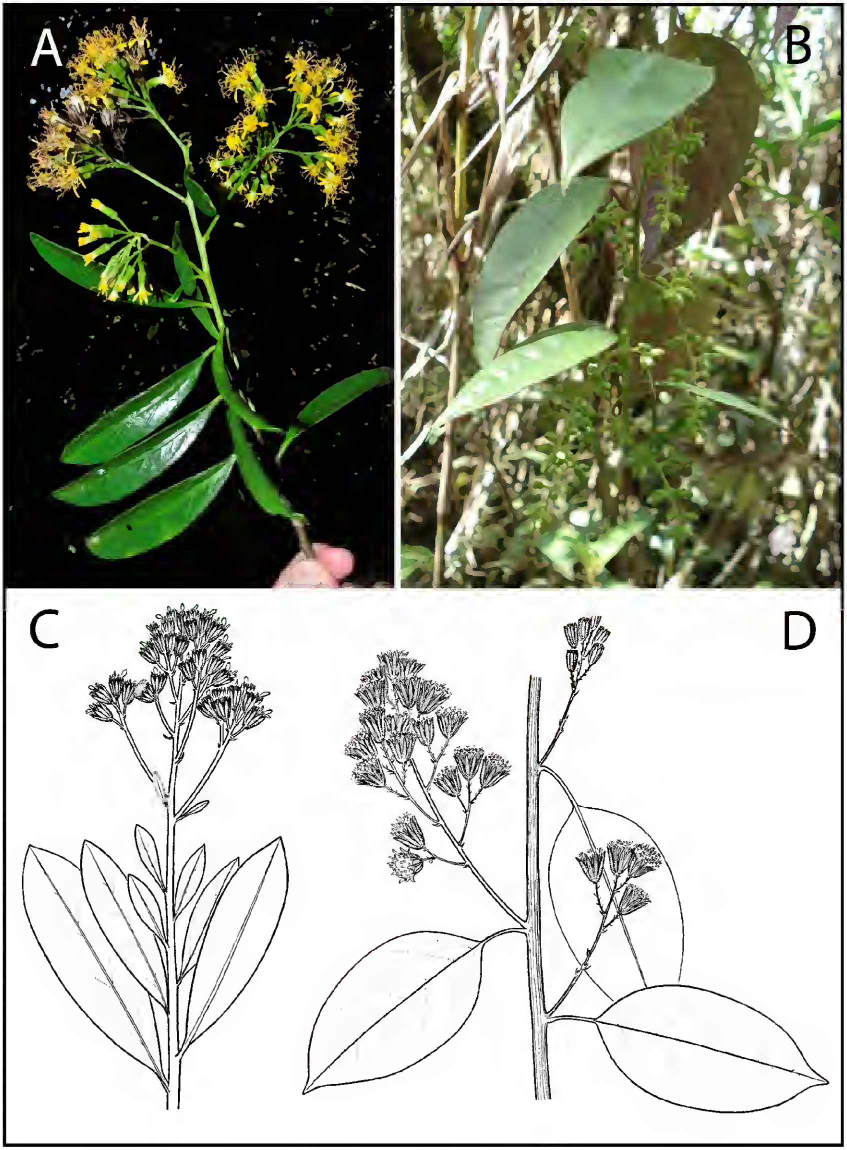


Figure 5. Capitulescence positions in Neotropical vining Senecioninae. A. Terminal capitulescence of *Ortizacalia austin-smithii*, generitype. B. Hanging flowering branch of a Peruvian species of *Pentacalia*, showing axillary capitulescences with budding capitula held within the subtending leaves. C. Terminal capitulescence of *Pentacalia phelpsiae*. D. Axillary capitulescences of *Pentacalia freemanii*. (A *Cascante-Marin & Trehos 2564*, photograph by Alfredo Cascante; B *Pruski et al. 4386*; C–D Drawn by Bruno Manara, modified from Pruski 1997 figures 286–287).

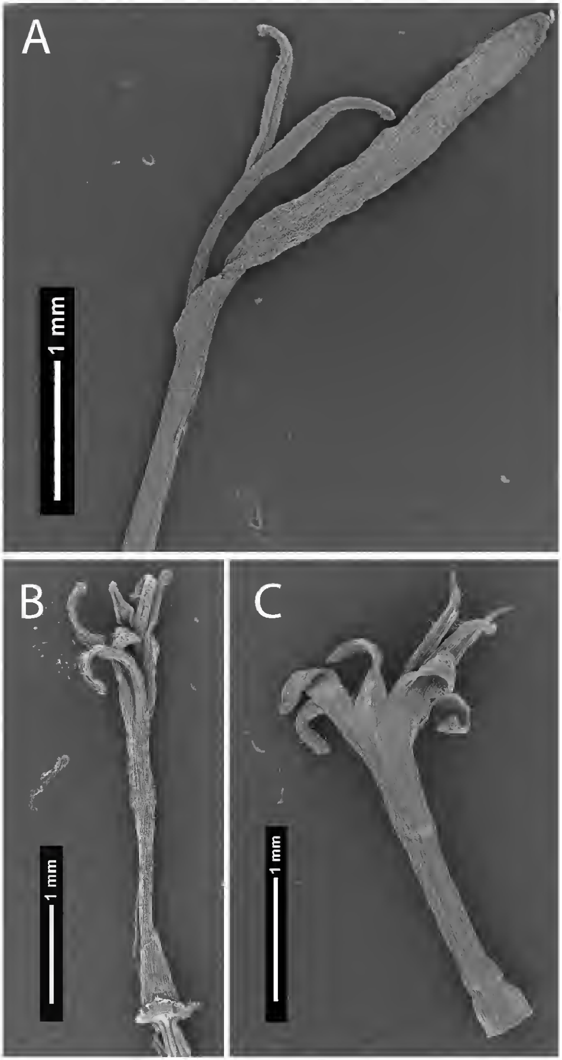


Figure 6. Floret and corolla types in *Dresslerothamnus* and *Pentacalia*; pappus bristles removed, A and C ovaries removed; florets in A–B are pistillate, C is bisexual. A. *Pentacalia tonduzii*, pistillate ray floret from heterogamous-radiate capitulum, corolla limb on upper right, bifid style on top center, adaxial view of style branch showing a 2-banded stigmatic surface, top center-left. B. *Dresslerothamnus hammelii*, pistillate marginal floret with tubular corolla from heterogamous-disciform capitulum. The two style branches are about as wide as the narrow corolla lobes. Disciform florets of heterogamous-disciform capitula are often overlooked, and the capitulum often incorrectly called homogamous-discoid. C. *Pentacalia phanerandra*, bisexual disk floret with funnelform corolla from disciform capitulum, anther cylinder on upper right, style removed. (A *Alfaro 1546*, MO; B *Kirkbride & Duke 977*, MO, holotype; C *van der Werff 7236*, MO).

Similarly, some yellowed-flowered, fleshy-leaved Pentacalias may perhaps belong to *Ortizacalia*, but the distal papillae between stigmatic bands, dimorphic stylar papillae, and stoutly long-comose stylar appendage characters (Fig. 2A) that help diagnose *Ortizacalia* are not seen in the yellow-flowered Pentacalias. Neither do the yellow-flowered vining Pentacalias seem congeneric with any of the West Indian vining segregates of *Senecio*. Nordenstam (2006, 2007) distinguished the West Indian vining genera from *Pentacalia* as follows: *Ekmaniopappus* Borhidi and *Odontocline* B. Nord. by 8–10-striate cypselae; *Herodotia* Urb. & Ekman and *Nesampelos* B. Nord. by ecaudate anthers; *Jacmaia* B. Nord. by its *Arbelaezaster-Garcibarrigoa-Pseudogynoxys*-like, cellular-triangular style branch appendage (Nordenstam 1978 fig. 30; Nordenstam 2007 fig. 53); and *Leonis* B. Nord. and *Mattfeldia* Urb. by trinerved leaves. Among these, *Ekmaniopappus* and *Herodotia* further differ from *Pentacalia* by their often opposite leaves. The yellow-flowered Pentacalias and the typical white-flowered elements of *Pentacalia* are treated here as congeneric.

The characters in *Pentacalia* of vining habit, herbage with simple trichomes, and 5-costate cypselae, albeit none of these characters unique in Senecioneae, are in combination useful in circumscribing *Pentacalia* (Jeffrey 1992a). The genera of the *Pentacalia* group (see generic key below) are mutually similar by their caudate anthers and solid clinanthia (Pruski 2012b fig. 3A), and by these characters genera of the group are obviously distinct from *Senecio* (Robinson 1989; Jeffrey 1992a: 62; Pruski 2012a; Pruski & Robinson 2018). Among neotropical genera, *Pentacalia* seems most similar to *Dresslerothamnus* by roughly similar habits, florets, and styles (Figs. 2, 5–6); and to *Monticalia* and *Ortizacalia* by pentagonal cypselae (Fig. 8). The genera in the following key, and their component species, were treated within *Senecio* prior to Robinson and Cuatrecasas (1978), Cuatrecasas (1981), Nordenstam (1978, 2006, 2007), Jeffrey (1992a), and Pruski (2012b).

Also revised here is *Zemisia* B. Nord., a genus of shrubs or trees that is reported as new to continental America. Continued work on the Trees of Mexico project has resulted in an acceptable generic placement of *Senecio thomasii* Klatt, the only generically unplaced Senecioneae in Pruski and Robinson (2018). A decade ago, I presumed this woody, caudate-anthered, yellow-rayed species with elongate, narrowly funnelform disk corollas was a *Monticalia*, but its (8–)10-costate, pubescent cypselae discouraged inclusion there. No American genus as currently circumscribed can house *S. thomasii*, although by woody habit, discolorous leaves, and similar (8–)10-costate, pubescent cypselae West Indian *Elekmania* B. Nord. and *Zemisia* B. Nord. do not seem very different. *Elekmania* differs from *S. thomasii*, however, by relatively short campanulate disk corollas with a short tube and ecaudate anthers. *Zemisia* as circumscribed by Nordenstam (2007) is white-flowered, thereby differing from both *Senecio thomasii* and *Elekmania*. In critical features other than flower color, however, *Senecio thomasii* Klatt matches *Zemisia* B. Nord., a formerly monotypic West Indian endemic described in 2006. *Zemisia* is monographed here, expanded here to include this second species––*Senecio thomasii*––resulting in a new generic record for continental America. The generic description of *Zemisia* is emended to reflect that it now contains both white-rayed and yellow-rayed plants.

A generic key that places *Dresslerothamnus*, *Pentacalia*, and *Zemisia*––each revised herein––into context follows. *Pentacalia*, and *Zemisia* were keyed by Nordenstam (2007: 213) following lead 136B "anthers basally obtuse to sagittate," but were described a few pages later by Nordenstam (2007: 227, 233) as including caudate-anthered species. *Dresslerothamnus*, keyed by Nordenstam (2007: 210) following trichome-based lead 23A, is also caudate-anthered.

Key to genera centering about Pentacalia

1. Vines or lianas.

2. Style branch papillae obviously dimorphic, distally papillose between stigmatic bands, branch apex densely long-comose with 15–20 stiffly erect penicellate papillae about twice as long as branch diam.; trichomes simple; leaves carnose, with arching pinnate venation; corollas yellow; (1 sp.; Costa Rica) .... **Ortizacalia** Pruski
2. Style branch papillae isomorphic or nearly so, not distally papillose between stigmatic bands, branch apex papillose usually as a crescent-shaped fringe or sometimes as an apiculum but then apical papillae only to about as long as branch diam., apex not long-comose; trichomes simple to compound (variously modified multistoried pseudostellate-to-T-shaped); leaves chartaceous to carnose, venation pinnate to trinerved; corollas white, yellow, or reddish.

3. Herbage with variously-modified multistoried pseudostellate-to-T-shaped trichomes; ray corollas (when present) filiform, reddish or yellow; cypselae 8–10-striate; (5 spp.; Colombia, Panama, Costa Rica) .... **Dresslerothamnus** H. Rob.
3. Herbage with simple trichomes; ray corollas (when present) lanceolate to elliptic-lanceolate, seldom narrowly linear-lanceolate, yellow; cypselae 5-costate; (100+ spp.; South America, less common northwards into Mexico).................... **Pentacalia** Cass.

1. Shrubby herbs, pachycaul trees, shrubs, or trees.

4. Leaves opposite, blade margins holly-like; (3 spp.; Andean Colombia, Andean Venezuela) .... **Scrobicaria** Cass.
4. Leaves alternate, blade margins usually entire to weakly dentate or serrate.

5. Cypselae 5-costate, glabrous; (50+ spp.; Andes, Panama, Costa Rica). .... **Monticalia** C. Jeffrey
5. Cypselae 8–10-striate-costate, glabrous or setose.

6. Shrubby herbs or pachycaul trees; cypselae glabrous; (90+ spp.; South America) .... **Dendrophorbium** (Cuatr.) C. Jeffrey
6. Shrubs; cypselae setose.

7. Leaf blade adaxial surfaces glutinous-nitidous, abaxial surfaces with secondary veins indistinct, yellow-tomentose; peduncles with few appressed bracteoles; styles sometimes with continuous stigmatic surfaces; (17 spp.; Cuba) .... **Antillanthus** B. Nord.
7. Leaf blade adaxial surfaces dull-green, abaxial surfaces with obvious secondary veins, white-tomentose; peduncles with several spreading bracteoles; styles with 2-banded stigmatic surfaces.

8. Capitula radiate or discoid; corollas yellow; disk corollas narrowly campanulate, tube shorter than limb; anthers auriculate-based; (9 spp.; Hispaniola) .... **Elekmania** B. Nord.
8. Capitula radiate; corollas white or yellow; disk corollas narrowly funnelform, tube as long as or longer than limb; anthers caudate; (2 spp.; Jamaica, Mexico, Central America) .... **Zemisia** B. Nord.

DRESSLEROTHAMNUS H. Rob., Phytologia 40: 494. 1978. **TYPE:** *Senecio angustiradiatus* T.M. Barkley (≡ *Dresslerothamnus angustiradiatus* (T.M. Barkley) H. Rob.).

Vines or lianas, flowering branches often completely pendent for 1–2+ m from tops of supporting trees; stems striate; herbage with variously-modified (T-shaped, pseudostellate, or schizotrichoid) multistoried trichomes with a many annular-celled, uniseriate stipe and multistoried unicellular cap cells equally (and appearing centric) or unequally (and appearing excentric) very elongated transversely (appearing branched), these cap cell arms (when viewed from above) may be fully superimposed and in a single plane or they may be arranged decussately and only superimposed at the stipe, arms each single-celled, often drying flat and slightly curved in four species but they are terete and straight in *D. angustiradiatus*, often fragile between stipe and cap cells with arms breaking off and the naked stipe imparting a hispid aspect to the indument. **Leaves** simple, alternate, petiolate; blade broad, often somewhat fleshy, venation pinnate, secondary veins forward-directed, often prominent, third order veins indistinct, margins entire, surfaces more or less concolorous. **Capitulescence** axillary from distal few-several distal nodes, pluricapitulate, variously paniculate, main lateral branches unbranched in proximal half, distal branchlets bracteolate, ultimate clusters of capitula subracemose to subumbellate; bracteoles linear-lanceolate. **Capitula** heterogamous, radiate or disciform; involucre 1-seriate, irregularly few-calyculate, calycular bracteoles and peduncular bracteoles similar, ascending; disk florets exserted about 2–5 mm from involucre; phyllaries commonly 5–8(–11), subequal, free, green to sometimes tinted reddish or purplish, the broader with tan-scarious margins; clinanthium solid, flat or weakly convex, epaleate, often enate-setose or setulose to aristate-squamellose; calycular bracteoles linear-lanceolate, resembling peduncular bracteoles. **Ray florets** 5 or 8, pistillate, rarely with staminodia; corolla glabrous, limb filiform, exserted but down-curved, visible surface reddish (color presumably in reference to the abaxial surface as seen when margins involute), perhaps obscured adaxial surface yellow, margins involute. **Marginal pistillate florets** 0 or 5–6; corolla actinomorphic, tubular-funnelform, yellow, tube longer than lobes. **Disk florets** 5–19, bisexual, 5-merous; corolla funnelform, 5-lobed, yellow, glabrous, tube elongate, gradually dilated at base, about as long as limb, thus throat shorter than tube, lobes lanceolate; anther thecae caudate, pale, tails straight, narrow, seemingly smooth, filament collar balusterform (basally broadened-bulbous and with enlarged basal cells) or sometimes somewhat indistinctly so with base very bulbous, endothecial tissue with cell wall thickenings radial(-transitional also with polar thickenings), apical appendage lanceolate to lanceolate-ovate, narrow apically or sometimes obtuse; style usually triangular-appendiculate, sometimes exappendiculate, base gradually dilated, branches recurved becoming once-coiled, stigmatic surfaces narrowly 2-banded, without distal papillae between stigmatic bands, apex subtruncate to triangular, never long-comose, often moderately papillose as subapical fringe or apiculum, papillae then isomorphic, free, and slightly shorter than to sometimes about as long as branch diameter, apex acute (infrequently rounded), the abaxial-lateral papillae gradually grading into sometimes longer terminal papillae. **Cypselae** tardily maturing, cylindrical or narrowly obconic, finely 8–10-striate, glabrous, brown, carpopodium annular, tan; pappus of many slender stramineous scabridulous capillary bristles, distal-most cells often acute-pointed and spreading, but obtuse (especially pre-anthesis) in two species.

Dresslerothamnus H. Rob. is a vining genus with senecioid microcharacters (Figs. 2C, 3A; balusterform filament collars, radial(-transitional) endothecial tissue, and 2-banded disk style branches). The genus was originally proposed as monotypic by Robinson (1978), who diagnosed it by the character combination of pseudostellate trichomes (Figs. 11A, 12; called 'stipitate-stellate' in Barkley 1975) and filiform ray corolla limbs (Fig. 19B). A decade later Robinson (1989) revised the genus and described two additional filiform-rayed species. The two newer species, however, have multistoried-T-shaped or schizotrichoid trichomes (Figs. 11B–C, 17, 20; trichome names derived from Greenman's *Senecio schizotrichus*; these called 'complex stelliform' by Jeffrey 1992a). The pseudostellate trichomes character once used to diagnose the genus became a species trait, and *Dresslerothamnus* was diagnosed then only by its filiform rays. The vining habit, tailed anthers, and solid clinanthia of *Dresslerothamnus* were used by Robinson (1978, 1989), Pruski (2012b), and Pruski and Robinson (2018) to ally it with *Ortizacalia* and *Pentacalia.*

Jeffrey (1992a) expanded *Dresslerothamnus* to include a fourth species, disciform-capitulate *D. schizotrichus* (Greenm.) C. Jeffrey from Costa Rica, which has schizotrichoid trichomes (Fig. 20) similar to those of Robinson's *D. gentryi.* However, the Greenman species is odd and disciform-capitulate, whereas by filiform-rays *D. gentryi* is comfortably at home in *Dresslerothamnus* sensu Robinson (1989). The circumscription by Jeffrey (1992a) is supported by the discovery of *D. hammelii,* a second disciform species (Fig. 15) and a connecting link of sorts, having T-shaped trichomes (Fig. 17) as in filiform-radiate *D. peperomioides* combined with the disciform capitula character of *D. schizotrichus.* The T-shaped trichome caps of the two newer disciform species, however, are often broken with the remnant stipe mimicking simple trichomes, and these two species continue to be confused with *Pentacalia.*

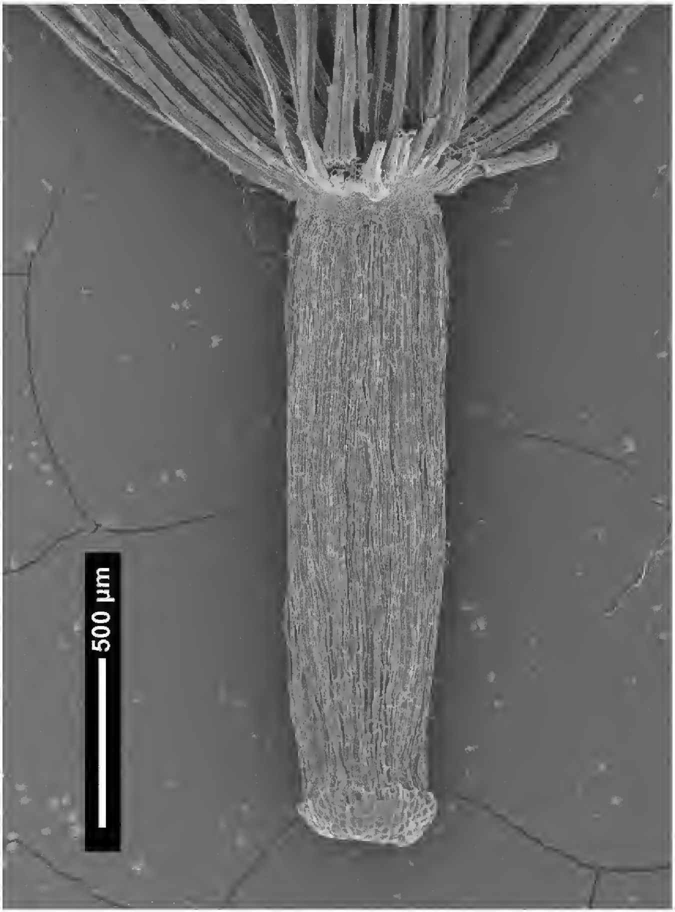


Figure 7. Pluristriate cypsela of *Dresslerothamnus angustiradiatus*, generitype. (*Croat 50008*, MO).

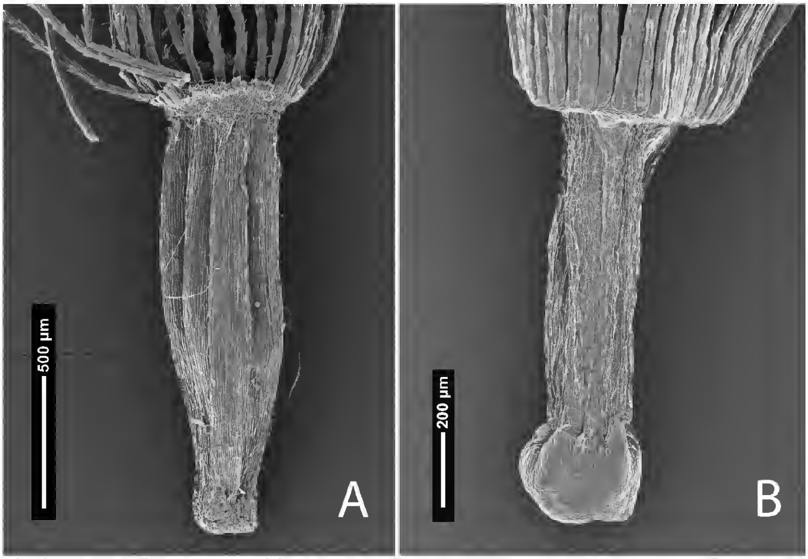


Figure 8. Cypselae in *Pentacalia* and *Monticalia*. A. *Pentacalia arborea*, generitype, mature 5-costate cypsela with a mid-sized annular carpopodium. B. *Monticalia pulchella*, generitype, immature cypsela showing large bulbous carpopodium, and two incipient costae apically. (A *King et al. 10136*, MO; B *Barclay 10427*, MO).

In Compositae, T-shaped or ramified trichomes are not peculiar to *Dresslerothamnus*. For example, pseudostellate trichomes sometimes occur in Cichorieae (e.g., Solereder 1908; Stebbins 1953; Metcalfe and Chalk 1979 fig. 5.4I) and *Olearia* Moench of Astereae (Solereder 1908 fig. 103D; Metcalfe and Chalk 1979 fig. 5.4G–H). Also in Cichorieae, Solereder (1908) notes that both pseudostellate and 'candelabra' trichomes occur in *Andryala* L. Dendroid trichomes were illustrated in *Artemisia* L. by Ling (1995). Holmes and Pruski (2000 fig. 2) reported *Mikania wurdackii* Pruski & W.C. Holmes as the sole Eupatorieae with dendroid trichomes. T-shaped (two-armed) trichomes have been found in Anthemideae (e.g., Solereder 1908; Ramayya 1962; Bremer and Humphries 1993; Ling 1995; Pruski and Robinson 2018), *Baccharis* L. (Müller 2006), mutisioids (Cabrera 1971; Freire et al. 2014; Padin et al. 2015), *Parthenium* L. (Ramayya 1962), and Vernonieae (e.g., Ramayya 1962; Faust & Jones 1973; Isawumi 1996; Robinson 2009; Redonda-Martínez et al. 2012; Wagner et al. 2014; Pruski 2016). Also in Vernonieae, stellate trichomes are found in some species of *Piptocarpha* R. Br. (Smith & Coile 2007; Pruski & Ortiz 2017), irregularly branched trichomes in *Critoniopsis* Sch. Bip. (Haro-Carrión & Robinson 2008; Robinson & Keeley 2015), and bladder-stellate trichomes in a few Brazilian and Andean genera (Wagner et al. 2014; Pruski 2016). The above examples suggest that in Compositae the T-shaped or ramified trichome characters are not tribally diagnostic, but are instead most useful in distinguishing genera and species (Sasikala & Narayanan 1998; Pruski 2016). Among American Senecioneae, however, the trichomes of *Dresslerothamnus* help circumscribe the genus.

In tribe Senecioneae, multistoried T-shaped trichomes were noted in *Brachyglottis* J.R. Forst. & G. Forst. and *Urostemon* B. Nord. (placed by Pelser et al. 2007 in provisional subtribe Brachyglottidinae) by Drury (1973a fig. 1G), Jeffrey et al. (1977), and Nordenstam (1978 fig. 16). Sahu (1983) reported stellate trichomes with 6–8 equal arms (and a short 6–8-celled stipe appearing embedded in the epidermis) in leaves of *Senecio nudicaulis* Buch.-Ham. ex D. Don (≡ *Jacobaea nudicaulis* (Buch.-Ham. ex D. Don) B. Nord.) and Pelser et al. (2004 fig. 4) showed single-cap-celled

T-shaped trichomes in several species of the *Incani* group of *Senecio* sect. *Jacobaea* (now *Jacobaea* Mill.). Nordenstam (2006) described 'much-branched' trichomes in monotypic West Indian *Herreranthus* B. Nord. (Senecioninae). On occasion, *Monticalia* (Senecioninae) has basic T-shaped trichomes with a single cap cell (Fig. 10B; Jeffrey 1987 fig. 3E–F; Jeffrey 1992a; Lapp et al. 2013 fig. 3B), which further distinguish some of its species from vining *Pentacalia*. Stipitate stellate-dendroid trichomes are found in the shrubby Andean genera *Nordenstamia* (Fig. 9C–D) and *Aequatorium*, with *Aequatorium* also having an underlayer of short-stipitate stellate-lepidote trichomes (Fig. 9A; Nordenstam 1978; Lundin 2006); each genus lacks the pluricellular stipe typical of *Dresslerothamnus*. The continuous stigmatic surfaces (Fig. 9B) of *Aequatorium* and *Nordenstamia*, however, position them in subtribe Tussilagininae (Nordenstam 1978; Lundin 2006). Moreover, the aforementioned American genera––except *Jacobaea*––are basically shrubs or trees, and none seem closely related to *Dresslerothamnus*, despite each group having faintly similar T-shaped or ramified trichomes.

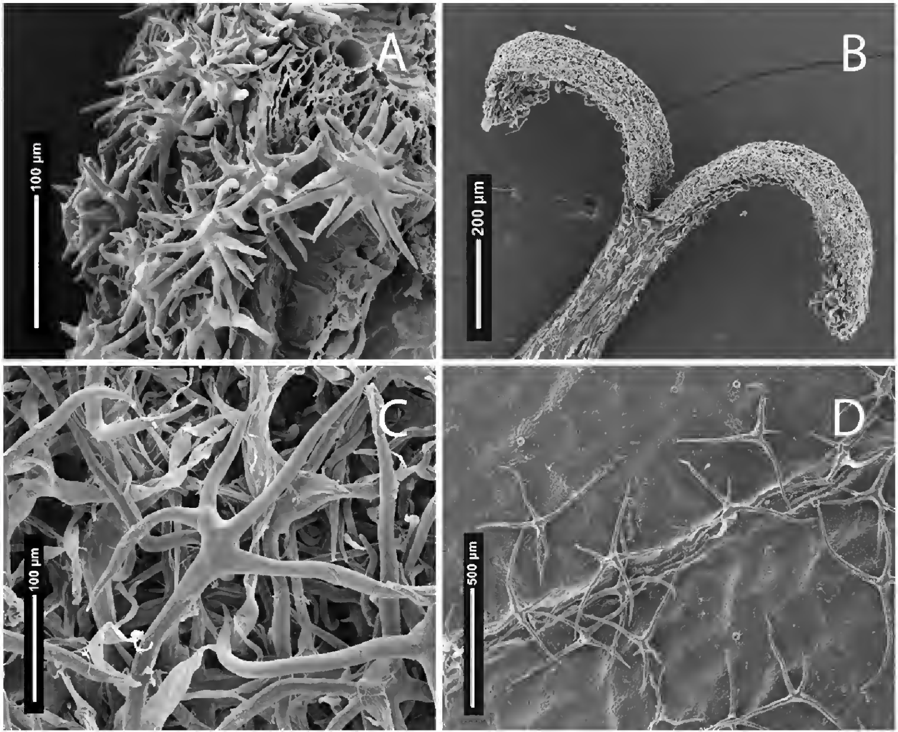


Figure 9. Branched trichomes and style branch of *Aequatorium* and *Nordenstamia* (subtribe Tussilagininae). A. Short-stipitate stellate-peltate-lepidote trichomes of the lower layer of tomentum on phyllary of *Aequatorium asterotrichum*, generitype. B. *Aequatorium asterotrichum*, generitype, style showing two branches with continuous stigmatic surfaces and obtuse branch tips. C. Long-stipitate stellate-dendroid trichomes on abaxial leaf blade surface of *Nordenstamia tovarii*. D. Moderately short-stipitate stellate-dendroid trichomes on adaxial leaf blade surface of *Nordenstamia tovarii*. The trichome arms in *Nordenstamia* are unequal, irregularly branched, and the trichomes are not truly stellate. (A–B *Cuamacás & Gudiño 459*, MO; C–D *Pruski et al. 4360*, MO).

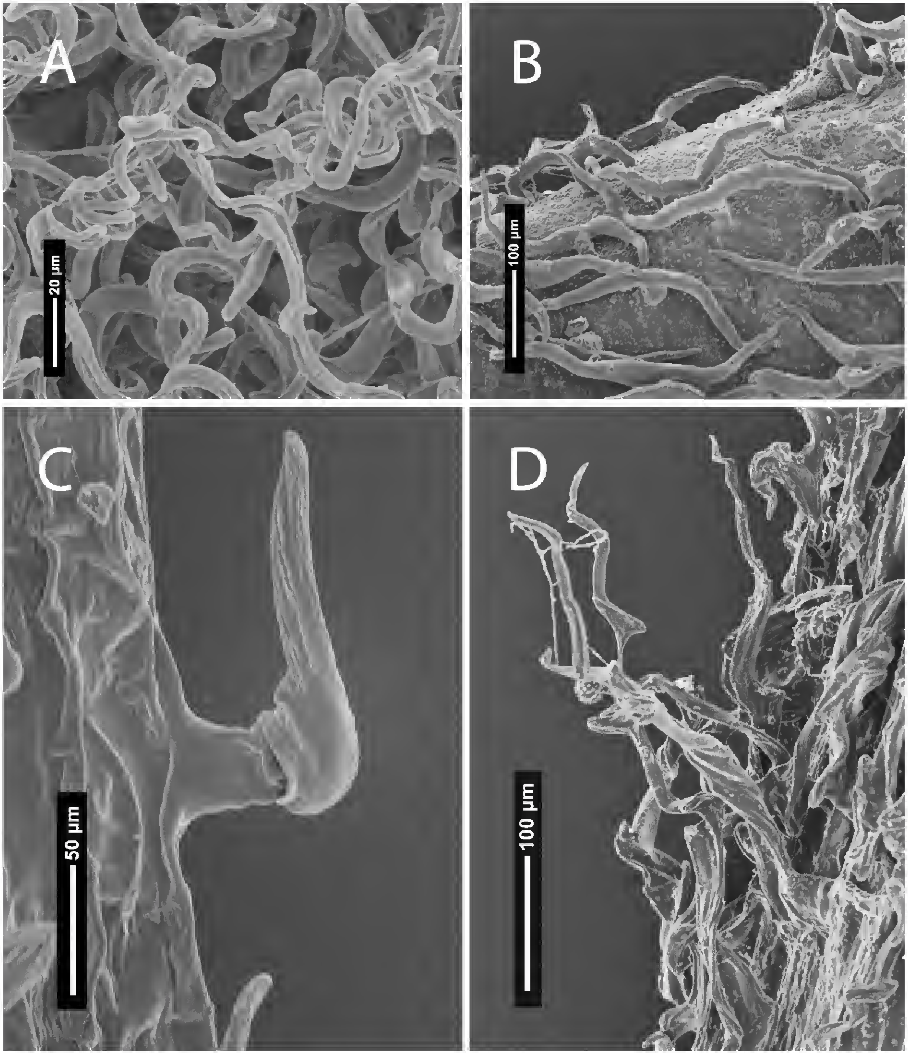


Figure 10. Trichomes in *Monticalia* and *Pentacalia* (subtribe Senecioninae). A. *Monticalia andicola*, simple, curled trichomes (similar to those in Drury and Watson 1965 fig. 5; and Jeffrey 1987 trichome type 3D) on abaxial leaf blade surface. B. *Monticalia ruiteranii*, short-stipitate, basic T-shaped trichomes with a single cap cell (similar to those in Jeffrey 1987 trichome type 3E) on adaxial leaf blade surface. C. *Pentacalia tonduzii*, collapsed, bent simple trichome on stem, the trichomes are often broken and mimic trichome stipes of *Dresslerothamnus*. D. *Pentacalia candelariae*, simple crisped-curled thin trichomes (similar to those in Jeffrey 1987 trichome type 3D). (A *Pruski et al. 3886*, MO; B *Duno et al. 1570*, MO; C *Hammel 7476*, MO; D *Wilbur 14351*, MO).

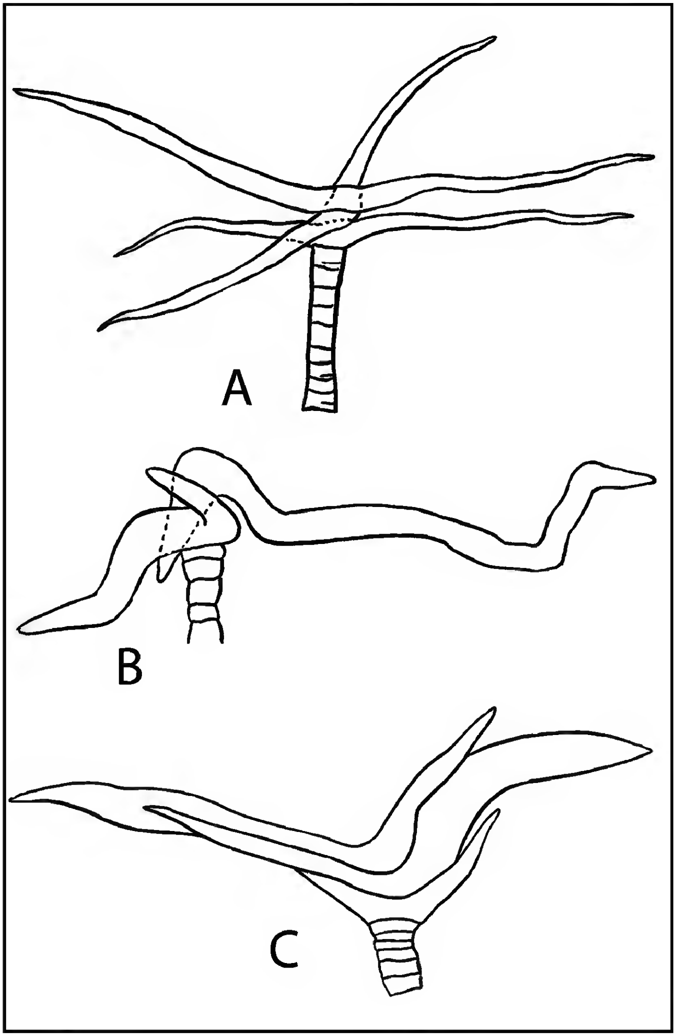


Figure 11. The three basic multistoried pseudostellate-to-T-shaped trichome type modifications in *Dresslerothamnus*. All trichomes are uniseriate, stipes pluricellular, and cap cells laterally elongated with two arms centric or excentric, equal or unequal, and decussate to superimposed. Tiers of cap cells vary from 2–5+. A. *Dresslerothamnus angustiradiatus*, generitype, "pseudostellate." Cap 3-storied, arms centric, equal, decussate. The stipe varies from shorter than to about as long as arms. B. *Dresslerothamnus gentryi*, "schizotrichoid." Cap 2-storied, arms as drawn here very excentric, unequal, irregular and sometimes curved, only partly superimposed, i.e., not in same plane when viewed from above. The same basic trichome type occurs in *D. schizotrichus*. C. *Dresslerothamnus peperomioides*, T-shaped, arms somewhat excentric, somewhat unequal, completely superimposed and in single plane when viewed from above. The same basic trichome type occurs in *D. hammelii* and the genus *Urostemon*. (Drawn by Alice Tangerini, modified from Robinson 1989).

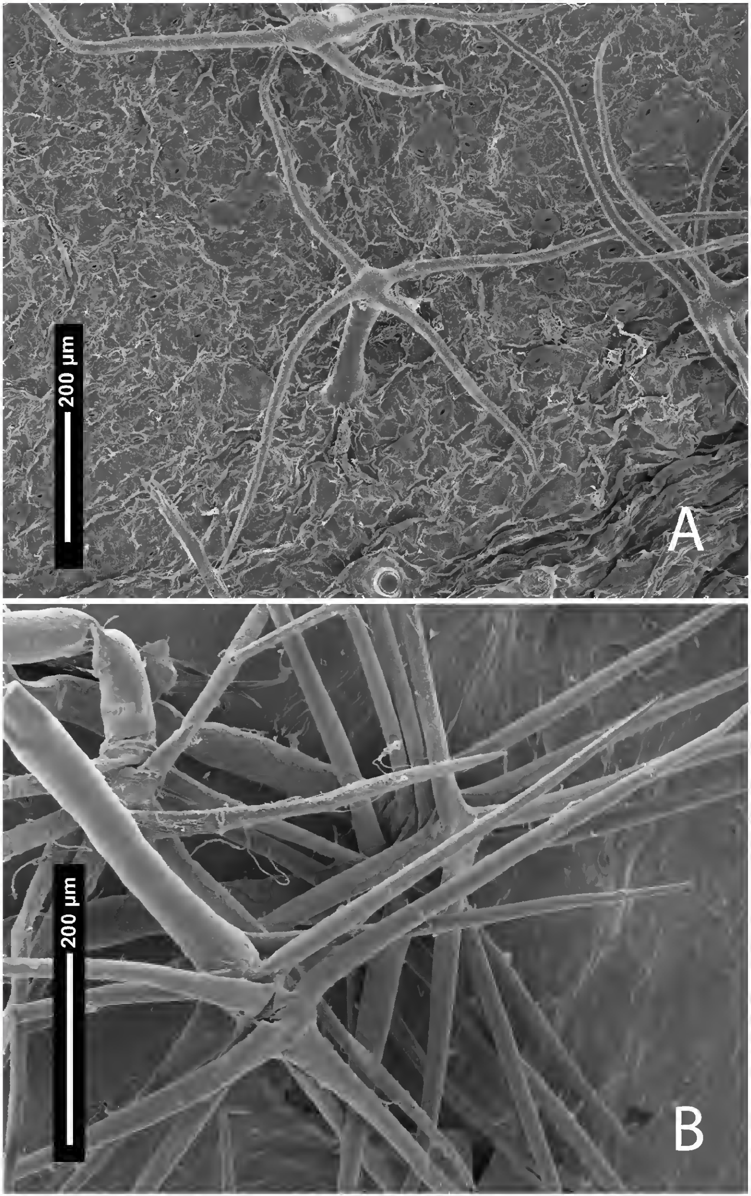


Figure 12. Variation in pseudostellate trichomes of *Dresslerothamnus angustiradiatus*, generitype. T-shaped or schizotrichoid trichomes infrequently co-occur with pseudostellate trichomes. A. Side view of trichome with pluricelled stipe and two cap cells with equal arms. B. View from above showing 5+ decussate cap cells. (A *McPherson 6990*, MO; B *Cogollo & Ramírez 3162*, MO).

Dresslerothamnus displays three basic types of pluricellular-stipitate multistoried trichomes (Figs. 11–12, 17, 20): pseudostellate, schizotrichoid, and T-shaped (Robinson 1989). Solereder (1908) stated T-shaped trichomes and pseudostellate trichomes in *Olearia* are "closely related," and also that transitional stages between these two trichome types occur in *Santolina* L. Similarly, in *Dresslerothamnus* intermediates may be found, both between species, within individual species, and within single individuals. For example, the schizotrichoid trichomes of *D. schizotrichus* seem intermediate between T-shaped and pseudostellate trichomes of other species. *Dresslerothamnus gentryi* contains both schizotrichoid and T-shaped trichomes, sometimes on the same leaf. *Dresslerothamnus angustiradiatus* typically has trichomes all pseudostellate, but both schizotrichoid and T-shaped trichomes may comingle with the pseudostellate trichomes on an individual leaf.

In *Dresslerothamnus*, the trichome cells are uniseriate, but variously pseudostellate-to-T-shaped by cap cell rotations and bilateral arm elongations. The 2(–several) apical cap cells are ‘attached’ directly above the obviously uniseriate stipe, with each cap cell having two arms. "What is not obvious is that the apical part is also uniseriate, but the cells are so elongated transversely as to obscure totally the fact" (quoted from Robinson 1989). The arms are equally or very unequally elongated, thereby appearing centrically or excentrically attached. The arms may be completely superimposed or superimposed only directly above stipe where ‘attached.’ In the herbarium, the cap cells of each type are sometimes fragile or damaged, and falling onto and littering the herbarium sheet. In these specimens the naked stipe may resemble a simple trichome, but their nature is revealed by the stipe's component annular cells, stoutness, and non-tapered apex.

The first multistoried pseudostellate-to-T-shaped trichome subtype in *Dresslerothamnus* is (1) that of the generitype *D. angustiradiatus*, for which Robinson used the term pseudostellate (viz Figs. 11A, 12; Robinson 1989 fig. 1B). These pseudostellate trichomes have 2-several cap cells with the radiating arms decussately arranged. The cap cells are superimposed only above attachment point with the stipe. Infrequently, intermediate stages of T-shaped or schizotrichoid trichomes seem to co-occur with pseudostellate trichomes. This pseudostellate trichome type (1) resembles those of *Olearia* and African *Andryala*. The pluricelled stipe in *D. angustiradiatus* appears, however, to be much stouter than those found in either *Olearia* or *Andryala*. The second trichome type (2) has cap cells excentric, arms unequal and only partly superimposed (irregularly T-shaped), curved, and flattened when dry. This trichome type modification is termed schizotrichoid (viz the *D. schizotrichus* protologue). In some Costa Rican material trichomes are often damaged and identification of imperfect material as either *Dresslerothamnus* or *Pentacalia* is problematic. The third trichome type (3) in *Dresslerothamnus* is T-shaped, with multistoried cap cell arms completely superimposed and oriented transversely in a single plane. This third type has a short several-celled stipe, with cap cell arms relatively broad and sometimes even some ranging to bulbous or inflated in appearance. Confusingly, *P. tonduzii* has collapsed, bent-broken simple trichomes (Fig. 10C), mimicking damaged T-shaped trichome type 3 of *Dresslerothamnus*. In any event, the multitiered pseudostellate type 1 trichome appears linked, by cap cell rotation, to T-shaped trichome type 3. The schizotrichoid type 2 appears to represent an intermediate stage (as suggested in other genera by Solereder 1908) of cap cell rotation.

Noteworthy unidentified collections of *Dresslerothamnus* or *Pentacalia* that do not conform include *Haber & Zuchowski 10384* from Monteverde, which is imperfect, has very thick leaves, and densely pubescent stems. The trichome type is not well seen but could be T-shaped or schizotrichoid, thus it could be a *Dresslerothamnus*, hence a western range extension. On the other hand, *Rodríguez et al. 7145* (INB) from 3200 meters elevation on Cerro Jaboncillo was originally determined and displayed on the Tropicos webpage as *Senecio angustiradiatus*, i.e., *Dresslerothamnus angustiradiatus*. The specimen of *Rodríguez et al. 7145* (MO) in front of me is imperfect, but it is likely a collection of radiate *P. tonduzii*, especially in light of the locality and elevation. Lastly, imperfect material that I am unable to identify includes the Coclé specimens mentioned under *D. hammelii* and some Costa Rican material mostly from volcanoes mentioned under *D. schizotrichus.*

Dresslerothamnus is monographed here, and Panamanian *D. hammelii* is newly described. *Dresslerothamnus* is consequently enlarged to five species, one species endemic to Valle de Cauca, Colombia and four species centered in Costa Rica and Panama, albeit with *D. angustiradiatus* also trickling into Colombia.

Key to species of Dresslerothamnus

1. Capitula disciform.

    2. Leaf blades 2–5 cm long, evidently subcarnose; capitula with 5–6 bisexual disk florets; herbage with multistoried T-shaped trichomes with arms superimposed; (Panama) .... **3. Dresslerothamnus hammelii** Pruski
    2. Leaf blades 3.5–9.5 cm long, drying as though chartaceous, sometimes becoming brittle and fragmenting; capitula with ca. 19 bisexual disk florets; herbage with schizotrichoid trichomes; (Costa Rica) .... **5. Dresslerothamnus schizotrichus** (Greenm.) C. Jeffrey

1. Capitula filiform-radiate.

    3. Leaves blades 7–16 × 3.5–10 cm; herbage mostly with pseudostellate trichomes; capitulescence usually racemiform-cylindrical-paniculate and columnar in aspect; longer pappus bristles at post-anthesis with distal-most cells acute-pointed, spreading; (Costa Rica, Panama, Colombia) .... **1. Dresslerothamnus angustiradiatus** (T.M. Barkley) H. Rob.
    3. Leaves blades 1.5–6.5 × 1–3.8 cm; herbage with T-shaped or schizotrichoid trichomes; capitulescence subumbellate-paniculate with rounded ultimate clusters of capitula; pappus bristles terminal cells mostly appressed, obtuse to rounded

        4. Leaf blade 3–6.5 × 1.8–3.8 cm, apex apiculate; ray florets ca. 8; disk florets ca. 15; phyllaries greenish; anther tails slightly irregular-contorted distally; trichomes schizotrichoid or multistoried T-shaped trichomes with arms superimposed; (Bajo Calima, Colombia) .... **2. Dresslerothamnus gentryi** H. Rob.
        4. Leaf blade 1.5–4(–5) × 1–2.5(–3) cm, apex broadly obtuse to rounded; ray florets ca. 5; disk florets 5–8; phyllary mid-zone purplish-reddish; anther tails straight; trichomes multistoried T-shaped with arms superimposed; (Panama) .... **4. Dresslerothamnus peperomioides** H. Rob.

1. DRESSLEROTHAMNUS ANGUSTIRADIATUS (T.M. Barkley) H. Rob., Phytologia 40: 494. 1978. *Senecio angustiradiatus* T.M. Barkley, Ann. Missouri Bot. Gard. 62: 1263. 1975 [1976]. **TYPE: PANAMA.** El Llano–Carti highway, ca. 10–12 km N of El Llano, 2 Mar 1974, *Dressler 4616* (holotype: MO; isotypes: MO, NY, US). Figures 2C, 7, 11A, 12–13.

Liana; stems hirsute-villous, brown, larger stems often fistulous; herbage mostly with pseudostellate brownish-red trichomes (seldom with each schizotrichoid and T-shaped types also on an individual leaf), trichome stipe stiff, mostly 1–1.5 mm long and 8–15 annular-celled, trichome cap cells multistoried in a decussate arrangement, arms mostly 3–6 mm long, radiating laterally, trichomes of stems much longer than those on the phyllaries, when cap cells of longer trichomes damaged, herbage may appear heterotrichous by the hispid appearance of these elongate naked stout trichome stipes. **Leaves** relatively short-petiolate; blade 5–16 × 3–10 cm, elliptic to ovate, subcarnose, lateral veins usually 4 or 5 per side, forward directed, base rounded, apex obtuse to acuminate, adaxial surface sparsely hirsute-villous to more commonly subglabrous, abaxial surface (densely) hirsute-villous to sparsely so; petiole 0.7–2.5 cm long, stout. **Capitulescence** lateral, branches leafless, 4–28 cm long, usually racemiform-cylindrical-paniculate and columnar in aspect but sometimes becoming rounded corymbiform-paniculate, shorter than to much longer than the subtending leaf, secondary lateral branchlets few, 2–9 cm long, main axis unbranched proximally and usually longer than the 4–20-capitulate few-branched flowering portion, ultimate groups of few capitula subracemose when main axis elongated and pluricapitulate, or corymbiform in early flower, distal branchlets bracteolate, peduncles 7–10 mm long, hirsute-villous, 1(–4)-bracteolate; distal bracteoles ca. 3 mm long. **Capitula** (8–)10–13 mm long, filiform-radiate, (15–)18–23-flowered; involucre (4–)5–8 mm diam., about 2/3 as long as the fruiting disks, (cylindrical–)campanulate; phyllaries (5–)8–11, 6.5–8 × 1.5–2.5 mm, slightly reddish or purplish, strigose-villous (trichomes often short-stipitate), the broader phyllaries with margins narrower than colored mid-zone; calycular bracteoles 2–3(–5) mm long; clinanthium setose, setae 0.5–1 mm long. **Ray florets** (5–)8; corolla tube 4.5–6 mm long, limb 7–12 mm long. **Disk florets** 10–15; corolla 7–9 mm long, tube ca. 5 mm long, lobes 1–1.5(–2) mm long, moderately bulbous-papillose; anthers ca. 2.5 mm long, thecae ca. 1.5 mm long, tails ca. 0.5 mm long, smooth, filament collar ca. 0.5 mm long, appendage ca. 0.5 mm long, longer than wide; style branches 1–1.4 mm long, apex obtuse to broadly triangular, often irregularly tufted-papillose with a few papillae, papillae 0.1–0.25 mm long, the apical often the longest, but shorter than branch diam. **Cypselae** 1–2 mm long; pappus bristles 7–7.5 mm long, longer bristles at post-anthesis with distal-most cells acute-pointed, spreading.

Distribution and ecology. *Dresslerothamnus angustiradiatus*, the generitype, is the most common and widely distributed species. It was long-considered endemic to Panama, but has since been collected in Costa Rica (Pruski and Robinson 2018), and is here newly reported in Colombia, where it has been collected in Antioquia and Valle del Cauca. *Dresslerothamnus angustiradiatus* occurs from 300–1500 meters elevation, and flowers from February to June. The Costa Rican collection is from 300 meters and marks the lowest known elevation and the most northern locality. *Hampshire & Whitefoord 156* at 1500 m near Fortuna dam is the highest elevational voucher, and the collection from Valle de Cauca marks the southern limit of the species.

Representative collections. **COLOMBIA. Antioquia.** P.N. Las Orquideas, Calles, 1280–1320 m, 2 Jun 1988, *Cogollo & Ramírez 3162* (JUAM, MO). **Valle del Cauca.** Buenaventura, R.N. del Río Escalerete, 500 m, (in bud), 14 Apr 1993, *Devia et al. 3986* (F, MO; trichomes pseudostellate to short-stipitate and nearly T-shaped). **COSTA RICA**. **Limón**. 300 m, 10 Feb 1990, *Grayum et al. 9648* (CR, MO, TEX). **PANAMA**. *Croat 50008* (MO); *Hampshire & Whitefoord 156* (BM, MO, PMA); *Liesner 789* (MO); *McPherson 6990* (COL, F, MO); *McPherson 7015* (MO, NY); *McPherson 12334* (MO, US); *Valdespino et al. 645* (MO, PMA, US); *van der Werff & van Hardeveld 6537* (GH, MO, S); Cerro Pate Macho, *van der Werff & van Hardeveld 6551* (MO, NY, USM; labeled as orange-rayed).

Dresslerothamnus angustiradiatus has long-enjoyed nominal status as a Panamanian endemic, but is now documented in both Costa Rica and Colombia. The localities in Panama are basically oriented in an east-west line (as is the country) and the presence of the plant in Limon, Costa Rican collection extends the distribution only slightly further to the west. The Antioquia collection of *D. angustiradiatus* was made in Las Orquideas National Park in the northwestern Cordillera occidental, and is an expected range extension. The Las Orquideas collection is only about 240 SE of the Panamanian locality of *McPherson 7015*, which is near Cerro Pirre and about 50 km from the border with Choco, Colombia. The Valle del Cauca collection (*Devia et al. 3986*) is the southernmost of the species, but is in the Chocó biogeographic province as are plants from southern Panama. This marks the first report of the species in both Antioquia (viz Pruski & Funston 2011) and Valle de Cauca, Colombia, a is new continental record of the species, and a new generic record for Antioquia.

Dresslerothamnus angustiradiatus
(T.M. Barkley) H. Rob.
det. John Pruski (MO), 2010
MISSOURI BOTANICAL GARDEN HERBARIUM

ISOTYPE OF:
Senecio angustiradiatus Barkley
Ann. Missouri Bot. Gard. 62: 1263. 1975.
det. John Pruski, 1988

= Dresslerothamnus angustiradiatus Rob.
Phytologia 1978. 40: 493

ISOTIPO

PLANTS OF PANAMA
prov. Panamá

Senecio angustiradiatus Barkley

El Llano - Cartí highway, 10-12 km. north of El Llano; 2 March 1974.

Epiphytic woody vine; bracts wine-red, flowers yellow.

Collected by: Robert L. Dressler No. 4616

Determined by: Barkley (Ann. Mo. Bot. Gard 1975. 62: 1263

Figure 13. Isotype of *Senecio angustiradiatus* T.M. Barkley (≡ *Dresslerothamnus angustiradiatus*), generitype of *Dresslerothamnus*. (*Dressler 4616*, NY).

The species is generally recognized by its large leaves with long-stipitate pseudostellate trichomes. The trichomes are the largest in the genus. But, on occasion leaves of a single individual may have trichomes mostly short-stipitate T-shaped, with fewer pseudostellate and T-shaped ones, but otherwise (in capitulescence shape, leaf size, and pappus distal cell shape) match the species. Some atypical plants (e.g., *Valdespino et al. 645*, *van der Werff & C. van Hardeveld 6537*) have shorter, few-capitulate capitulescences, cylindrical involucres, on average fewer phyllaries (a character often used elsewhere as a species marker) and disk florets, 5 rays, shorter (7–8 mm long) ray corolla limbs, as compared to the more typical 8-rayed plants. The typical plants have longer pluricapitulate capitulescences and broader more-flowered capitula, but intermediates occur on these same specimens. Also very striking is the very dense pubescence of *van der Werff & C. van Hardeveld 6551*, collected at the same locality a day later than *6537*. In some Senecioneae genera such differences in indument density, number of phyllaries, and ray florets number are taken as species characters, but the plants in front of the author are all very similar in aspect and technical characters, and are taken here as conspecific. All but three collections known to me are from Panama, so basically the variation seen is not taken as geographically significant, and instead could be responses to micro-environmental conditions.

2. **DRESSLEROTHAMNUS GENTRYI** H. Rob., Syst. Bot. 14: 384. 1989. **TYPE: COLOMBIA. Valle del Cauca.** Bajo Calima, Juanchao Palmeras area, mature pluvial forest, 3° 55' N, 77° 02' W, 50 m, 29 Aug 1986, *Gentry & Monsalve 55603* (holotype: US; isotype: MO). Figure 11B.

Scandent vines; stems moderately hirsute-pilose; herbage with T-shaped to schizotrichoid trichomes, stipe 2–4-celled, cap cells somewhat excentrically and sometimes only partly superimposed with ends free. **Leaves** petiolate; blade 3–6.5 × 1.8–3.8 cm, ovate, subcarnose, lateral veins 2–3 per side, base broadly acute to obtuse, apex apiculate, surfaces hirsute-pilose; petiole 0.7–1.5 cm long. **Capitulescence** subumbellate-paniculate with rounded ultimate clusters of capitula, ultimate groups of (3–)5–6 capitula, subumbellate; peduncles 3–7 mm long, somewhat dense hirsute-villous, 1bracteolate; bracteoles linear. **Capitula** 11–12 mm long, filiform-radiate, ca. 23-flowered, pedunculate, weakly calyculate; involucre 5–7 mm diam., narrow-campanulate; phyllaries 8, ca. 9 × 1.5–2.5 mm, lanceolate to lance-ovate, glabrous or base weakly hirsute-pilose, mostly greenish, apex acute; clinanthium not setose. **Ray florets** ca. 8; corolla tube ca. 7 mm long, limb ca. 11 mm long, sometimes with staminodia. **Disk florets** ca. 15; corolla 9–10 mm long, tube 4–6 mm long, lobes ca. 2 mm long, shorter than throat; anthers 2–2.5 mm long, tails slightly irregular-contorted; style branch apex obtuse or triangular, evenly low-papillose or sometimes with 1–few longer somewhat tufted papillae. **Cypselae** (immature) ca. 1.5 mm long; pappus bristles ca. 8 mm long, terminal cells mostly appressed, obtuse to rounded, but not at all obviously bulbous.

Distribution and ecology. *Dresslerothamnus gentryi*, named by Harold Robinson of the Smithsonian Institutions and dedicated to Al Gentry, was the initial *Dresslerothamnus* reported in Colombia. *Dresslerothamnus gentryi* is at present known from only two collections and is a narrow endemic in the Chocó forest region at Bajo Calima, where it was collected in flower in August. One of the two Colombian collections that newly documents former Panamanian endemic *D. angustiradiatus* in Colombia is from the Bajo Calima region, the second is to the north in Antioquia. In turn, *D. gentryi* could reasonably be expected to occur also between Bajo Calima (perhaps in Choco or Antioquia) and the Panamanian frontier.

Additional collection. COLOMBIA. Valle del Cauca. Bajo Calima, along road between Buenaventura and Málaga, 40–65 m, 28 Feb 1990 (post fruit), *Croat 71030* (MO, US).

The trichomes of *Dresslerothamnus gentryi* (Fig. 11B) are similar to those of disciform-capitulate *D. schizotrichus*. In leaf size and filiform-radiate capitula, *D. gentryi* is similar to *D. peperomioides*.

3. **DRESSLEROTHAMNUS HAMMELII** Pruski, **sp. nov. TYPE: PANAMA. Bocas del Toro-Chiriquí** border. Elfin forest at divide on Chiriquicito-Calderas trail, sin. elev., 20 Apr 1968, *Kirkbride & Duke 977* (holotype: MO). [*977* was cited in Barkley (1975: 1272) and Wetter (1983: 21) as *Senecio parasiticus*, and was one of two floral microcharacter vouchers cited by Wetter as *Pentacalia*]. Figures 6B, 14–18.

Suffrutex volubilis; caules glabri vel distale valde puberuli; folia simplicia alterna petiolata, lamina 2–5 × 0.7–2 cm elliptico-ovata subcarnosa concolora pinnatim venosa glabrata vel puberula basi cuneata margine integra vel crenulata concolorata, petiolo 0.7–1.4 cm longo; capitulescentia 4–7 × 6–9 cm terminalis late corymbiformis; pedunculi 1–8 mm longi; capitula heterogama disciformia 9–10 mm alta; involucrum 2–3 mm diam. cylindricum; phyllaria 5–6, 6.5–7.5 × circiter 1 mm lanceolata glabra; flosculi pistillati circiter 5, corolla 5–6.5 mm longa tubulosa luteola lobis 4–5 circiter 1.5–2 mm longis lanceolatis; flosculi disci 5–6, corolla 6–7 mm longa infundibuliforma luteola glabra, tubo et limbo subaequalia lobis 5, 1.5–2 mm longis lanceolatis; antherae 2.2–2.5 longae caudatae, collum basi anguste dilatatum appendicibus apicalibus anguste lanceolatis; styli rami 1.2–1.5 mm longi breviter appendiculati papillae 0.1–0.2 mm longae, areis stigmaticis discretis; cypselae 1.3–2.2 mm longae circiter 5-costatae glabrae; setae pappo 5–5.5 mm longo.

Scandent vines; stems glabrous to puberulent distally, apparently solid, flowering stems leafy to near apex; herbage with brownish, multistoried, 2-armed T-shaped trichomes with cap cells sometimes variously shaped, stipe of each type 5–6 annular-celled, shorter than arms, cap cells usually 2, centric to somewhat excentric, arms superimposed throughout, ranging from relatively thick, either bulbous-inflated and reflexed thereby partly obscuring stipe to more commonly cap cells thinner and laterally spreading often parallel to leaf or stem epidermis, arms infrequently minute (or broken) and the naked trichome stipe falsely resembling simple trichomes or stipitate glands. **Leaves** petiolate; blade 2–5 × 0.7–2 cm, elliptic-ovate, subcarnose, venation pinnate, lateral secondary veins 2–4 per side, forward-directed, tertiary venation indistinct, base cuneate, margins subentire to paucicrenulate, apex acute(obtuse), surfaces more or less concolorous, glabrous to sparsely puberulent; petiole 0.7–1.4 cm long, moderately slender. **Capitulescence** 4–7 × 6–9 cm, broadly corymbiform, 15–30+capitulate, somewhat open, rounded on top with lateral branches ascending and nearly over-topping central axis, leafless, held above stem leaves, main lateral branches to 6 cm long, much longer than the subtending bracteate leaves, distal branches and branchlets drying terete; peduncles 1–8 mm long, puberulent. **Capitula** disciform, 9–10 mm long, 10–11-flowered; involucre 2–3 mm diam., cylindrical; phyllaries 5–6, 6.5–7.5 × ca. 1 mm, glabrous; clinanthium ca. 0.7 mm diam., enate, enations 0.1–0.2 mm long. **Ray florets** absent. **Marginal florets** ca. 5; corolla 5–6.5 mm long, actinomorphic, tubular, yellow, lobes 4–5, 1.5–2 mm long. **Disk florets** 5–6; corolla 6–7 mm long, funnelform, yellow, glabrous, tube 3.5–4 mm long, throat ca. 1 mm long, lobes 1.5–2 mm long, lanceolate, longer than throat; anthers 2.2–2.5 mm long, narrowly balusterform, with enlarged basal cells; style branches 1.2–1.5 mm long, stigmatic lines separated by a very narrow groove, apex obtuse to broad triangular, short-appendiculate, papillae 0.1–0.2 mm long. **Cypselae** 1.3–2.2 mm long, ca. 5-costate, glabrous; pappus bristles 5–5.5 mm long, many, distal-most cells acute-pointed, somewhat spreading.

Distribution and ecology. *Dresslerothamnus hammelii* is endemic to western Panama, and known from only three sympatric collections (Fig. 16). It occurs in elfin and dwarf cloud forests near Cerro Pate Macho (Cerro Pata de Macho), near the Bocas del Toro-Chiriquí borders. The localities are about 40 km east of Volcán Chiriquí (Volcán Barú). The type locality is near Fortuna Dam, and the two paratypes from Cerro Pate Macho were collected only about 15 km to the west of the type locality. *Dresslerothamnus hammelii* has been collected at (1646–)2164 meters elevation, and flowers from November to April.

Figure 14. Paratype of *Dresslerothamnus hammelii* Pruski. (*D'Arcy et al. 12637*, MO).

Figure 15. Paratype of *Dresslerothamnus hammelii* Pruski, disciform capitula with narrow involucre of five phyllaries. (*D'Arcy et al. 12637*, MO).

Paratypes. PANAMA. Bocas del Toro-Chiriquí border. Forest along trail from end of Río Palo Alto road, near peak of Cerro Pate Macho, 7100 ft [2164 m], 20 Nov 1978, *Hammel 5778* (MO). **Chiriquí.** Between Palo Alto and top of ridge (divide) near Cerro Pate Macho, above Río Palo Alto, NE of Boquete, 5400–7100 ft. [1646–2164 m], 18 Mar 1979, *D'Arcy, Hammel & Averett 12637* (MO; voucher of photographs used).

Eponymy. The epithet of *Dresslerothamnus hammelii* honors Barry E. Hammel, collector of the two paratypes. Barry Hammel is well-known for his taxonomic work in Clusiaceae and as co-editor of the "Manual de Plantas de Costa Rica."

Dresslerothamnus hammelii is an elfin forest species collected at about (1646–)2164 meters elevation. It is characterized by disciform capitula (Fig. 15), 5–6 phyllaries, and multistoried T-shaped trichomes with cap cell arms fully superimposed throughout. The lateral flowering branches of *D. hammelii* are elongate, ascending, nearly overtop the central axis, and the relatively small capitulescence is overall moderately open and round-topped. The leaves are weakly pubescent, but the stems appear nearly heterotrichous with extreme forms of a few scattered trichomes that are large and thick-armed (Fig. 17A) to many smaller and thin-armed trichomes (Fig. 17B), but with intermediate forms linking these extremes. I do not know if the extremes in trichome morphologies are ontological, in response to damage or environmental conditions, or because material was pressed in EtOH. Often, the nature of the trichomes in *D. hammelii* are difficult to discern, and as alluded to below it seem likely that material of this species may pass at times as *Pentacalia.* Indeed, both Barkley (1975) and Wetter (1983) cite the holotype as *S. parasiticus* (now *Pentacalia parasitica*), which I exclude from Panama. In any event, *D. hammelii* becomes the fifth species attributed to *Dresslerothamnus.*

Dresslerothamnus hammelii is similar to Costa Rican *D. schizotrichus* by similar-sized disciform capitula, but differs by geography and T-shaped (vs. schizotrichoid) trichomes. *Dresslerothamnus hammelii* has leaves similar-sized (although obtuse to round-tipped) to Panamanian *D. peperomioides*, but the Robinson species differs obviously by radiate capitula. The two other species of *Dresslerothamnus*, *D. angustifolia* and *D. gentryi*, seem only moderately similar to *D. hammelii.*

By the similar-sized disciform capitula and similar size-leaves, I have also mistaken the new species for the similar-in-gestalt and partly sympatric *P. candelariae.* For example, the imperfect *Hammel 6290* was cited in haste by Pruski and Robinson (2018) as *D. hammelii*, but this collection fits better within the broadly defined *P. candelariae. Dresslerothamnus hammelii* differs from *P. candelariae* by having 5–6 (vs. 7–8) phyllaries and by T-shaped (Fig. 17) (vs. simple merely slightly curled-coiled, viz Fig. 10D) trichomes, albeit the trichomes are often not well-preserved in herbarium material. Also, in *P. candelariae* the distal flowering branches tend to be very flattened as in the imperfect material. The trichomes in *P. candelariae* are simple, crisped, darker, and much thinner (Fig. 10D) than in the new species, but in the imperfect material the trichomes are mostly damaged, and generic disposition unresolved. Nevertheless, imperfect material (*D'Arcy 11343*; *Folsom & Robinson 2398*; *Hammel 6290*) from 800–1066 meters elevation in cloud forests flowering in March and April in Coclé, some 200 km to the east of *D. hammelii* localities, appears to be disciform and recalls *D. hammelii.* Although many trichomes in the Coclé plants seem damaged, others seem crisped, and imperfect materials from Coclé are provisionally referred to in *P. candelariae.*

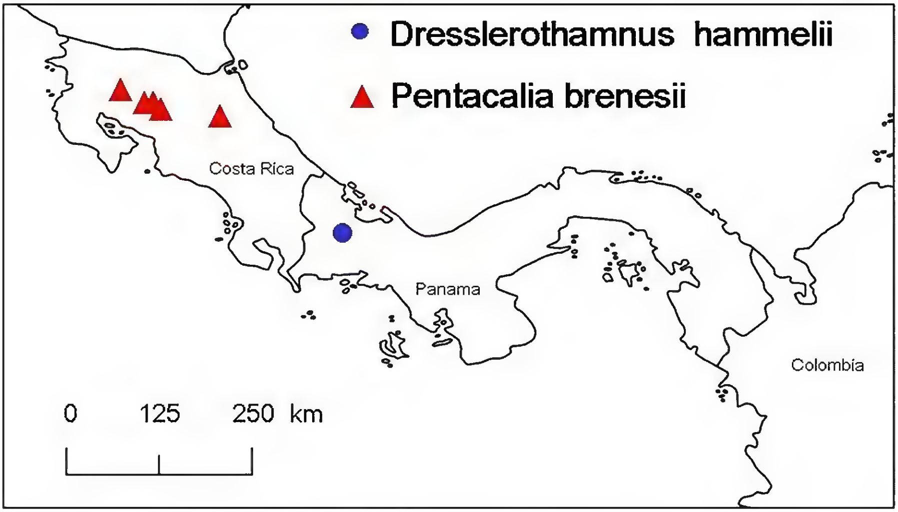


Figure 16. Distributions of *Dresslerothamnus hammelii* and *Pentacalia brenesii.*

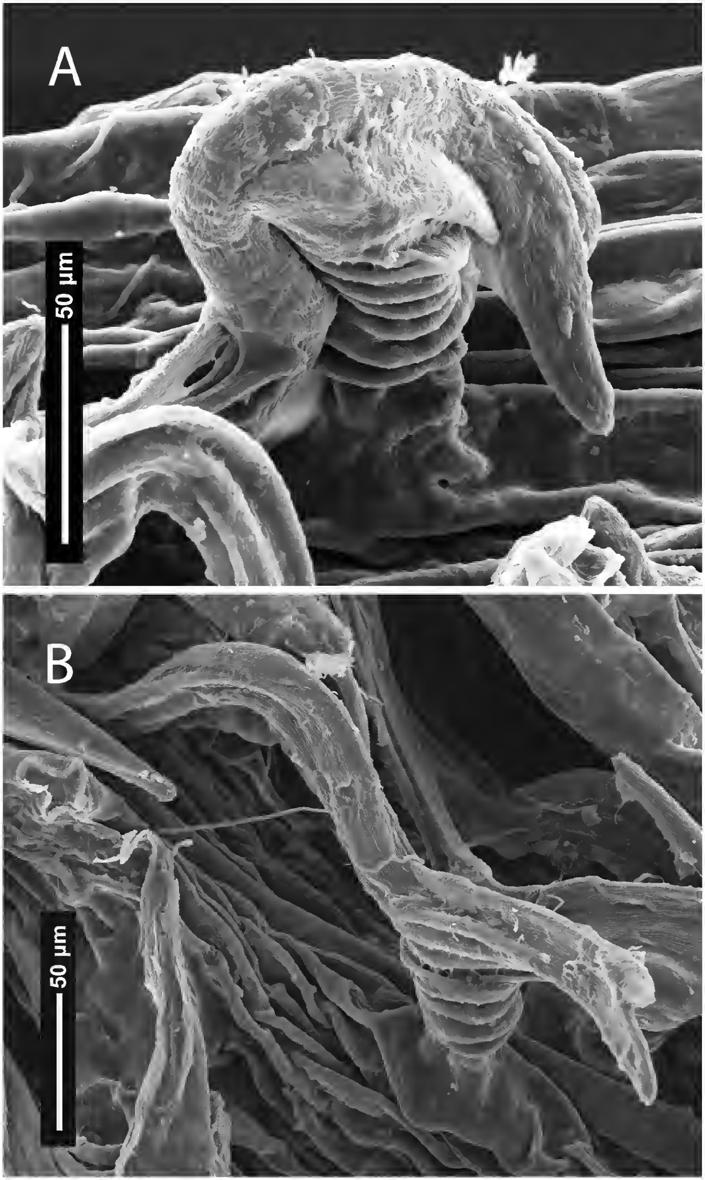


Figure 17. Variation in T-shaped trichomes on peduncle of *Dresslerothamnus hammelii* showing pluricelled stipes and 2-celled caps with arms superimposed. A. Cap cells centric and arms down-turned; under the dissection scope this relatively uncommon trichome type appears as a dark bump. B. Cap cell arms excentric and directed laterally; trichomes very abundant and light-colored. (From the holotype, *Kirkbride & Duke 977*, MO).

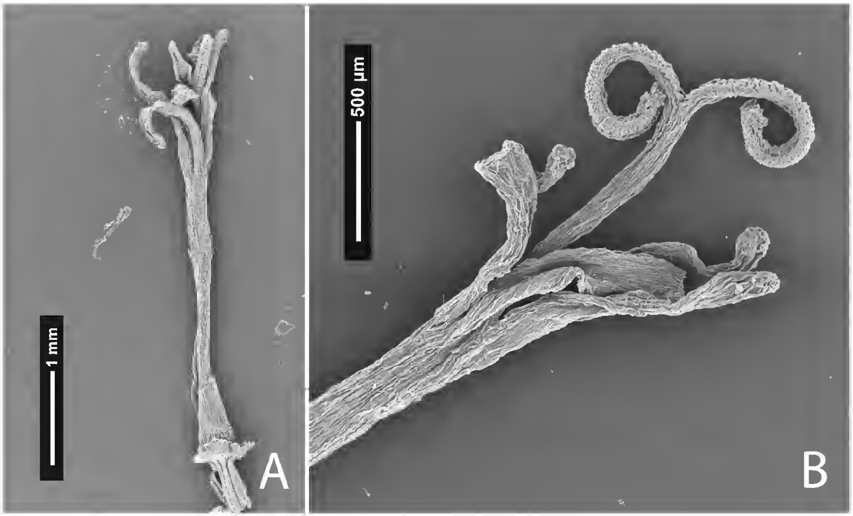


Figure 18. Marginal pistillate florets of *Dresslerothamnus hammelii*. The corollas are tubular but slightly asymmetric. (From the holotype, *Kirkbride & Duke 977*, MO).

4. **DRESSLEROTHAMNUS PEPEROMIOIDES** H. Rob., Syst. Bot. 14: 386. 1989. **TYPE: PANAMA. Chiriquí.** Fortuna Dam watershed, above Rio Hornito, 8° 45' N, 82° 15' W, 1250 m, 1 Jul 1987, *McPherson 11160* (holotype: MO). Figures 11C, 19.

Scandent vines; stems hirsute-pilose with T-shaped trichome arms mostly upturned, brown, herbarium specimens mostly of leafy-bracteate lateral flowering branches that are thin and seem to have a solid pith, sometimes leafless larger stems also present on specimens; herbage with brownish trichomes with cap cells superimposed and in a single plane to sometimes slightly oblique-spirally oriented as seen from above and with ends free, arms mostly to ca. 5 mm long with shorter ca. 1 mm long stipes, but stems of *Sullivan 361* with many trichomes with stout stipes to 7 mm long, stem trichomes 2(–4)-armed, cap cells often excentric, superimposed and in single plane or sometimes oblique, cap cell arms commonly upturned (at least in dried material) and trichomes in turn Y-shaped, leaf trichomes very short-stipitate, mostly 2-armed, cap cells centric, in a single plane, often close to surface, T-shaped trichomes, and indument appearing strigose. **Leaves** petiolate; blade 1.5–4(–5) × 1–2.5(–3) cm, ovate to suborbicular, subcarnose, lateral veins 1–2 per side, base obtuse to subtruncate, apex broadly obtuse to rounded, surfaces strigose to sparsely pilosulose; petiole 0.6–2.5 cm long. **Capitulescence** (narrowly) subumbellate-paniculate with rounded ultimate clusters of capitula, main lateral branches 15–30 cm long, bracteate-leafy proximally, 20–30-capitulate, branches and branchlets brown, straight; secondary lateral branchlets 2–4 cm long, ultimate groups of 4–8 capitula subumbellate with proximal peduncles noticeably elongate but not over-topping distal peduncles; peduncles 3–9 mm long, hirsute-villous, ca. 3-bracteolate; distal bracteoles ca. 2 mm long. **Capitula** 9–12 mm long, filiform-radiate, 10–13-flowered, pedunculate; involucre 2.5–3.5(–4) mm diam., nearly as long as the disk florets, cylindrical, base sparsely pilosulose; phyllaries usually 8, (6.5–)7–8.5 × 1–1.6(–2.1) mm, lanceolate, glabrous for most of their length, the broader phyllaries with margins subequal in diam. (infrequently much narrower) to purplish-reddish colored mid-zone, apex acute to acuminate; clinanthium somewhat setose-squamellose, setae-squamellae ca. 0.5 mm long, bordering alveolate; calycular bracteoles ca. 2 mm long, linear to linear-lanceolate. **Ray florets** 5; corolla tube 3.5–4 mm long, limb 4–7 mm long, often damaged. **Disk florets** 5–8; corolla 7.5–8 mm long, tube ca. 4 mm long, lobes 1.3–1.9 mm long, shorter than throat, weakly papillose, often spreading post-anthesis and exposing half or more of the anther, but anthers not fully exserted and collar not visible; anthers yellow, 2.5–3 mm long, tails straight; style branch apex broadly obtuse, with short semicircle or crown of few papillae 0.1–0.2 mm long. **Cypselae** 1.2–2.5 mm long, carpopodium sometimes to 0.2 mm long; pappus bristles 5–7.5 mm long, longer bristle terminal cells mostly appressed, obtuse (sometimes obviously bulbous in budding capitula).

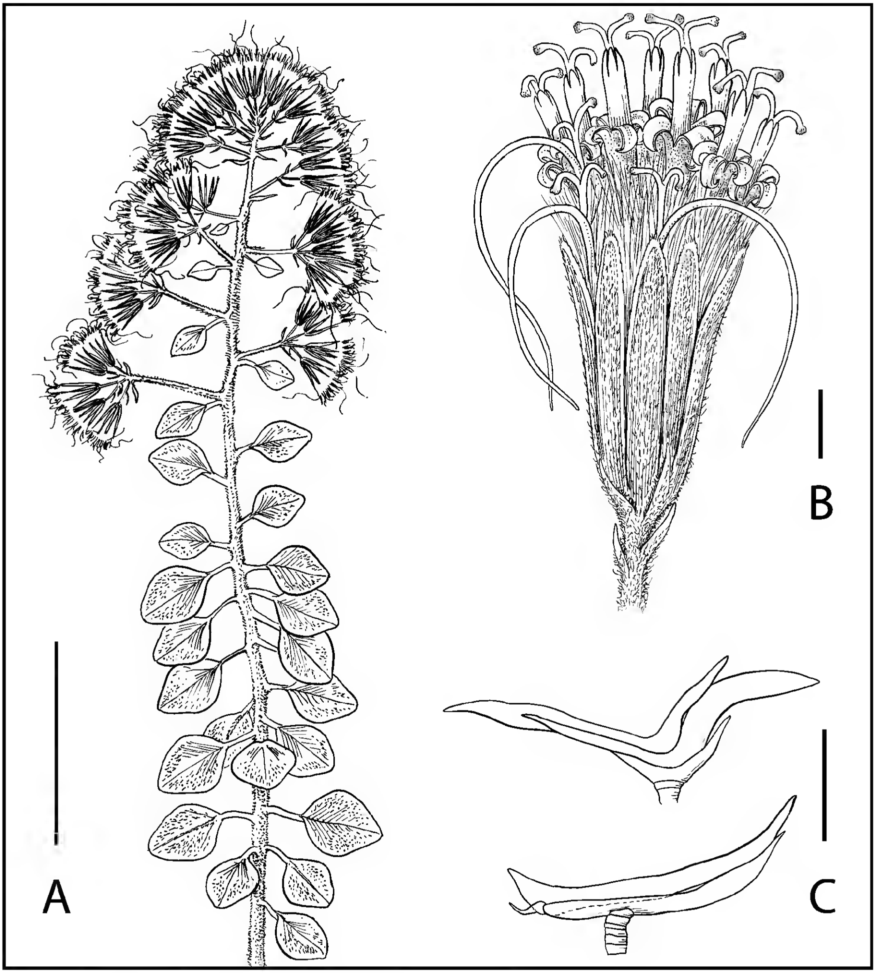


Figure 19. Drawing of holotype of *Dresslerothamnus peperomioides*. A. Leafy lateral flowering branch with subumbellate capitula. B. Capitulum showing subequal phyllaries, filiform ray corolla limbs, and anther cylinders and styles exserted from disk florets. C. Multistoried T-shaped foliar trichomes with arms superimposed, stipe many annular-celled, cap cells unicellular, excentric, arms in a single plane. (*McPherson 11160*, MO; drawn by Alice Tangerini, modified from Robinson 1989 fig. 2). [Scale bars: A 5 cm, B 2 mm, C 0.2 mm].

Distribution and ecology. *Dresslerothamnus peperomioides* is endemic to Panama (Chiriquí and Darién). The species was described by Robinson (1989) as then known from only the type, but is now known to me from seven collections. Several collections are from near Fortuna Dam (the type locality), but the initial collections of the species appear to be the two collections made on 15 July 1976 on Cerro Colorado, some 60 km to ESE of the Fortuna site. The recent Flores collection was made on Cerro Chucanti, in Darién very near the border with Panama; it extends the known range of the species 400+ km to the east. *Dresslerothamnus peperomioides* is found from 900–1600 meters elevation, and flowers from March to September.

Collections examined. **PANAMA**. **Chiriquí.** *Correa et al. 2241* (MO, PMA); *Croat 37239* (MO, US); *Folsom et al. 5356* (MO); *McPherson 12848* (F, K, KSC, MO, US); *Sullivan 361* (MO). **Darién.** *Flores & Morales 577* (MO).

Most collections known to me of this small-leaved species date from the 1970s and 1980s, with two of these collections originally determined as *P. streptothamna*, a species very similar in gestalt. Further regional plants with similar aspects are *P. candelariae*, *D. hammelii*, and *D. schizotrichus*. *D'Arcy et al. 12637*, a paratype of similar-sized-leaved but disciform *Dresslerothamnus hammelii* Pruski, for example, was initially misdetermined by the author as *D. peperomioides*. These four near look-alike but different plants mostly differ from filiform-radiate *D. peperomioides* by disciform capitula, or in the case of *P. streptothamna* by broader ray corolla limbs. Other distinctions include the simple trichomes in the Pentacalias and the sessile ultimate capitula and pointed terminal pappus cells in *D. schizotrichus*.

Dresslerothamnus peperomioides is similar to Colombian *D. gentryi* H. Rob. by gestalt, filiform rays, and appressed obtuse or rounded apical pappus cells, albeit these almost bulbous in *D. gentryi*. *Dresslerothamnus peperomioides* differs from *D. gentryi* by 1–4(–5) cm long round-tipped (vs. 3–7 cm long acute-tipped) leaf blades, purplish-reddish (vs. green) phyllaries, and five (vs. eight) ray and 5–7 (vs. 10–15) disk flowers per capitulum.

5. **DRESSLEROTHAMNUS SCHIZOTRICHUS** (Greenm.) C. Jeffrey, Kew Bull. 47: 64. 1992. *Senecio schizotrichus* Greenm., in Standley, Flora of Costa Rica, Publ. Field Mus. Nat. Hist., Bot. Ser. 18: 1518. 1938. **TYPE: COSTA RICA. San José.** Vicinity of El General, 975 m, Jan 1936, *Skutch 2502* (holotype: MO; isotypes: K, MICH, NY, US). [The Compositae introduction in Standley (1938: 1419) stated that Greenman supplied three new species descriptions]. Figures 3A, 20–21.

High climbing liana; stems densely villous-strigose, grayish-brown, fistulose, sometimes nodally deflected distally; herbage grayish with schizotrichoid trichomes, trichomes short-stipitate multistoried 4–8-armed trichomes (often damaged or poorly preserving), cap cells 2–4, unequally elongated (excentric), only partially superimposed as seen from above and with ends free, cap cell arms sometimes curved, often parallel to stems and leaf epidermis but sometimes upturned or ascending. **Leaves** moderately petiolate; blade 3.5–9.5 × 1.5–5.5 cm, elliptic-lanceolate to elliptic, subcarnose but drying as though chartaceous (herbarium material sometimes becoming brittle and fragmenting), lateral secondary veins 5–7 per side, third order veins slightly visible as well, base cuneate to obtuse, margins sometimes drying crenulate or at least when damaged appearing crenulate, apex acute(obtuse), surfaces hirsute-villous to sparsely so; petiole 0.7–1.2 cm long, moderately slender. **Capitulescence** corymbiform-paniculate, subcylindrical or narrow-pyramidal, distal few nodes of main axis deflected at nodes or straight, main lateral branches 4–14 cm long, slightly longer than the main axis subtending leaves, 10–40+capitulate, lateral branches leafless but branchlets each subtended by axially linear-lanceolate bracteoles, branches and branchlets griseous-villosulous; secondary lateral branchlets ≤ 2 cm long, columnar in aspect, ultimate three capitula sometimes in subsessile clusters, but irregularly ternate or short-pedunculate and racemiform; peduncles 1–4 mm long, hirsute-villous, 1–3-bracteolate; distal bracteoles 2.5–7 mm long. **Capitula** (in early anthesis) disciform, 9–12 mm long, 22–25-flowered; involucre 3.5–4 mm diam., cylindrical-turbinate; phyllaries usually 8, 6.5–8 × 1.5–1.8 mm, rarely a few connate to near apex, puberulent, the broader phyllaries with margins slightly narrower than colored mid-zone; clinanthium enate-setulose, enations-setulae 0.1–0.2 mm long; calycular bracteoles 2.5–4 mm long, narrowly linear-lanceolate. **Ray florets** absent. **Marginal florets** 5–6; corolla 4–6 mm long, actinomorphic, tubular-funnelform, yellow, tube 3–5 mm long, lobes 4–5, ca. 1 mm long. **Disk florets** 17–19; corolla (4–)5–6(–7.5) mm long, tube 2–3.8 mm long, lobes 1–1.4 mm long, weakly papillose; anthers ca. 1.5 mm long, collar ca. 0.5 mm long, tails ca. 0.2 mm long, less than half as long as the collar, appendage narrowly lanceolate, apex obtuse; style branches 1–1.4 mm long, apex nearly truncate, with only a few spreading distal papillae ca. 0.1 mm long in an abaxial semicircle, no central tuft seen. **Cypselae** (immature) ca. 1 mm long; pappus bristles (3.5–)4.5–6(–6.5) mm long, longer bristle distal-most few cells very slightly spreading and not as long as bristle width, broadly acute-pointed.

Distribution and ecology. *Dresslerothamnus schizotrichus* is endemic to Costa Rica, where it flowers in January and February from 975–1500 meters elevation. I know the species with certainty from only the two collections cited here.

Additional collection. COSTA RICA. Cartago. Between 2–4 km SW of Muñeco on steep slopes of remnant forest and pasture above Río Sombrero, 1500 m, 25 Feb 1978, *Utley 5858* (MO).

The schizotrichoid trichomes of *Dresslerothamnus schizotrichus* have 2–4 variously superimposed cap cells, thereby showing up to eight radiating arm tips. When dry, the arms may shrivel irregularly, curve, become variously directed, and as distorted they may appear to be slightly stellate, serrate, or divided. The trichomes of *D. schizotrichus* thus are very different in aspect from those of the common *D. angustiradiatus*, which has arms free and decussate. Instead, the trichomes of *D. schizotrichus* are more similar to those occasionally seen in Colombian *D. gentryi* (Fig. 11B; Robinson 1989 fig. 2B) and *Urostemon kirkii* (Hook. f. ex Kirk) B. Nord. (viz Drury 1973a fig. 1G; Nordenstam 1978 fig. 16N), the latter from New Zealand.

This species was described in the protologue as discoid, and was long known from only the type. An additional collection from Costa Rica (*Utley 5858*) distributed as *Senecio candelariae*, however, in SEM study (Fig. 20C) proves to be *D. schizotrichus*. The two known localities are in central Costa Rica and about 50 km apart. Another collection (*Salas et al. 185* n.v.) in the Tropicos database may be this species (as determined by Alex Rodríguez in 2015) or the similar *P. candelariae*. Among the type specimens of *D. schizotrichus*, some have the stem apex nodally deflected (zig-zag), whereas in *Utley 5858* and some type material the stems are straight.

Dresslerothamnus schizotrichus further differs from *D. gentryi* by its smaller disciform (vs. filiform–radiate) capitula and by pointed (vs. obtuse to rounded) apical pappus cells. The similarity in trichome types of filiform-radiate *D. gentryi* and disciform *D. schizotrichus*, supports Jeffrey's (1992a) inclusion of *D. schizotrichus* in the genus. The broader circumscription of *Dresslerothamnus* by Jeffrey (1992a) is further supported here by discovery of disciform *D. hammelii*, which has T-shaped trichomes, and serves to link the two disciform species to three radiate *Dresslerothamnus* sensu Robinson (1989).

The two cited collections of *Dresslerothamnus schizotrichus* have abaxial leaf blade trichomes with moderately long stipes, and the schizotrichoid nature of the trichomes apparent in SEM studies (Fig. 20). It seems possible that further collections are similarly filed in herbaria as either *Pentacalia* or *Senecio*, as was the Utley collection. Moderately similar-in-leaf-size Costa Rican material mostly from volcanoes of disciform-capitulate *P. candelariae* with damaged trichomes resembles *D. schizotrichus*, but the *Dresslerothamnus* differs by petioles and abaxial leaf blade surfaces that are denser pubescent and by non-fascicled capitula. In general, the trichomes of Pentacalias are often thin, elongate terminal cells, whereas the trichome arms in species of *Dresslerothamnus* are thicker, relatively short, thereby helping distinguish the genera.

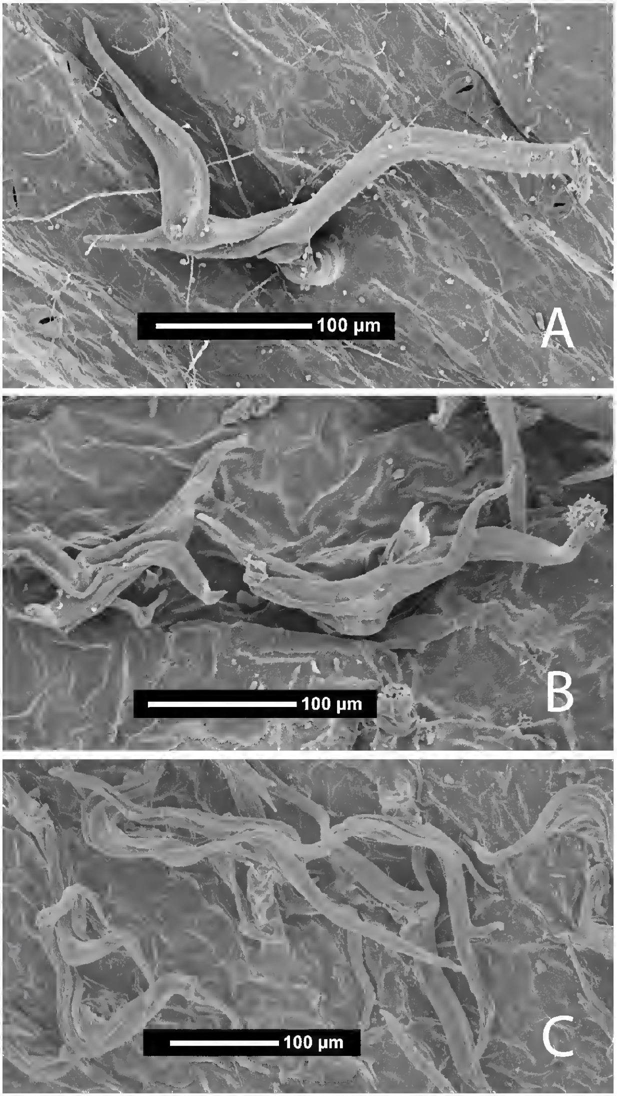


Figure 20. Schizotrichoid trichomes of abaxial leaf surfaces of *Dresslerothamnus schizotrichus*. The 2–3 cap cells are excentric, unequal, and only partly superimposed. The stipes are relatively short and few-celled. The trichome in A is moderately well-preserved; trichomes in B–C are poorly preserved, and grotesquely disfigured. (A–B from the holotype, *Skutch 2502*, MO; C *Utley 5858*, MO).

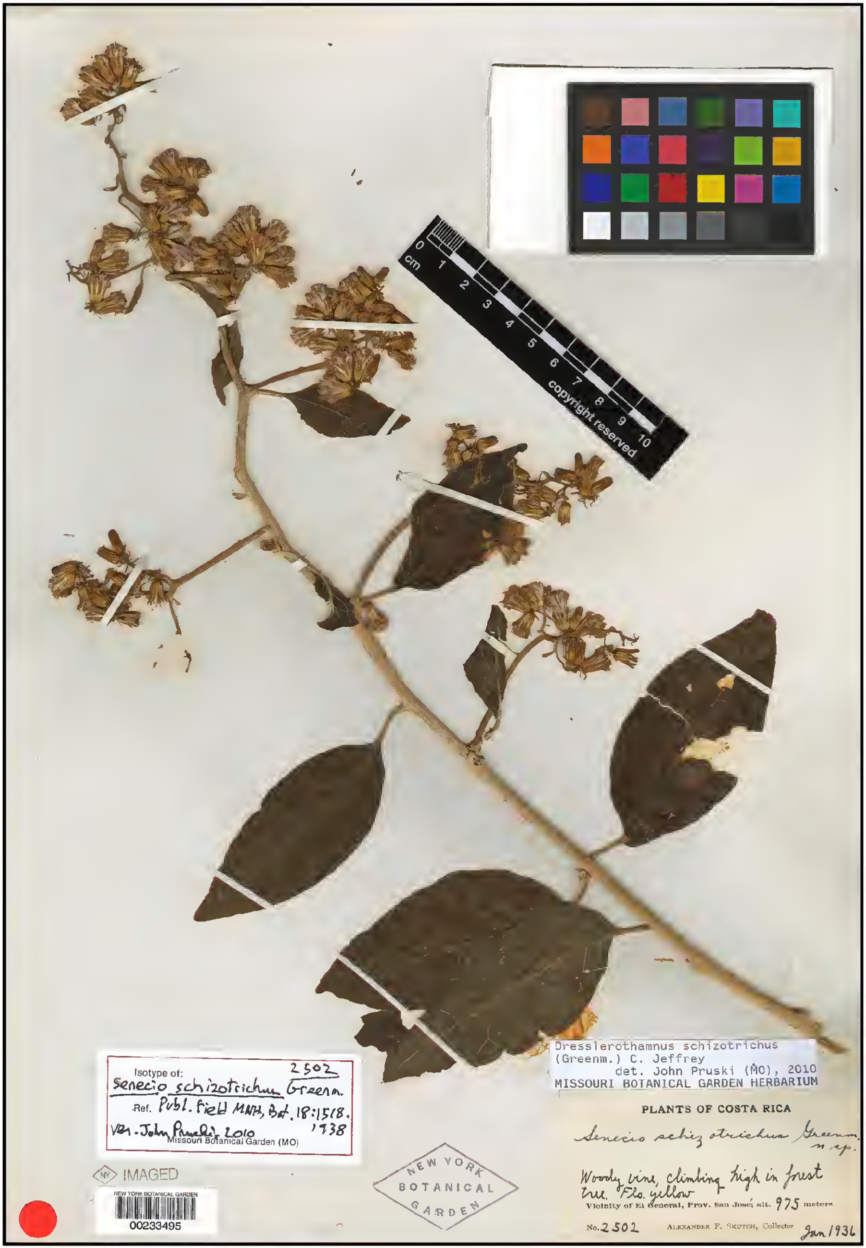


Figure 21. Holotype of *Senecio schizotrichus* Greenm. (≡ *Dresslerothamnus schizotrichus*), showing stems deflected at distal nodes. (*Skutch 2502*, MO).

PENTACALIA Cass. in F. Cuvier (ed.), Dict. Sci. Nat. (ed. 2) 48: 449, 461, 466. 1827. **TYPE:** *Cacalia arborea* Kunth (≡ *Pentacalia arborea* (Kunth) H. Rob. & Cuatr.).

Senecio sect. *Streptothamni* Greenm., *Senecio* sect. *Triana* Cuatr.

Scandent to climbing woody vines, often with long hanging-pendent flowering branches with the leaves upside-down or upturned; stems subterete, pubescent or glabrous, leaves mostly in distal half but often not greatly decrescent, distal internodes often shorter than leaves; herbage with simple trichomes when pubescent, sometimes obliquely appendaged but appendage thin-walled. **Leaves** simple, alternate or rarely opposite, petiolate or rarely sessile; blade generally elliptic to ovate, sometimes oblanceolate or obovate, subcarnose to less commonly chartaceous or coriaceous, venation typically pinnate with secondary veins forward-directed, infrequently (the generitype group) secondaries at nearly right angles to midrib, margins usually entire or when serrate the serrations regular, our eglandular. **Capitulescence** terminal (on main axis or on elongated branches much longer than main stem leaves) or less commonly axillary on branches shorter than subtending leaves, pluricapitulate to less frequently paucicapitulate, generally corymbiform-paniculate, often pyramidal to rounded or flat-topped, less commonly cylindrical, not usually leafy with specialized large primary bracts. **Capitula** nearly always heterogamous (radiate or disciform), some South American species consistently homogamous-discoid, usually (5–)11–64-flowered, not nutant, subsessile or more commonly pedunculate; involucre 1-seriate, typically calyculate; phyllaries commonly 5–13, subequal, free, rarely strongly connivent to near apex, usually stiff, median abaxial surface with nerves well-embedded, without evident nerves or costae, often with narrowly scarious (outer) ones alternating with broadly scarious-margined (inner) ones, slightly to moderately spreading in fruit; calycular bracteoles usually small and subglabrous, typically less than half the length of involucre (rarely obviously calyculate with calycular bracts as long as involucre or even white-lanate-tomentose calycular bracts and then about half as long as involucre); clinanthium solid, flat, epaleate, often shortly cristate. **Ray florets** (when present) usually (1–)4–14, pistillate, corolla sometimes quickly deciduous; corolla commonly yellow, glabrous, tube and limb often subequal, limb weakly to moderately exserted, usually lanceolate or elliptic-lanceolate to oblong or obovate, usually 4(+)-nerved and about as wide as phyllaries, infrequently linear-lanceolate, 2-nerved, and obviously narrower than phyllaries. **Pistillate marginal florets** (when disciform) usually 1–8, often shorter than and held within involucre; corolla tubular-funnelform; shortly symmetrically 3–5-lobed, flattened radiating limb absent, or very rarely corollas pseudobilabiate and florets with staminodia. **Disk florets** usually (4–)7–50, bisexual, 5-merous; corolla campanulate or more commonly funnelform and often much-elongated at maturity, commonly yellow, glabrous, tube base usually dilated around stylopodium at maturity, lobes longer than wide, sometimes with a medial resin duct; anthers stramineous, filament collar balusterform (swollen), with enlarged basal cells, thecae caudate (not rounded), tails usually shorter than collar, apical appendage oblong and sometimes thick-margined; style exappendiculate or seldom somewhat appendiculate, base nodular, held above basal nectary on stipe, branches with paired stigmatic lines, papillae isomorphic, adaxially without distal papillae arising between stigmatic bands, abaxially with gradually diminishing collecting papillae, apices mostly truncate or obtuse, sometimes triangular, smooth to slightly papillose with short apical tuft or peripheral semicircular fringes of relatively small papillae shorter than branch diam., apices never long-comose. **Cypselae** obconic, subterete, tardily maturing and in capitula of herbarium specimens, often more or less collapsed, 5-costate at maturity (but mature fruits infrequently seen), pericarp with rectangular and hexagonal crystals (Fig. 3B), ribs sometimes decurrent onto carpopodium, glabrous or rarely long-pilose near base; carpopodium symmetric-annular, moderate-sized, broader than cypsela base, with a narrow distal rim; pappus bristles of rays and disks similar, many, 1(–2)-seriate, white to stramineous (rarely pinkish), scabridulous to barbellate, about as long as the disk corollas, apex usually evenly narrowed. $x = 20, 40$ (viz Robinson et al. 1997; higher counts reported by them as *Pentacalia* prove instead to be for species of *Dendrophorbium*).

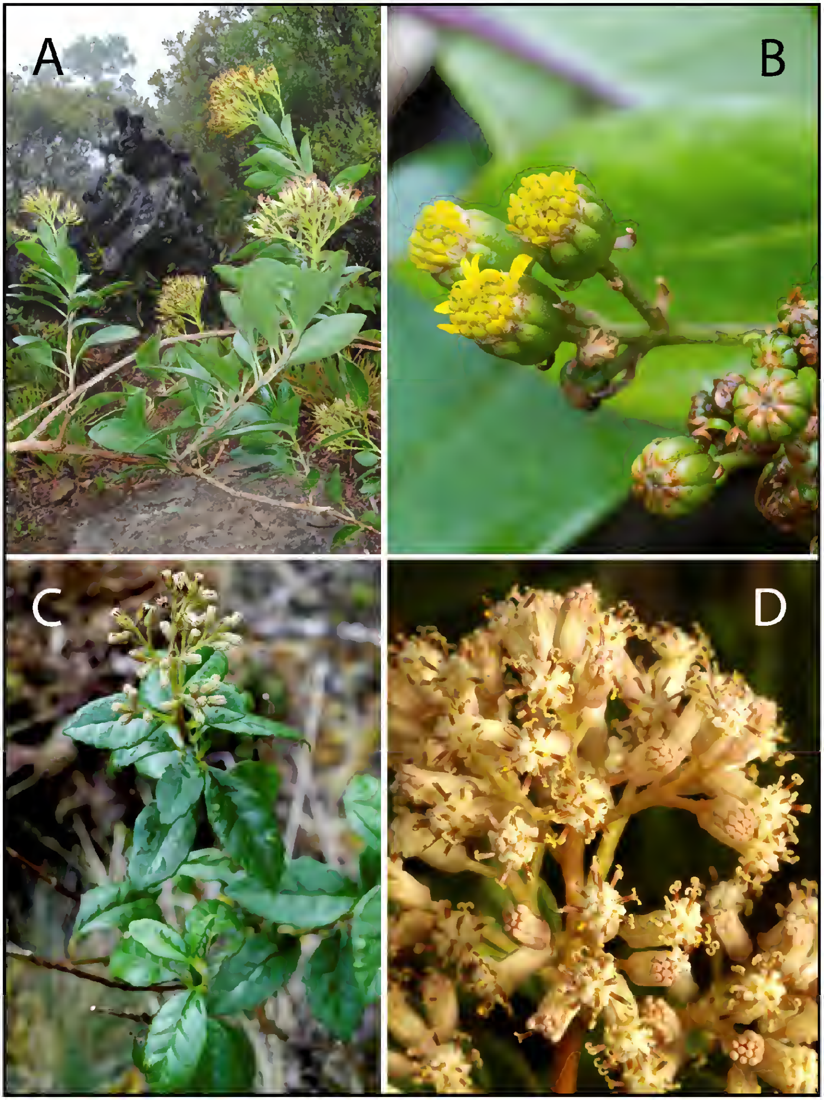


Figure 22. Habit, leaves, terminal capitulescences, and corolla colors in *Pentacalia*. A. *Pentacalia wilburii*, showing vining habit, subcoriaceous, entire-margined leaves with immersed, arching secondary veins, and post-anthesis capitulescences with cylindrical capitula. B. *Pentacalia morazensis*, capitulescence showing short-radiate, broadly campanulate capitula with eight phyllaries and yellow corollas. C. *Pentacalia phanerandra*, pre-anthesis flowering branch showing the chartaceous, pinnately veined, denticulate leaves. D. *Pentacalia phanerandra*, capitulescence showing disciform, broadly cylindrical capitula with white corollas. (A *Santamaría & Monro 8848*, photograph by Alex Monro; B *Stevens et al. 32812*, photograph by Olga Martha Montiel; C–D *Monro & Knapp 5175*, photographs by Alex Monro).

Pentacalia is a speciose (about 130 species) neotropical segregate of *Senecio*, distinguished from *Senecio* by its vining habit (Figs. 5B, 22A, 22C), typically subcarnose leaf blades with arching-pinnate or immersed secondary venation (Figs. 5B–D, 22A, 32), caudate anthers (Fig. 1D), and 5-costate glabrous cypselae (Fig. 8A). However, in herbarium material of *Pentacalia* the cypselae are nearly always immature and not clearly 5-costate (viz Barkley 1990). The usually immature cypselae of *Pentacalia*, consequently, slow determinations and limit pericarp surface detail studies. *Pentacalia* resembles *Senecio* by its herbage with simple trichomes (Figs. 10D, 24) and typically truncate exappendiculate styles (Fig. 2D). Most Pentacalias are South American forest-dwellers with long-pendent flowering branches and yellow flowers. The generitype and a small species group are characterized as often vining shrubs with hanging vine-like branches and having discoid capitula with white corollas (Figs. 22C–D, 23). Here the 12 Mesoamerican species are treated, with microscopic images and specimen photographs supplementing the treatment. Four species of *Pentacalia* occur in Mexico (Villaseñor 2016), two of these, *P. guerrerensis* (T.M. Barkley) C. Jeffrey and *P. venturae* (T.M. Barkley) C. Jeffrey, are extra-Mesoamerican (not present in Chiapas or the Yucatan) and not treated here.

The vining habit and gestalt are basically as useful in recognizing *Pentacalia* as are floral microcharacters. For example, truncate to short triangular style branches, caudate anthers, and solid clinanthia are each useful in helping circumscribe *Pentacalia*, but none are diagnostic. In Mesoamerica, *Pentacalia* ranges from mostly having truncate style branches (Fig. 2D) typical of *Senecio* (Fig. 2F), to triangular style branches (Fig. 2B) more typical of *Dresslerothamnus* (Fig. 2C). Nevertheless, *Pentacalia* is maintained as generically distinct from them. The triangular moderately papillose style branch apex seen in *P. brenesii* (Fig. 2B) and in some South American species recalls *Lasiocephalus*, *Ortizacalia* (Fig. 2A), and *Dresslerothamnus* (Fig. 2C), but Pentacalias never have style apices with dimorphic papillae, stout-comose appendages longer than the branch width, nor do they have distal papillae between the stigmatic bands. Most Pentacalias have anther tails shorter than the filament collar (Fig. 1D), but on occasion (e.g., *P. wilburii*) the tails are obviously longer than the filament collars. Similar variation in anther tail relative length is found in West Indian *Odontocline* B. Nord., and Nordenstam (1978: 23) concluded tail lengths are "generally of poor diagnostic value within the tribe."

Characters, the key to species, and species delimitation. Because Mesoamerican Pentacalias are basically always heterogamous (radiate or disciform), I do not use a heterogamous vs. homogamous lead in the first key couplet. Instead, the initial couplet uses a radiate-obviously zygomorphic vs. disciform-actinomorphic or subradiate lead. Specifically, because *Pentacalia matagalpensis* and *P. phorodendroides* capitula are indistinctly short-radiate, termed here subradiate (i.e., with ray corolla limbs shorter than tube and only about as long as anther cylinders of disk florets), I key them together with disciform species in lead 1A. Each of our five primarily heterogamous disciform-capitulate *Pentacalia* species (as well as *Dresslerothamnus schizotrichus*) were original described in their protologues as homogamous-discoid-capitulate, but nevertheless correctly key via the actinomorphic first couplet. *Pentacalia matagalpensis* has disk floret anther cylinders about half as long as ray limbs, sometimes obscuring them, and thus keys better following lead 1A. In *P. phorodendroides*, on occasion, typical disciform capitula are sometimes very short-radiate, and the species as circumscribed by the author is plastic. It seems possible that favorable garden conditions favored the elongation of normally actinomorphic marginal floret corolla limbs in *P. phorodendroides* into the subradiate corollas seen in the type of the synonymous described-from-cultivation *P. horickii*. In this case, the disciform and subradiate conditions seem linked. Moreover, *P. phorodendroides* appears plastic in involucre characters, with its often eight phyllaries tending to coalesce into as few as five phyllaries. The moderate-exserted radiate condition of species that follow the second half of the first key couplet do not seem as flexible as the aforementioned species, and seem best keyed this way. But, in some radiate species ray corollas may break or fall, and keying becomes difficult.

Within this context, we should note that although the ray corollas of radiate species do not deviate much, other mostly vegetative characters––capitulescence branch bract sizes, peduncle lengths, phyllary number, pappus bristles cell tip shapes––in radiate species may vary more than seen in disciform species. The best marked key characters in the Central America species are the chartaceous leaves with lateral-spread prominent secondary veins (viz Figs. 22C, 23) and white flowers of *Pentacalia phanerandra* (Fig. 22C–D), our only confirmed white-flowered species; the white-lanate-tomentose indument of the calyculus in *P. calyculata* (Fig. 25B, vs. typical subglabrous ones in Figs. 22B, 25A, 25C, 31C); moderately prominent secondary veins in leaf blades of *P. epidendra*; and the discolorous leaves of *P. brenesii* (Fig. 26). Each of these is a clearly marked species.

Figure 23. Protologue illustration of *Cacalia arborea* Kunth (≡ *Pentacalia arborea*), generitype of *Pentacalia*. (From Kunth, Nov. Gen. Sp. Pl., folio ed. 4 figure 359. 1818).

The remaining species are less well-marked taxa, and I have taken a broad species concept, opting to be conservative given the paucity and poor state of materials at hand. Although much variation has been seen, this variation is mostly in trivial or flexible characters, and it is routine for me to conceptualize intermediate character states in yet-to-be-collected plants. For example, it seems reasonable to allow a fair amount of variation in usually disciform *Pentacalia phorodendroides* (syn.: *P. horickii* H. Rob.), as well as in radiate *P. morazensis* (syn.: *P. magistrate), P. streptothamna*, and *P. tonduzii*. On the other hand, two narrow endemics, *P. matagalpensis* and *P. wilburii*, are circumscribed nearly as narrowly as in Robinson and Cuatrecasas (1978); both are usually recognized by relatively few-flowered capitula usually with five phyllaries. The corollas of *P. matagalpensis* have been called white, which seems odd. Also, some imperfect materials with eight phyllaries are provisionally referred to otherwise narrowly circumscribed *P. wilburii*, highlighting the need for fieldwork observation of character variation in populations in western Panama, basically where I have seen the least material and where I feel least confident with the material in front of me.

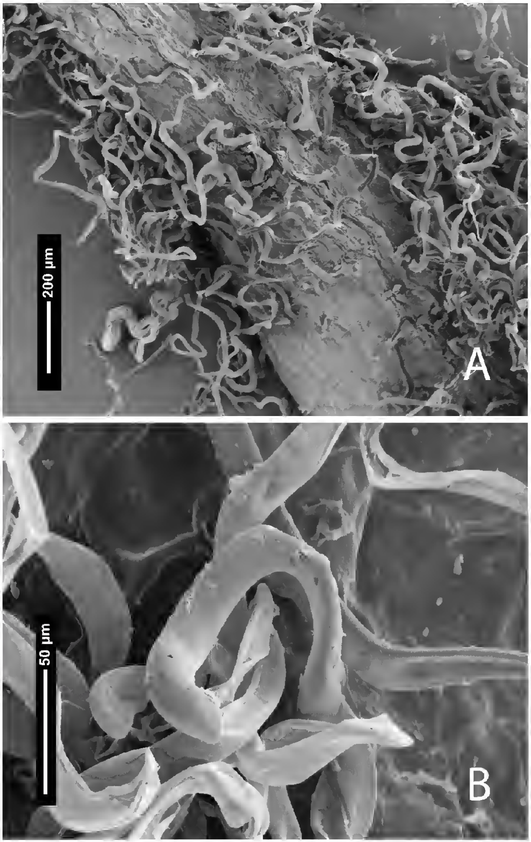


Figure 24. Simple trichomes of *Pentacalia brenesii*, the trichomes have terminal cell curved-coiled. These trichomes are similar to those illustrated in Drury and Watson (1965 fig. 5) and Jeffrey (1987, trichome type 3D), common in *Pentacalia*, and much of Neotropical Senecioneae. A. Phyllary. B. Adaxial leaf blade surface. (From isotype, *Brenes 5342*, NY).

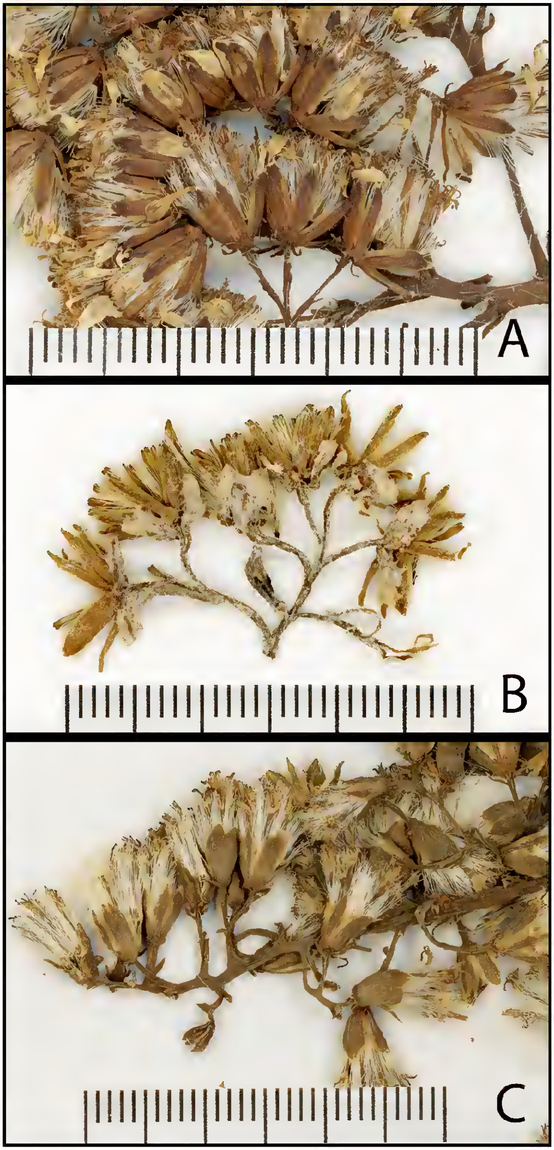


Figure 25. Capitula of *Pentacalia* showing florets, involucres, phyllaries, and calycular bracts. A. *Pentacalia streptothamna*, short-radiate capitula, weakly calyculate, the calycular bracts are small and subglabrous, typical of the genus. B. *Pentacalia calyculata*, post-anthesis capitula, obviously calyculate, showing densely white-lanate-tomentose indument covering the large outer calycular bracts. C. *Pentacalia phorodendroides*, disciform capitula, weakly calyculate, adjacent phyllaries often connate and broad. (A *Haber et al. 11029*, MO; B *Pittier 7503 / 13242*, MO, isotype of *Senecio calyculatus*; C *Standley 85080*, MO).

Geography, authors, and history. The Central American Pentacalias have been treated by Greenman (1901, 1902, 1950), Standley (1938), Robinson and Cuatrecasas (1978), and Williams (1976, 1984). Barkley (1990) provisionally assigned two Chiapas collections to *Pentacalia venturae* (T.M. Barkley) C. Jeffrey, a taxon which he compared to *P. magistri*, *P morazensis*, *P. parasitica*, and *P. phorodendroides*. Here, these collections from Chiapas are referred to *P. epidendra*, but because I have not seen the type material from Veracruz of the very similar *P. venturae*, Barkley's species is placed adjacent to, rather than treated in synonymy of *P. epidendra*. *Pentacalia parasitica* may be safely excluded from Panama, and it proves to be a more northerly species. No Pentacalias are known in Belize or in Mexican Yucatan, but both *P. parasitica* and *P. phorodendroides* should be looked for in Tabasco and Campeche. None of the twelve species treated here occur in South America, but because similar species abound it is obvious that Central American Pentacalias are "merely an appendage on the Andean group" (Barkley 1990).

Four species of Central American *Pentacalia* are more or less historically recognized: *P. candelariae* (Benth.) H. Rob. & Cuatr., *P. calyculata* (Greenm.) H. Rob. & Cuatr., *P. parasitica* (Hemsl.) H. Rob. & Cuatr., and *P. phanerandra* (Cufod.) H. Rob. & Cuatr. The next four species were described in the mid-1900s by Dr. Jesse More Greenman (1867–1951), long-time curator at the Missouri Botanical Garden and admired *Senecio* specialist, whose bulk determinations, herbarium curation, and publications are the foundation of this revision. The regional species, all Central America endemics, described by Greenman that postdate his *P. calyculata* are: *P. brenesii* (Greenm. & Standl.) Pruski, *P. morazensis* (Greenm.) H. Rob. & Cuatr., *P. streptothamna* (Greenm.) H. Rob. & Cuatr., and *P. tonduzii* (Greenm.) H. Rob. & Cuatr., with *S. morazensis* Greenm. described in Dr. Greenman's final publication. Four more recently named regional species are recognized, of these four species two were described by each Louis O. Williams and Harold Robinson. Two proposed species, one each by Robinson and Williams, are treated here in synonymy.

Key to species of Pentacalia in Mesoamerica

1. Capitula disciform or infrequently discoid, sometimes inconspicuously subradiate with ray corolla limb shorter than tube, included or nearly so within involucre, limb about as long as disk anthers and somewhat falsely resembling them.

  2. Disk corollas white and leaf blades chartaceous, secondary veins spreading at nearly right angles to midrib, margins usually denticulate or dentate; (Costa Rica, Panama) .... **8. Pentacalia phanerandra** (Cufod.) H. Rob. & Cuatr.
  2. Disk corollas yellow or pale yellow, rarely reportedly white in *P. matagalpensis* but then never with leaves chartaceous nor with secondary veins spreading at nearly right angles to midrib; leaf blades mostly subcarnose, secondary veins moderately forward directed, margins entire.

    3. Leaf blade surfaces strongly discolorous, abaxial surfaces densely lanate-tomentose; (Costa Rica) .... **1. Pentacalia brenesii** (Greenm. & Standl.) Pruski
    3. Leaf blade surfaces concolorous, surfaces glabrous to sparsely crisped-puberulent.

      4. Capitula 6–8.5 mm long, ultimate capitula typically subfasciculate; stems or peduncles often crisped-pubescent, hispidulous, villosulous to sometimes subglabrous.

        5. Capitula disciform; phyllaries usually 8; disk corollas (yellow), lobes 1.3–2 mm long, spreading with anthers exserted and collars sometimes visible, filaments included in corolla; (Costa Rica, Panama) .... **3. Pentacalia candelariae** (Benth.) H. Rob. & Cuatr.

5. Capitula indistinctly subradiate; phyllaries 5; disk corollas (reportedly white), lobes 1.5–2.5 mm long, spreading to recurved with anthers, collars, and filaments visible; (Nicaragua) .... 5. **Pentacalia matagalpensis** H. Rob.

4. Capitula 7.5–10.5 mm long, ultimate capitula pedunculate and usually well-spaced; stems glabrous or subglabrous.

6. Capitulescences terminal or when mostly axillary the branches much longer than the subtending leaves (e.g., Fig. 5A, 5C); phyllaries 8, typically nearly as long as disk florets and free; (Mexico, Guatemala, ?Honduras) .... **7. Pentacalia parasitica** (Hemsl.) H. Rob. & Cuatr.

6. Capitulescences of mostly axillary branchlets shorter than to slightly longer than the subtending leaves (e.g., Fig. 5B, 5D); phyllaries 5–8, typically shorter than disk florets, several capitula per branch with some phyllaries connate to near apex; (Chiapas, Guatemala, El Salvador) .. **9. Pentacalia phorodendroides** (L.O. Williams) H. Rob. & Cuatr.

1. Capitula radiate with ray corolla limb usually moderately exserted from involucre, ray limb usually about as long as tube.

7. Capitula obviously calyculate, calycular bracts completely covered with dense white-lanate-tomentose indument, bracteoles usually about half as long as involucre; (Costa Rica) .... **2. Pentacalia calyculata** (Greenm.) H. Rob. & Cuatr.

7. Capitula usually slightly to moderately calyculate, but not with white-lanate-tomentose calycular bracteoles, bracteoles typically less than half as long as involucre.

8. Capitula broadly campanulate.

9. Stems moderately to densely villosulous, peduncles moderately puberulent or villosulous; leaf blades 6–14 cm long, secondary veins moderately prominent; disk corollas lobes 1–1.5 mm long, usually shorter than throats; (Chiapas, Guatemala, Nicaragua) .... **4. Pentacalia epidendra** (L.O. Williams) H. Rob. & Cuatr.

9. Stems glabrous, peduncles sparsely puberulent; leaf blades 4–7(–8) cm long, secondary mostly immersed; disk corollas lobes 1.5–2 mm long, about as long as throat; (Honduras, El Salvador, Nicaragua) .... **6. Pentacalia morazensis** (Greenm.) H. Rob. & Cuatr.

8. Capitula cylindrical to narrowly campanulate or turbinate-campanulate.

10. Capitulescences leafy-bracteate with specialized large elliptic to ovate primary bracts; stems puberulent with collapsed bent simple trichomes; ray corolla limbs often linear-lanceolate; (Costa Rica, Panama) .... **11. Pentacalia tonduzii** (Greenm.) H. Rob. & Cuatr.

10. Capitulescences not leafy-bracteate, without specialized large primary bracts; stems glabrous, or when pubescent trichomes not bent; ray corolla limbs elliptic-oblong.

11. Stems puberulent to glabrate; phyllaries 8; capitula 10–15-flowered; disk corolla lobes about as long as throat; pappus bristles usually reaching to about the middle of the disk corolla lobes; (Nicaragua, Costa Rica, Panama) .... **10. Pentacalia streptothamna** (Greenm.) H. Rob. & Cuatr.

11. Stems glabrous; phyllaries 5(–8); capitula 7–11(–14)-flowered; disk corolla lobes shorter than throat; pappus bristles at maturity usually reaching to only about base of the disk corolla lobes; (Costa Rica, Panama) .... **12. Pentacalia wilburii** H. Rob.

Figure 26. Isotype of *Senecio brenesii* Greenm. & Standl. (≡ *Pentacalia brenesii*). (*Brenes 5342*, NY).

1. **PENTACALIA BRENESII** (Greenm. & Standl.) Pruski, Flora Mesoamericana vol. 5, parte 2: 444. 2018. *Senecio brenesii* Greenm. & Standl., in Standley, Flora of Costa Rica, Publ. Field Mus. Nat. Hist., Bot. Ser. 18: 1513. 1938. **TYPE: COSTA RICA. Alajuela.** La Palma de San Ramón, 1100 m, 16 Jan 1927, *Brenes 5342* (holotype: F; isotype: NY). Figures 2B, 24, 26.

Climbing vines, flowering branches pendent; stems few-several branched distally, brownish-gray lanate-tomentose distally, glabrate proximally, pith solid; herbage with simple trichomes with long and curved terminal cell appendages. **Leaves** petiolate; blade 5–9 × 1.7–4 cm, elliptic to elliptic-ovate, subcarnose, pinnately veined, 2–4 arching secondaries per side, these forward directed, surfaces strongly discolorous, adaxial surface glabrous, abaxial surface yellowish-brown, densely lanate-tomentose, midrib visible, secondary veins thin and obscured by indument, base broadly cuneate to rounded, margins entire, often pressing revolute, apex acuminate; petiole 0.7–2.5 cm long. **Capitulescence** 10–23 × 5–10 cm, openly corymbiform-paniculate to sometimes columnar in aspect, terminal and exserted from distal leaves, often also axillary on lateral branchlets 2–5 cm long, from distal few nodes, branchlets subequal to slightly longer than subtending stem leaf, ultimately in subumbellate cluster of 3–7(–13) capitula; peduncles 3–9 mm long, lanate-tomentose. **Capitula** 10–14 mm long, disciform(discoid); 15–25-flowered; involucre 5–6 mm diam., campanulate or narrowly so, disk florets moderately exserted (or in fruit sometimes rarely well-exserted by ca. 5 mm); phyllaries ca. 8, 7.5–9.5 × 1–2 mm, lanceolate, laxly tomentose to glabrate, bases often quickly indurate; clinanthial setae to ca. 0.5 mm long. **Ray florets** absent. **Marginal florets** (0–)1–2; corolla slightly exserted from involucre. **Disk florets** 15–23; corolla 8–10 mm long, campanulate, yellow, glabrous, tube 5–6 mm long, much longer than limb, lobes 1.5–2.5 mm long, shorter than to about as long as the throat; anthers 2.2–2.4 mm long, collar ca. 0.5 mm long, filament collar balusterform, with enlarged basal cells, tails about 1/2 as long as thecae, appendage 0.3–0.4 mm long, lanceolate-ovate, apex obtuse; style base gradually dilated in basal ca. 0.7 mm, branches 1.6–1.9 mm long and often well-exserted from anther cylinder, stigmatic surfaces 2-banded and reaching to the apex, without papillae arising between the stigmatic surfaces, apex tufted-papillose (papillae varying from short to long but more or less isomorphic), triangular in outline, abaxially papillose in distal 1/4 with papillae smaller but otherwise similar to apical papillae, composed of cellular material, laterally and apically papillose, papillae 0.1–0.2 mm long, isomorphic, subequal to usually shorter than branch diam. **Cypselae** 1–1.5 mm long, glabrous; pappus bristles 8–10 mm long, usually reaching to about the middle of the disk corolla lobes, barbellate distally.

Distribution and ecology. *Pentacalia brenesii* is a Costa Rican endemic (Fig. 16) known from 800–1100 meters elevation, and flowers in January and February.

Collections examined. COSTA RICA. *Bello 1917* (CR, MO); *Herrera & Chacón 492* (MO); *Herrera & Schik 3830* (CR, MO, UC); *Herrera et al. 4925* (CR, INB, MO, UC).

By the character combination of discolorous abaxially-tomentose leaves and at maturity large capitula (Fig. 26), *Pentacalia brenesii* is remarkable and unequaled in Central America. In these characters it closely matches Colombian *P. popayanensis* (Hieron.) Cuatr., which is a different radiate-capitulate species. Similarly, other large-capitulate species, e.g., Peruvian *P. carpishensis* (Cuatr.) Cuatr., Bolivian *P. dictyophlebia* (Greenm.) Cuatr., Mesoamerican *P. epidendra*, Bolivian *P. epiphytica* (Kuntze) Cuatr., and Mesoamerican *P. morazensis*, also differ from *P. brenesii* by radiate capitula; moreover, each is concolorous-leaved.

The style branches of *Pentacalia brenesii* often have a central papillose apiculum Fig. 2B), recalling both *Dresslerothamnus* and *Ortizacalia*, never have distal papillae between stigmatic lines, as in *Ortizacalia*. The style branch apex of *P. brenesii* is sometimes triangular in outline (Fig. 2B), as often occurs in *Dresslerothamnus* too, but herbage trichome characters distinguish the two genera. In species of the Peruvian-Bolivian *P. oronocensis* (DC.) Cuatr. group, we find the apiculate-stylar condition loosely associated with discolorous leaves, but the species of this group are relatively small-capitulate as compared to *P. brenesii.*

2. **Pentacalia calyculata** (Greenm.) H. Rob. & Cuatr., Phytologia 40: 41. 1978. *Senecio calyculatus* Greenm., Bot. Gaz. 37: 419. 1904. **Type: COSTA RICA. Cartago.** Volcán Turrialba, 2700 m, Jan 1899, *Pittier 7503 / 13242* (lectotype, designated here: US-1404140 ex J.D. Smith herb.; isolectotypes: G-3, MO, US-2). Both numbers are cited in the protologue. It seems as though 7503 is Smith exsiccatae distribution number, and that 13242 is the Pittier collection number. The US lectotype and US isolectotype each include both numbers. None of the sheets seen by the author include a hand-written determination in the hand of Greenman. Figure 25B.

Woody vines to 10 m tall; stems closely arachnoid-tomentose to quickly puberulent or glabrate, pith solid. **Leaves** petiolate; blade 2.5–6 × 1.3–4 cm, elliptic to ovate, subcarnose, pinnately veined, usually with 2–5 pairs of partly immersed arching secondaries per side, tertiary venation indistinct, surfaces concolorous, glabrous or midrib adaxially arachnoid-puberulent, base cuneate to sometimes obtuse, margins entire, apex acute(–acuminate) to sometimes obtuse; petiole 1–2 cm long. **Capitulescence** terminal, broadly corymbose-paniculate, moderately dense, without specialized large primary bracts, few-bracteolate, branchlets arachnoid-tomentose, ultimate clusters with capitula not fasciculate, bracteoles to 10 mm long, lanceolate; peduncles 1–7 mm long, arachnoid-puberulent, often 1–2-bracteolate, bracteoles usually arachnoid-pubescent or white-lanate-tomentose. **Capitula** radiate, 8–11 mm long, 8–12-flowered, obviously calyculate; involucre 3–4 mm diam., narrowly campanulate, at anthesis slightly shorter than disk florets, in fruit the persistent disk corolla sometimes exserted 3–4 mm from involucre; phyllaries 5–6(–7) × 1.2–2.5 mm, broadly lanceolate to ovate, sparsely arachnoid-puberulent to glabrate, apex acute to obtuse, often fimbriate-papillose; calycular bracts 2–3(–4), 3–4.5 mm long, usually about half as long as involucre, elliptic to obovate, completely covered with dense white-lanate-tomentose indument. **Ray florets** 2–5; ray corolla yellow, glabrous, limb 3–4 mm long, about as long as to slightly shorter than tube, elliptic-lanceolate. **Disk florets** 6–7; corolla 5.5–7 mm long, narrowly funnelform, yellow, glabrous, lobes ca. 1.5 mm long, triangular-lanceolate, slightly shorter to about as long as throat. **Cypselae** 1–2 mm long, glabrous; pappus bristles 4–6 mm long, usually reaching to about the middle of the disk corolla lobes.

Distribution and ecology. *Pentacalia calyculata* is a local endemic known only from montane areas (e.g., Volcán Irazú, Volcán de Turrialba, Cordillera de Talamanca) of Costa Rica. It occurs from 2000–3300 meters elevation, and flowers from (August–)November–February.

Representative collections. COSTA RICA. *Garwood et al. 344* (BM, MO-2); *Jiménez 2649* (MO, NY); *Pittier 16985* (US); *Standley 35206* (US); *Wilbur & Teeri 13745* (MO, US); *Williams et al. 24444* (NY, US).

This species was cited in the protologue as discoid, and as sessile-capitulate in Standley (1938), but instead is radiate and short-pedunculate.

3. **Pentacalia candelariae** (Benth.) H. Rob. & Cuatr., Phytologia 40: 41. 1978. *Senecio candelariae* Benth., Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 1852: 108. 1853. **Type: COSTA RICA. San José/Cartago.** Candelaria, 6000 ft, 1851, *Oersted 148* (holotype: K). [An isotype in C was not found in IDC microfiche 2204]. Figure 10D.

Climbing vines; stems often densely crisped-pubescent (Fig. 10D; these crisped trichomes have been loosely described elsewhere as torulose or loriform), villosulous to subglabrous, larger stems sometimes narrowly fistulose; herbage (when pubescent) with crisped trichomes. **Leaves** petiolate; blade 6–9 × 2–4.5 cm, lanceolate to elliptic or less commonly elliptic-ovate, subcarnose, thinly pinnate-veined or sometimes indistinctly pinnate with secondary veins sometimes immersed, typically with 3–6 visible secondary veins per side, these moderately forward directed, tertiary venation immersed or slightly visible and forming a very loose reticulum with areolae 2–5+ mm diam., surfaces sparsely crisped-puberulent to glabrous, base cuneate to obtuse or less commonly rounded, margins entire, apex acute to attenuate; petiole 0.5–2 cm long. **Capitulescence** mostly terminal, sometimes on axillary branches but then often about 1.5 times as long as the often large subtending leaves of main stem, pyramidally corymbiform-paniculate, each branchlet subtended by a linear-lanceolate bracteole 2–4 mm long, branches and branchlets usually crisped-puberulent or villosulous, ultimate branchlets mostly racemose with ultimate capitula mostly subsessile and in subfasciculate clusters, 3–7-capitulate, infrequently capitula always pedunculate, branchlets in herbarium material often dries flattened; peduncles 0–2(–6) mm long, crisped-puberulent or villosulous, sometimes few-bracteolate, bracteoles 1–2 mm long, usually much shorter than 1/2 as long as the phyllaries, lanceolate to elliptic. **Capitula** 6–8 mm long, disciform, 8–14-flowered; involucre 3–4.3 mm diam., broadly cylindrical, disk florets only slightly exserted to well-exserted, basal disk sometimes broadened and indurate, phyllaries usually 8, 3.5–6 × ca. 1.1 mm, lanceolate to lanceolate-ovate, typically free or rarely a few connate to near apex, glabrous or sparsely crisped-puberulent, apex usually acute, sometimes ciliate-fimbrillate; calycular bracteoles ca. 1 mm long, lanceolate, subglabrous. **Ray florets** absent. **Pistillate marginal florets** 1–3, noticeably smaller than disk florets, corolla sometimes quickly deciduous; corolla 4–4.5 mm long, usually yellow or pale yellow, lobes 1–1.2 mm long. **Disk florets** 7–11; corolla 4.8–5.6 mm long, usually yellow or pale yellow, glabrous, lobes 1.3–2 mm long, about as long as throat, spreading with anthers exserted and collars sometimes visible, filaments included in corolla, lobes with faint medial nerve sometimes visible. **Cypselae** 1–2 mm long, glabrous; pappus bristles 4–5.3 mm long, mostly 1-seriate, usually reaching to about the middle of the disk corolla lobes, distal-most few cells slightly more scabrid with spreading tips nearly as long as bristle width.

Distribution and ecology. *Pentacalia candelariae* is a common regional endemic known only from Costa Rica and Panama. It occurs from 800–2000 meters elevation, and flowers mostly from February to May.

Representative collections. **COSTA RICA**. *Fletes 4* (INB, MO, NY; weak-puberulent, pedunculate-capitulate); *Gómez 20075* (K, MO, NY, TEX, USM); *Gómez et al. 21066* (CR, MO, TEX); *Haber & Zuchowski 10521* (F, MO, UC); *Herrera 3767* (CR, MO, UC); *Herrera 6012* (INB, MO; weak-puberulent, pedunculate-capitulate; cited in Monro 2017: 161 as *Pentacalia* "*parasiticus*" [sic]); *Standley & Torres 51132* (MO); *Wilbur 14351* (MO, NY, US). **PANAMA**. *Churchill et al. 4573* (MO, US); *Hammel 6290* (KSC, MO-2; cited in haste by Pruski and Robinson 2018 as *D. hammelii*, but subsequent slower-paced SEM study showed the trichomes to be simple); *Sytsma and D'Arcy 3633* (MO); *van der Werff & Herrera 7228* (MO, US).

Standley (1938) mentioned that "considerable variation" in *P. candelariae,* that Greenman used a non-published name for some specimens, and that the many specimens may "represent as many as three entities." The species generally has flowering branches crisped-pubescent and ultimate capitula subfasciculate, but some collections have peduncles weak-puberulent, and non-fasciculate capitula as in *P. parasitica* and *P. phorodendroides*, but the capitula in *P. candelariae* are smaller and the species is more southerly distributed. Some material determined as disciform *P. candelariae* by Standley (in sched.), is instead radiate *P. streptothamna*. Also, it seems possible that some variation noted by Standley, is instead in reference to low-elevational material of *P. phanerandra* or to near look-alike *D. schizotrichus*. It seems Standley may have been referencing variation based on both subglabrous plants and radiate plants of other species. Although Panamanian *D. hammelii* in gestalt is similar (viz the Pruski and Robinson 2018 misdetermination of *Hammel 6290* cited as *D. hammelii*), it seems unlikely that Standley was referencing the plants from Panama.

4. **PENTACALIA EPIDENDRA** (L.O. Williams) H. Rob. & Cuatr., Phytologia 40: 41. 1978. *Senecio epidendrus* L.O. Williams, Phytologia 31: 440. 1975. **TYPE: MEXICO. Chiapas.** Near crest of ridge on road from San Cristobal de las Casas to Tenejapa, Chamula paraje of Las Ollas, 8300 ft (= 2530 m), 19 Feb 1965, *Breedlove 9053* (holotype: MICH; isotypes: CAS-3, ENCB, F, NY, TEX, WIS).

Woody vines; stems moderately to densely villosulous, often fistulous, those on herbarium sheets relatively thick. **Leaves** petiolate; blade 6–14 × 4.5–9 cm, ovate, subcarnose, pinnately veined with 4–8 moderately prominent forward-directed secondaries per side, surfaces concolorous, adaxial surface subglabrous or midrib sparsely villosulous, adaxially sparsely villosulous, base cuneate to obtuse, sometimes obliquely so, margins entire, apex acute to obtuse but mucronate; petiole 1.5–3 cm long. **Capitulescence** corymbiform-paniculate, terminal or on spreading axillary branches to (5–)30 cm long, much longer than subtending leaves, main branches bracteolate but without specialized large primary bracts; peduncles 5–15 mm long, moderately puberulent or villosulous, often indistinctly 1–few-bracteolate. **Capitula** 9–13 mm long, radiate, 20–30-flowered, loosely few-calyculate; involucre 4–9 mm diam., broadly campanulate at anthesis, disk florets well-exserted with most of limb fully visible; phyllaries 8, 4.5–8 × 1.5–2 mm, noticeably shorter than disk florets, narrowly oblong to ovate, usually puberulent; calycular bracteoles 1–few, 1–2.5 mm long, usually arising from base of subinvolucre; clinanthium crest evident. **Ray florets** ca. 5; corolla yellow, glabrous, limb 5–6 × 1–1.5 mm, about as long as tube, oblanceolate, 4–7-nerved. **Disk florets** 15–25; corolla 7–8.5 mm long, funnelform, yellow, glabrous, lobes 1–1.5 mm long, usually shorter than throat; anthers 2.5–3 mm long, connective often resinous. **Cypselae** 1–2 mm long, glabrous; pappus bristles usually 5–7 mm long, nearly as long as disks and reaching to about the middle of the disk corolla lobes, apical cells pointed or a few bristles with cells sometime bulbous-obtuse.

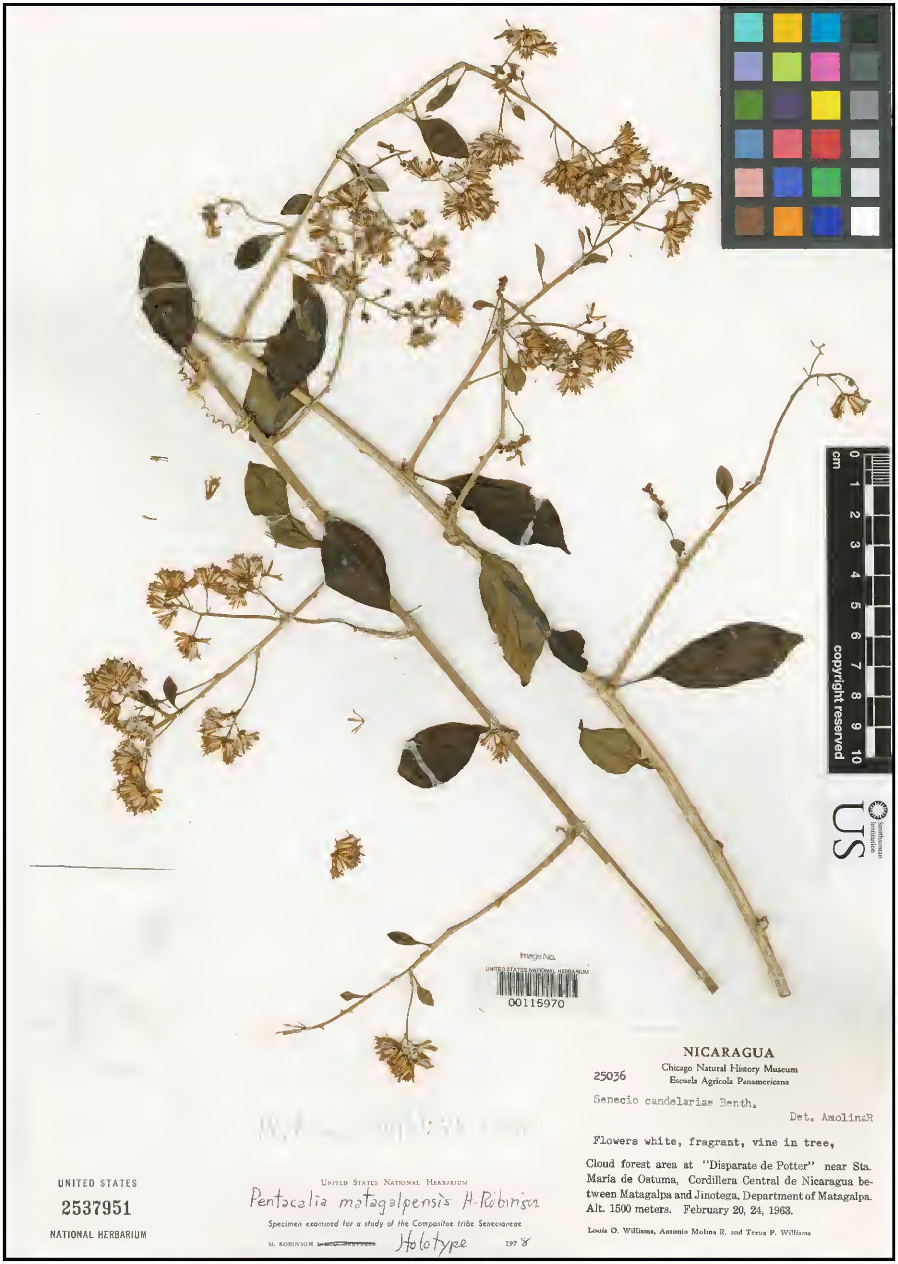
Distribution and ecology. *Pentacalia epidendra* is an infrequent regional endemic described from Chiapas and Guatemala, and extending southeastwards into Nicaragua, where it is rare. Nicaragua material was determined by Neil Harriman (in Dillon et al. 2001), and is relatively low-elevational. The Guatemalan paratype is immature, as noted by Williams (1976: 410), but the species has more recently been collected flowering on Sierra de las Minas. The species is known to me from only half a dozen collections, two of these imperfect. *Pentacalia epidendra* occurs from (1100–)1500–2700 meters elevation, and flowers from January to March.

Collections examined. GUATEMALA. *Peña-Chocarro et al. 2920* (BM, MO); *Steyermark 42889* (F, MO). **MEXICO. Chiapas.** *Breedlove 9053* (type as cited above); ?*Breedlove 31764* (CAS n.v., web shows and imperfect sheet, referred by Barkley 1990 to extra-Mesoamerican *P. venturae*); *Breedlove 49771* (CAS, MO); *Breedlove & Almeda 58095* (CAS, US). **NICARAGUA.** *Williams et al. 23508* (F, NY; in bud, but stems villosulous and secondary leaf veins prominent).

Among Central American species, *P. epidendra* may be recognized by its radiate capitula with campanulate involucres, villosulous herbage, and large fleshy leaves with prominent arching secondary veins. Barkley (1990) provisionally referred *Breedlove 31764* to *P. venturae* (T.M. Barkley) C. Jeffrey, a plastic-capitulate species originally described as radiate, but which sometime has marginal florets with staminodia and pseudobilabiate corollas. I find *Breedlove 31764* to have typical radiate capitula and thus this collection fits comfortably within either *P. morazensis* or more likely *P. epidendra.*

5. **PENTACALIA MATAGALPENSIS** H. Rob., Phytologia 40: 43. 1978. **TYPE: NICARAGUA. Matagalpa.** Near Sta. Maria de Ostuma, between Matagalpa and Jinotega, 1500 m, 20–24 Feb 1963, *Williams et al. 25036* (holotype: US; isotypes: F-2, NY). Figure 27.

Climbing vines; stems much-branched, pale brown, distally hispidulous to subglabrous, internodes often elongate, at least some trichomes obliquely appendaged. **Leaves** petiolate; blade



NICARAGUA
Chicago Natural History Museum
Escuela Agrícola Panamericana
25036

Senecio candelariae Benth.
Det. AmolinaR

Flowers white, fragrant, vine in tree,

Cloud forest area at "Disparate de Potter" near Sta. María de Ostuma, Cordillera Central de Nicaragua between Matagalpa and Jinotega, Department of Matagalpa. Alt. 1500 meters. February 20, 24, 1963.

Louis O. Williams, Antonio Molina R. and Terua P. Williams

UNITED STATES
2537951
NATIONAL HERBARIUM

UNITED STATES NATIONAL HERBARIUM
Pentacalia matagalpensis H. Robinson
Specimen examined for a study of the Compositae tribe Senecioneae
H. ROBINSON Holotype 1978

Figure 27. Holotype of *Pentacalia matagalpensis* H. Rob. (*Williams et al. 25036*, US).

2.5–6 × 1–2.3 cm, elliptic, subcarnose, thinly pinnately veined, usually with 2–4 visible arching secondary veins per side, surfaces concolorous, glabrous, base cuneate, margins entire, apex acuminate; petiole 0.5–1 cm long. **Capitulescence** mostly axillary, branches longer than subtending leaves (position typically apparent on herbarium specimens), mostly 10–20 cm long, each pyramidal and moderately longer than subtending leaf, ultimate capitula subfasciculate; peduncles 1–4 mm long, densely crisped-hirsutulous, usually 1–4-bracteolate or capitula 1–2-calyculate, peduncular or calycular bracteoles 1–1.5(–2) mm long, sessile, elliptic-ovate, chartaceous. **Capitula** inconspicuously subradiate, 6.5–8.5 mm long, 5–7-flowered; involucre 2–2.5 mm diam., cylindrical, moderately shorter than florets; phyllaries 5, 5–6 × 1–1.5 mm, lanceolate to elliptic-lanceolate, glabrous, margins very narrowly scarious, apex acute to obtuse. **Ray florets** indistinct, 1–2; corolla reportedly white (but this perhaps in reference instead to exserted anther thecae), glabrous, tube 3–4 mm long, limb 2–2.5 × ca. 0.5 mm, shorter than tube, elliptic-lanceolate, limb about as long as disk anther cylinders and somewhat falsely resembling them. **Disk florets** 4–5; corolla ca. 6 mm long, reportedly white, glabrous, lobes 1.5–2.5 mm long, lanceolate, sometimes longer than the throat, lobes spreading to recurved with anthers, collars, and filaments visible; anthers ca. 2 mm long; style branch distally abaxially and marginally papillose, papillae 0.1–0.2 mm long. **Cypselae** 1–2 mm long, glabrous; pappus bristles ca. 5 mm long, bristle apical cells pointed.

Distribution and ecology. *Pentacalia matagalpensis* is an uncommon regional endemic known only from Nicaragua. It occurs from 900–1500 meters elevation, and flowers in February and March. It has been collected in fruit in April.

Representative collections. NICARAGUA. *Pipoly 6076* (MO); *Rueda et al. 13363* (MO); *Rueda et al. 13431* (MO); *Rueda et al. 15947* (MO).

Pentacalia matagalpensis is the only *Pentacalia* typified by material from Nicaragua. The type of *P. matagalpensis* H. Rob. was distributed as *Senecio candelariae*, which occurs in Costa Rica and Panama, and differs by its disciform capitula with eight phyllaries. By its five phyllaries P. *matagalpensis* is similar to *P. wilburii*, and by its long axillary capitulescences is similar to *P. phorodendroides*.

Pentacalia matagalpensis is keyed here as inconspicuously subradiate following lead 1A, and its corollas have been called white, which seems odd. Nordenstam (1978) stated the adaxial surfaces of the ray corolla limbs of white-rayed Senecioneae are generally papillose, but at low magnifications those of *P. matagalpensis* seem neither obviously papillose, nor oblong-tabular celled. The corolla color of *P. matagalpensis* needs further observation.

6. PENTACALIA MORAZENSIS (Greenm.) H. Rob. & Cuatr., Phytologia 40: 44. 1978. *Senecio morazensis* Greenm., Ceiba 1: 122. 1950. **TYPE: HONDURAS. Francisco Morazán.** Mountains above San Juancito, 2000 m, 25 Mar 1948, *Williams & Molina 13976* (holotype: MO; isotypes: EAP, F, MO). The sheet in F is a fragment. Figures 22B, 28.

Pentacalia magistri (Standl. & L.O. Williams) H. Rob. & Cuatr., *Senecio magistri* Standl. & L.O. Williams.

Climbing vines, 1–3+ m tall; stems glabrous to infrequently sparsely tomentose, often fistulous. **Leaves** petiolate; blade 4–8 × (1.5–)2–3 cm, elliptic-lanceolate to sometimes ovate, subcarnose, pinnately thin-veined, 4–5 mostly immersed arching secondary veins per side, surfaces concolorous, glabrous, base broadly cuneate to obtuse, margins entire, apex acuminate to acute; petiole 1–1.5 cm long. **Capitulescence** corymbiform-paniculate, terminal or on spreading axillary branches longer than subtending leaves, sometimes with relatively large bracts subtending branchlets; peduncles 5–15 mm long, typically sparsely villosulous especially immediately below involucre, infrequently glabrate, often 1–3-bracteolate, bracteoles 3–5 mm long, sessile, linear-lanceolate, thin-chartaceous. **Capitula** radiate to (on poor soils) rarely seemingly disciform, 10–14 mm long, 22–38-flowered; involucre 5–8 mm diam., broadly campanulate at anthesis, disk florets well-exserted; phyllaries 8–13 (often on a single plant), 6–7 × 2–3(–4) mm, linear-lanceolate to oblong, glabrous except at the ciliate-fimbriate apex, some phyllaries partly connate, apex acute to obtuse; calycular bracts 1–few, 3–6 mm long, usually linear or very narrowly oblanceolate, often arising from base of subinvolucre, often half as long to as long as involucre, slightly spreading, sometimes drying much paler in color than phyllaries. **Ray florets** 5–8; corolla yellow, glabrous, tube 3–3.5 mm long, limb 4–7 × 1–2.5 mm, elliptic to oblong, usually about as long as tube, rarely some per plant deeply bilobed to near tube, with lobules 1–2 mm long and thus these few capitula seemingly disciform. **Disk florets** 17–30; corolla 5.5–6.5 mm long, yellow, glabrous, lobes 1.5–2 mm long, about as long as throat. **Cypselae** (immature) 1–1.8 mm long, glabrous; pappus bristles 7–8 mm long, usually reaching to about the middle of the disk corolla lobes, apical cells pointed, pre-anthesis bristles sometimes clavate distally.

Distribution and ecology. *Pentacalia morazensis* is an occasional regional endemic long-known only in Honduras, but more recently collected in both El Salvador and Nicaragua, where it seems less frequent. It was not reported in Nicaragua by Harriman (in Dillon et al. 2001). *Pentacalia morazensis* occurs from 2000–2600(–2800) meters elevation, and flowers mostly from January–March(–April).

Representative collections. EL SALVADOR. *Martinez 874* (B, EAP, LAGU, MO); *Tucker 1028* (US). **HONDURAS**. *Dario 347* (EAP, KSC, MO); *Evans 1473* (K, MO, NY); *Evans 1524* (EAP, KSC, MO, TEFH); *Kelly et al. 16122* (MO, TRIN); *Molina 5050* (F, US; type collection of synonymous *Senecio magistri;* stems sparsely tomentose); *Molina 13752* (NY, US); *Molina 17423* (NY, US); *Molina 23397* (NY, US); *Molina 23404* (NY, US); *Molina et al. 31318* (MO); *Williams & Molina 13705* (MO); *Williams & Molina 17104* (EAP, MO; paratype). **NICARAGUA**. *Stevens et al. 32812* (MO; voucher of photograph used here as Fig. 22B); *Stevens & Montiel 34283* (MO).

Williams (1984) gave *Pentacalia morazensis* as the only regional "forest inhabiting, fleshy-leaved vine." By radiate capitula with broad involucres (Figs. 22B, 28), *P. morazensis* is among Central American species similar to *P. epidendra*, but in Honduras may be mistaken for *P. parasitica* as well. Robinson and Cuatrecasas (1978) recognized as distinct *P. morazensis* by clavate pappus bristles and *P. magistri* by apically narrowed pappus bristles, whereas Williams (1984) and Pruski and Robinson (2018) treated *P. magistri* in synonymy of *P. morazensis.* The pappus bristles in this species seem more typically clavate in young flower, but post-anthesis are often apically narrowed. While the clavate pappus bristle condition (not as extreme as seen in *Monticalia firmipes*, Fig. 3E) was used by Robinson and Cuatrecasas (1978) to distinguish *P. magistri*, its type (*Molina 5050*) is otherwise a good match for *P. morazensis.* A few imperfect Honduran plants, perhaps a poor soil ecotype, resemble *P. morazensis* and have somewhat clavate pappus bristles, but appear disciform. These imperfect Honduran plants may be the same that Nelson (2008) called *P. parasitica.* In Oaxaca, *Breedlove & Sigg 65897* was determined by B.L. Turner (in sched.) as *P. morazensis*, but is referred here to *P. parasitica.*

Barkley (1990) provisionally assigned two Chiapas collections (including *Breedlove 31764*) to *Pentacalia venturae* (T.M. Barkley) C. Jeffrey, a taxon that he compared to *P. magistri*, *P morazensis*, *P. parasitica*, and *P. phorodendroides.* Here, these collections from Chiapas are referred to *P. epidendra*, but because I have not seen the type material from Veracruz of the very similar *P. venturae*, it is placed adjacent to, rather than in synonymy of *P. epidendra.*

Pentacalia morazensis (Greenm.)
H. Rob. & Cuatrec.
det. John Pruski (MO), 2011
MISSOURI BOTANICAL GARDEN HERBARIUM

Holotype:
SENECIO MORAZENSIS GREENM.
Ref.
CEIBA 1(2):122. 1950
Missouri Botanical Garden (MO)
ver John Pruski. 2011

No. 13976

Type Specimen
HERB. M.B.G.

HONDURAS
Herbarium of
Escuela Agrícola Panamericana

Nº 13976
Senecio morazensis Greenm., n. sp.
Fls. yellow, vine in tree cloud forest
area in montains above
San Juancito, Departamento Morazán
Louis O. Williams
Antonio Molina R.
Alt. 2000 m.
March. 25-48

Figure 28. Holotype of *Senecio morazensis* Greenm. (≡ *Pentacalia morazensis*). (*Williams & Molina 13976*, MO).

7. **Pentacalia parasitica** (Hemsl.) H. Rob. & Cuatr., Phytologia 40: 44. 1978. *Senecio parasiticus* Hemsl., Biol. Cent.-Amer., Bot. 2: 244. 1881. *Cacalia parasitica* (Hemsl.) Sch. Bip. ex A. Gray, Proc. Amer. Acad. Arts 19: 53. 1883. Syntypes: **MEXICO. Veracruz**. Orizaba, Mar 1855, *Botteri 1087* (G, K-HOOK). **MEXICO. Veracruz**. Vallée de Cordova, 24 Feb 1866, *Bourgeau 1926* (BR, K, MPU, P, US). **MEXICO. Veracruz**. Mirador, 1842, *Liebmann 165 (8873)* (C-2, GH, K, P; the two sheets in C of *Liebmann 165 (8873)* are on IDC microfiche 2204 set, 192.I.1–192.I.2; the sheet in GH is a fragment and drawing of sheet 1 in C, the sheet with a single large branch; *8873* may be the collection number, but *165* is the number in the protologue, albeit perhaps a species number).

[Lectotypification is neither nomenclaturally nor taxonomically needed, and I simply follow traditional application of the name using the circumscription method. Study in NY, US, and MO over the years hints that each of the three syntypes of *P. parasitica* represents the same disciform taxon, and it seems unlikely that any K syntype sheets are instead radiate *P. venturae*. Nevertheless, lectotypification will be proposed only when each K syntype is in hand, critical details of the florets of each are studied simultaneously, and can be confirmed to represent a single taxon.]

Climbing vines; stems glabrous or subglabrous; herbage glabrous or subglabrous. **Leaves** petiolate; blade 4–9 × 1.4–3 cm, elliptic-ovate to ovate, subcarnose, pinnate-veined with 2–4 visible or immersed arching secondary veins per side, tertiary venation usually not visible, when visible tertiary venation forming an extremely loose reticulum with areolae ca. 5+ mm diam., surfaces concolorous, glabrous, base cuneate to obtuse, margins entire, apex acuminate to attenuate; petiole 0.4–1.2 cm long. **Capitulescence** to 20+ × 15+ cm, mostly terminal, pyramidally racemose or cymose-paniculate, leafless, proximal lateral branches to 10+ cm long, ultimate 2–4 capitula pedunculate, usually well-spaced (sometimes closely spaced); peduncles 1–5(–7) mm long, puberulent or subglabrous, sometimes weakly 1–2-bracteolate or capitula 1–2-subcalyculate, bracteoles ca. 1–1.5 mm long, sessile, lanceolate, chartaceous. **Capitula** disciform (?sometimes discoid), 8–10.5 mm long, (15–)19–23-flowered; involucre 2.5–4 mm diam., broadly cylindrical, florets usually only slightly exserted to rarely post-fruit well-exserted; phyllaries usually 8, (5–)6.5–9 × 1–1.5 mm, about as long as disk florets, lanceolate to elliptic-lanceolate, typically free, glabrous or rarely apex ciliate-fimbrillate, apex acute to obtuse; calycular bracteoles usually 1–4 and 1–3.5 mm long. **Ray florets** absent. **Marginal pistillate florets** usually (4–)5, sometimes loosely associated with an individual phyllary and not much exserted from it; corolla 5–6 mm long, yellow, lobes ca. 1 mm long. **Disk florets** (11–)14–18; corolla 6–7.5 mm long, yellow, glabrous, tube longer than or subequal to limb, lobes 1–1.5 mm long, usually shorter than to about as long as throat; anthers ca. 2 mm long, tails ca. 0.2–0.3 mm long, shorter than to about half as long as collar. **Cypselae** 1–2 mm long, glabrous; pappus bristles 5–7 mm long, 1(–2)-seriate, usually reaching to about the middle of the disk corolla lobes, apices sometimes obtuse.

Distribution and ecology. *Pentacalia parasitica* is an infrequent regional Atlantic slope endemic known only from Mexico and Guatemala. It may also occur in Honduras. The species flowers mostly from October to April, and occurs from (700–)1000–2300(–2700) meters elevation.

Representative collections. **GUATEMALA**. *Contreras 9451* (MO, TEX, US; with budding disciform capitula, elongate phyllaries, and mostly short terminal capitulescences). [?**HONDURAS**. *House 1132* n.v., cited by Nelson 2008, but neither seen nor verified by the author, may perhaps be the *P. morazensis*-like imperfect plants with somewhat clavate pappus bristles seen by the author]. **MEXICO. Chiapas**. Cited by Redonda-Martínez and Villaseñor-Ríos (2011) and Villaseñor (2016). **Oaxaca**. *Breedlove & Sigg 65897* (CAS, MO, TEX; distributed as *P. morazensis*); *García 157* (MEXU n.v., cited by Redonda-Martínez and Villaseñor-Ríos 2011); *Lorence et al. 4342* (MO, NY); *Torres & Martinez 4831* (MO; from Cerro Baul within a few km of the border with Chiapas, appears to be a short involucral variant of *P. parasitica*). **Puebla**. Cited by Villaseñor (2016: 93). **Veracruz**. *Purpus 8160* (MO, US); *Schaffner 358* (P).

Pentacalia parasitica is recognized by its terminal capitulescence of disciform capitula (given as discoid in the protologue) with an involucre of eight free phyllaries nearly as long as the florets. *Pentacalia parasitica* is, among regional species, similar to both Mexican *P. guerrerensis* (T.M. Barkley) C. Jeffrey and Pacific-slope Mesoamerican *P. phorodendroides*, both of which differ from *P. parasitica* by their relatively short involucres, with P. *phorodendroides* differing further by its axillary flowering and its adjacent phyllaries often connate.

Material of *Pentacalia parasitica* from Oaxaca may have involucres much shorter than the disk florets as typical of *P. guerrerensis*, but otherwise, especially in lacking the large calycular bract of *P. guerrerensis*, the Oaxacan material seems to match *P. parasitica*. *Torres & Martinez 4831* (MO) from Oaxaca, on the western foot of Cerro Baul within a few km of the border with Chiapas, appears to be another unusually short involucral disciform variant of *P. parasitica*. Some collections from Guatemala and Chiapas formerly referred to *P. parasitica* have axillary capitulescences and are now referred to *P. phorodendroides*.

Breedlove (1986: 54) cited *Matuda 5461* from Chiapas as *Pentacalia parasitica*, but instead this collection is a paratype of *P. phorodendoides*. Barkley (1975: 1272) referred material from Panama to *Senecio parasiticus*, but *Kirkbride & Duke 977* cited by Barkley as *Senecio parasiticus*, is instead the type of *Dresslerothamnus hammelii*. Of material of the three collections (two imperfect) cited in the Flora of Panama, Barkley (1975) says they possibly represent "more than one entity." Robinson and Cuatrecasas (1978) and Pruski and Robinson (2018) excluded this species from Panama, and instead give its distribution as only Mexico, Guatemala, and possibly Honduras.

8. PENTACALIA PHANERANDRA (Cufod.) H. Rob. & Cuatr., Phytologia 40: 44. 1978. *Senecio phanerandrus* Cufod., Arch. Bot. (Forlì) 9: 203 (as "103"). 1933. **TYPE: COSTA RICA. Alajuela.** Volcán Poás, 2400 m, 25 Apr 1930, *Cufodontis 544* (holotype: W; isotypes: F, MO). Figures 2D, 6C, 22C–D, 29.

Sprawling shrub with hanging branches to climbing vines 1–5 m tall; stems much-branched, often at nearly right angles, pluristriate, hirsutulous-puberulent at least in axils to sometimes subglabrous, pith solid, trichomes uniseriate, several-celled, patent. **Leaves** petiolate; blade 2.5–8 × 1–2.8 cm, lanceolate to elliptic, chartaceous to stiffly so, pinnately veined, secondary veins not immersed, 6–13 per side, spreading at nearly right angles to midrib, tertiary venation visible and forming reticulum, surfaces concolorous, glabrous, base cuneate to obtuse, margins usually denticulate or dentate with 10–17 teeth per side or less frequently subentire, apex usually acute to acuminate; petiole 0.5–1.4 cm long. **Capitulescence** terminally corymbiform-paniculate on the many elongate (10–25 cm long) distal axillary laterally spreading branches, branches much longer than subtending leaves, ultimate capitula 3–10 in 1–2 cm diam. clusters; peduncles 2–5 mm long, crisped-puberulent, often 1–2-bracteolate; bracteoles ca. 1 mm long, sessile, elliptic-lanceolate, thin-chartaceous. **Capitula** disciform or sometimes discoid, 5–7 mm long, 10–14-flowered; involucre usually ca. 2(–2.5) mm diam., shorter than florets, broadly cylindrical, usually loosely 2–5-calyculate, calycular bracteoles 1–3 mm long, elliptic-lanceolate; phyllaries 8, 3.8–4.2 × 0.8–1.2 mm, linear-lanceolate, typically free, often 3-costate proximally, glabrous or apex sometimes fimbrillate, base often gibbous, usually narrow-margined, apex acute to obtuse. **Ray florets** absent. **Marginal florets** (0–)1–2; corolla 4–5-lobed. **Disk florets** 10–12; corolla 3.5–4.5 mm long, white, glabrous, lobes 1.2–1.7 mm long, usually much longer than the throat, often recurved, central resin duct often visible; anthers usually well-exserted, sometimes pale violet; styles often directed outward, margins distally papillose, apex sometimes also papillose. **Cypselae** 1–1.5 mm long, glabrous, pappus bristles 3–3.5 mm long, 2-seriate with some bristles distinctly inserted within outer series.

Distribution and ecology. *Pentacalia phanerandra* is a locally common regional endemic known only from Costa Rica and Panama, most often on volcanoes and the Cordillera de Talamanca. It occurs from (1300–)1500–3300 meters elevation, and flowers mostly from January–May(–July).

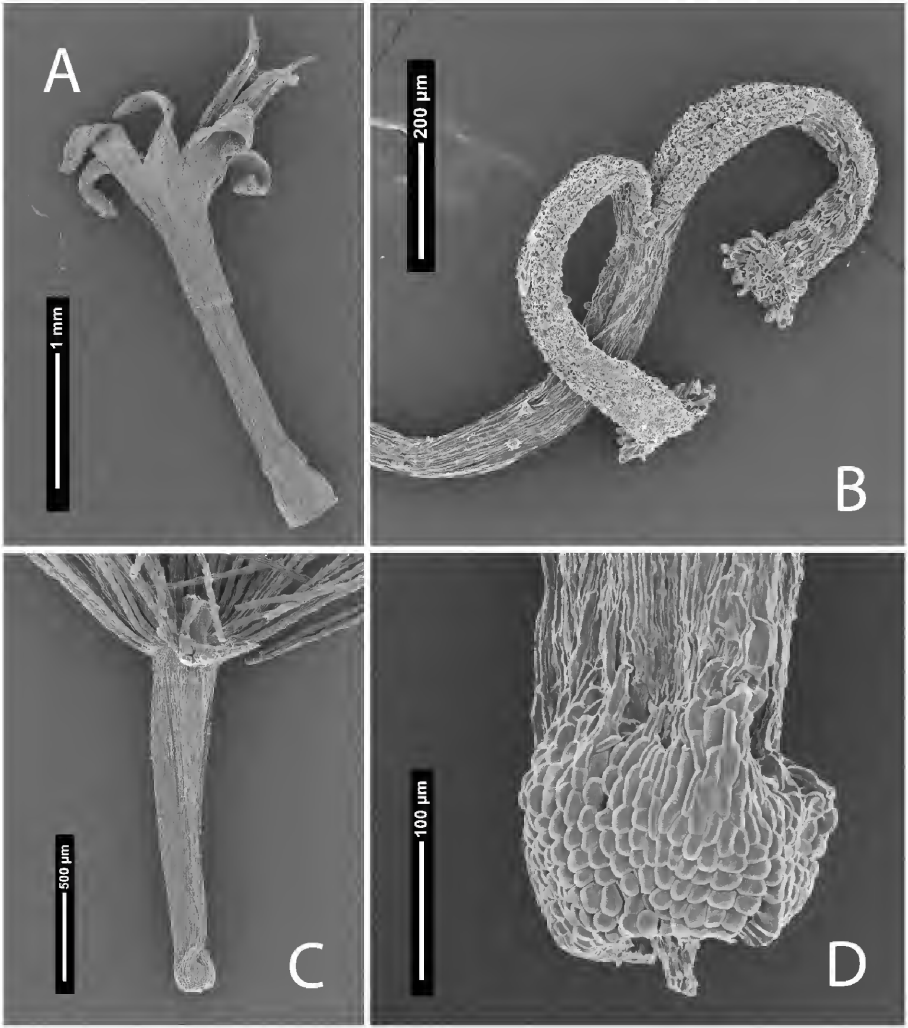


Figure 29. Floral characters of white-flowered *Pentacalia phanerandra*. A. Anther cylinder (upper right) and disk corolla. B. Bifid style, with branch on right showing the 2-banded adaxial stigmatic surface. C. Obconic, glabrous, immature cypsela. D. Immature cypsela base showing symmetrical mid-sized carpopodium and several rows of carpopodial cells. (From *van der Werff & Herrera 7236*, MO).

Representative collections. **COSTA RICA.** *Almeda & Nakai 3806* (US); *Grayum & Quesada 7433* (MO, TEX); *Greenman & Greenman 5392* (MO); *Hammel et al. 19484* (CR, MO); *King 6436* (MO, NY, US); *King & Castro 10005* (MO, US); *Morales 7533* (MO); *Pittier 2050* (US); *Rodríguez et al. 10662* (INB, MO); *Standley & Valerio 50544* (MO, US); *Tonduz 1894* (US): *Williams 16280* (MO). **PANAMA.** *Davidse et al. 25466* (MO); *Gómez et al. 22667* (MO, US); *Hammel 7384* (MO, US); *Klitgaard et al. 835* (BM, MO, PMA; in PMA web database as *P. wilburii*); *Monro & Knapp 5175* (BM, INB, MEXU, MO, PMA; voucher of photographs used here in as Fig. 22C–D); *van der Werff & Herrera 7236* (MO, US).

By its leaves that are chartaceous, pinnately veined, often ovate and dentate and by its white or ochroleucous corollas (Fig. 22C–D), *Pentacalia phanerandra* is obviously similar to a group of otherwise South American species centering about *P. arborea*, the generitype (Figs. 3B, 8A, 23). *Pentacalia phanerandra* is the only Central American member of this tightly knit species group. *Pentacalia phanerandra* is endemic to Central America and was named for its well-exserted anthers. The species is now known from both Costa Rica and Panama, but was long-known from only Costa Rica (viz Greenman 1950; Robinson and Cuatrecasas 1978). Barkley (1975) did not report the species in Panama, but *P. phanerandra* is now known from several Panamanian collections.

As an aside, one noteworthy range extension of a related species is recorded here. Colombian *Pentacalia chaquiroensis* (Greenm.) Cuatr. is the *P. arborea* group member geographically nearest to Central America. *Pentacalia chaquiroensis* was long-known from only the type (Díaz-Piedrahita and Cuatrecasas 1999) collected near Páramo de Chaquiro about 200 km SW of Panama. The type is labeled as Bolívar, but instead is in Córdoba along the northern frontier with Antioquia. The species was not listed in Antioquia, Colombia by Pruski and Funston (2011), but is documented here as new to Antioquia, where it is known to the author from eight collections in páramos and montane forests. The voucher information is: **Pentacalia chaquiroensis** [Colombia. Córdoba (*Pennell 4290*, holotype NY, isotype MO); **Antioquia** (*Alzate et al. 4523*, *4716*, *4830*; *Atehortúa et al. 1253*; *Callejas & Uribe 12305*; *Fonnegra et al. 4369*; *Pipoly et al. 18555*, *18558*; specimens of each at MO)]. *Pentacalia chaquiroensis* occurs from 2200–3400 meters elevation, and should be looked for in Panama along the Colombian border on Serranía del Darién (Cerro Tacarcuna, 1875 m), Alturas de Nique (1700 m), and on Serranía de Pirre (ca. 1450 m). These peaks in Panama, however, are several hundred meters lower in elevation than the lowest recorded elevation for *P. chaquiroensis* in Colombia.

Standley (1938) noted that "tuberculate-scabrous" indument characterized *Pentacalia phanerandra*, in reference to the stiff trichomes of the dense-pubescent stemmed plants, although weaker pubescent plants often have merely crisped trichomes and then mostly in the inflorescence. Basically, the stems are more pubescent than the often subglabrous or glabrous leaves. Standley (1938) noted that some plants have distinctly narrow leaves that are subentire, thus atypical for the species. From material in front of me it appears that such variation is environmental, and the entire lanceolate leaves plants are generally from the lower elevation than are the typical ovate dentate leaved plants.

9. PENTACALIA PHORODENDROIDES (L.O. Williams) H. Rob. & Cuatr., Phytologia 40: 44. 1978. *Senecio phorodendroides* L.O. Williams, Phytologia 31: 445. 1975. **TYPE: GUATEMALA. Escuintla.** Finca Monterrey, south slope of Volcán de Fuego, 1140–1260 m, 5 Feb 1939, *Standley 64554* (holotype: F). Figure 25C.

Pentacalia horickii H. Rob.

Large climbing vines; stems subglabrous, internodes much shorter than the relatively narrow leaves. **Leaves** petiolate; blade 4.5–10 × 1–4 cm, lanceolate to elliptic or oblong, subcarnose, indistinctly pinnately veined, surfaces concolorous, glabrous, base narrowly cuneate, margins entire, apex acuminate or attenuate to infrequently obtuse; petiole 0.7–1.5 cm long. **Capitulescence** of mostly axillary (position distinctive even on fragmentary herbarium specimens) branchlets from the distal 5–10+ nodes, corymbiform or corymbiform-paniculate, more or less cylindrical in shape, branches 3.5–10 cm long and shorter than to slightly longer than subtending leaves, ultimate capitula pedunculate and usually well-spaced; peduncles 1.5–13 mm long, puberulent, often 1–3-bracteolate, bracteoles 1–2 mm long, sessile, lanceolate, chartaceous. **Capitula** disciform or sometimes obscurely very short-subradiate with limb or limb-like spreading throat-lobes of marginal florets held within involucre (sometimes both conditions on single individuals), 7.5–9.5 mm long, 10–18-flowered; involucre 2–3.5 mm diam., narrowly campanulate, disk florets well-exserted, not obviously calyculate to sometimes loosely few-calyculate; phyllaries 5–8 (i.e., 8 coalescing into as few as 5), 4–6 × 1.2–2.5 mm, typically shorter than disk florets, lanceolate to ovate, glabrous, apex acuminate to obtuse, several capitula per branch with some phyllaries connate to near apex. **Ray florets** characteristically absent, but sometimes pistillate showing a very reduced to minute limb; they are described below as marginal florets, where they are termed subradiate. **Pistillate marginal florets** 2–3, actinomorphic and narrowly tubular or sometimes slightly zygomorphic and subradiate; corolla yellow, glabrous, tube (3–)4–5 mm long, longer than limb, limb 1–2 × ca. 0.5 mm and slightly zygomorphic (then limb about as long as disk anthers and somewhat falsely resembling them) or 1–2.5 mm and actinomorphically 3–5-lobed, when zygomorphic sometimes loosely enclosing style trunk. **Disk florets** 8–15; corolla 6–7 mm long, yellow, glabrous, lobes (1–)1.5–2.2 mm long, about as long as throat; style branch distal abaxial surface and margins relatively short-papillose, papillae to ca. 0.1 mm long. **Cypselae** 1.4–2.4 mm long, glabrous; pappus bristles 5–6.5 mm long, usually reaching to about the middle of the disk corolla lobes.

Distribution and ecology. *Pentacalia phorodendroides* is an uncommon regional endemic known from mostly Pacific slopes in Chiapas, Guatemala, and El Salvador. It occurs in forests from 1100–2800 meters elevation, and flowers mostly from December–February.

Representative collections. **EL SALVADOR.** *Villacorta 528* (LAGU, MO). **GUATEMALA.** *Horich /Blydenstein 57.247-1* (US; of Guatemalan stock, but grown in California); *Kellerman 6805* (US); *Standley 85080* (MO; voucher of photograph of involucres with connate phyllaries used here). **MEXICO. Chiapas.** *Breedlove & Almeda 58149* (CAS, US); *Breedlove & Thorne 31042* (CAS, MO); *Matuda 5461* (CAS, MEXU, TEX).

Pentacalia phorodendroides is somewhat morphologically plastic in that the adjacent phyllaries are sometimes connate (Fig. 25C), and its capitula may be either disciform or obscurely very short-subradiate. *Pentacalia phorodendroides* is unusual among disciform species by its proximal nodes often with an axillary capitulescence, this characteristically shorter than the subtending leaves. This axillary flowering character occurs elsewhere in Central American species, e.g., *P. matagalpensis*, which is consistently (short) radiate and has disk corolla lobes much longer than throat. The involucre characters of its eight phyllaries sometimes fused into as few as five overly broad phyllaries is noteworthy. The connate phyllary character diagnoses the species among Central American species, but occasional fusion of phyllaries occurs sporadically elsewhere in the genus. In *P. phorodendroides* the involucre often much shorter than the florets, but nevertheless the species is similar to disciform *P. parasitica*, a species that occurs in the Gulf-Atlantic slope forests and has free phyllaries about as long as the disk florets and terminal capitulescences.

Pentacalia phorodendroides was described by Williams (1975, 1976) as "discoid." The paratypes *Standley 85080* from San Martín Chile Verde and *Matuda 5461* from Chiapas were cited by Williams (1975), respectively, as *"58080"* and "*15461*". *Matuda 5461* is from an elevation of 2585 meters, but was cited by Williams as from "258" meters elevation.

10. PENTACALIA STREPTOTHAMNA (Greenm.) H. Rob. & Cuatr., Phytologia 40: 44. 1978. *Senecio streptothamnus* Greenm., in Standley, Flora of Costa Rica, Publ. Field Mus. Nat. Hist., Bot. Ser. 18: 1518. 1938. **TYPE: COSTA RICA.** Las Vueltas, Tucurrique, 635–700 m, Mar 1889, *Tonduz 13275* (holotype: GH; isotypes: B† (as Macbride negative 15756), K, MO, P-2, US). Figures 25A, 30.

Figure 30. Isotype of *Senecio streptothamnus* Greenm. (≡ *Pentacalia streptothamna*). The species is radiate, but nevertheless similar in gestalt to *P. candelariae*. (*Tonduz 13275*, B†).

Woody vines to 15 m tall; stems puberulent to glabrate, sometimes fistulose, trichomes not bent. **Leaves** petiolate; blade (2.5–)4–7 × 1.5–2.5(–3.5) cm, elliptic to ovate or oblanceolate, subcarnose, with 3–5 mostly immersed arching secondaries per side, tertiary venation somewhat distinct, surfaces concolorous, glabrous, base cuneate to attenuate, margins entire, apex acuminate to obtuse; petiole 0.5–1(–2) cm long. **Capitulescence** terminal on larger stems and held above leaves, corymbiform-paniculate, not leafy-bracteate, without specialized large primary bracts, moderately dense, larger branchlets crisped-puberulent, subtended by a thin-chartaceous lanceolate to ovate bracteole 5–20 mm long; peduncles 2–20 mm long, few-bracteolate, crisped-puberulent, bracteoles 2–4 mm long, linear-lanceolate, often spreading. **Capitula** radiate, (6–)7–10 mm long, 10–15-flowered; involucre 3–5 mm diam., narrowly campanulate, disk florets slightly to moderately exserted; phyllaries 8, 5–6.5(–7) mm long, lanceolate, typically glabrous (infrequently puberulent) with apex usually ciliate-fimbriate; calycular bracteoles 1–3 mm long, lanceolate to elliptic. **Ray florets** 2–5; corolla yellow, glabrous, tube ca. 3.5 mm long, limb 2.5–5 × 1–1.5 mm, elliptic-oblong, 4-nerved. **Disk florets** 8–10; corolla (4.5–)5.5–7 mm long, narrowly funnelform, yellow, glabrous, lobes 1.5–2 mm long, about as long as throat; style branch papillae to ca. 0.15 mm long. **Cypselae** 1–2 mm long, glabrous or subglabrous; pappus bristles 5–6 mm long, usually reaching to about the middle of the disk corolla lobes.

Distribution and ecology. *Pentacalia streptothamna* is one of the most common regional endemic Pentacalias, and is known from Nicaragua southeast to Panama. It occurs from 500–2600 meters elevation, and flowers mostly from February–July.

Representative collections. COSTA RICA. *Burger & Gentry 8644* (F, MO, US); *Grayum 9685* (K, MO, NY, USJ, TEX, US); *Haber et al. 11029* (INB, MO, TEX); *Herrera 5859* (CR, MO, TEX); *King 6834* (MO, US); *Skutch 3440* (MO, NY, US). **NICARAGUA.** *Wright s.n.* (NY, US; the budding NY sheet is presumably the same collection as flowering US sheet). **PANAMA.** *Croat 37239* (MO, US); *Croat 66596* (MO); *van der Werff & Herrera 7103* (KSC, MO).

Among Central American Pentacalias, *Pentacalia streptothamna* is obviously similar to *P. tonduzii*, but the two are readily distinguished by technical characters. *Senecio streptothamnus* (*P. streptothamna*) is the type of synonymous *Senecio* sect. S*treptothamni* Greenm. Although the author citation of *Senecio streptothamnus*, the basionym, is sometimes given as 'Greenm. ex Standl.', Standley (1938: 1419) in his introduction to the Compositae treatment for Flora of Costa Rica, credits 'Dr. J. M. Greenman' who "supplied descriptions of several new species" (i.e., *S. brenesii* Greenm. & Standl., *S. schizotrichus* Greenm., *S. streptothamnus* Greenm., and *S. tonduzii* Greenm.). The author citations attributions used by Standley are followed here.

11. **PENTACALIA TONDUZII** (Greenm.) H. Rob. & Cuatr., Phytologia 40: 44. 1978. *Senecio tonduzii* Greenm., in Standley, Flora of Costa Rica, Publ. Field Mus. Nat. Hist., Bot. Ser. 18: 1519. 1938. **TYPE: COSTA RICA.** La Palma, 1459 m, 8 Sep 1898 [as 'August' in protologue], *Tonduz 12542* (holotype: US; isotypes: B† (as Macbride negative 15770), BM, G, GH, K). Figures 1D, 6A, 10C, 31–33.

Scrambling vines; stems puberulent with collapsed bent simple trichomes, falsely appearing oblique-appendiculate, pith solid or sometimes narrowly fistulous. **Main stem leaves** petiolate; blade 6–12(–17) × 3.5–9.5 cm, ovate, subcarnose, with 3–5 partly immersed arching secondaries per side, surfaces concolorous, glabrous or subglabrous, base cuneate, margins entire, apex acuminate or acute to broadly ovate or rounded acute; petiole 1–2.5 cm long. **Capitulescence** terminal on main axis or on lateral branches and moderately longer than subtending leaves, openly corymbiform to corymbiform-paniculate, leafy-bracteate with specialized large elliptic to ovate, subsessile primary bracts to ca. 4 cm long; peduncles 10–30 mm long, paucibracteolate, puberulent. **Capitula** radiate, 9–10 mm long, 17–21(–24)-flowered; involucre 5–7 mm diam., turbinate-campanulate, disk florets slightly to moderately exserted; phyllaries 8, 6–8 mm long, lanceolate, glabrous with apex ciliate-fimbriate; short-calyculate. **Ray florets** ca. 5(–8); corolla yellow, glabrous, tube 2.7–5 mm long, limb 3.7–5 mm long, often linear-lanceolate and 2-nerved to oblong and 4-nerved. **Disk florets** 12–16; corolla 7.2–8 mm long, narrowly funnelform, yellow, glabrous, lobes 1.5–2 mm long, about as long as throat; anthers 2–2.2 mm long, collar ca. 0.5 mm long; style branch papillae to ca. 0.1 mm long. **Cypselae** (immature) ca. 1 mm long, glabrous; pappus bristles 4–5.5 mm long, reaching only to about the base of the disk corolla lobes.

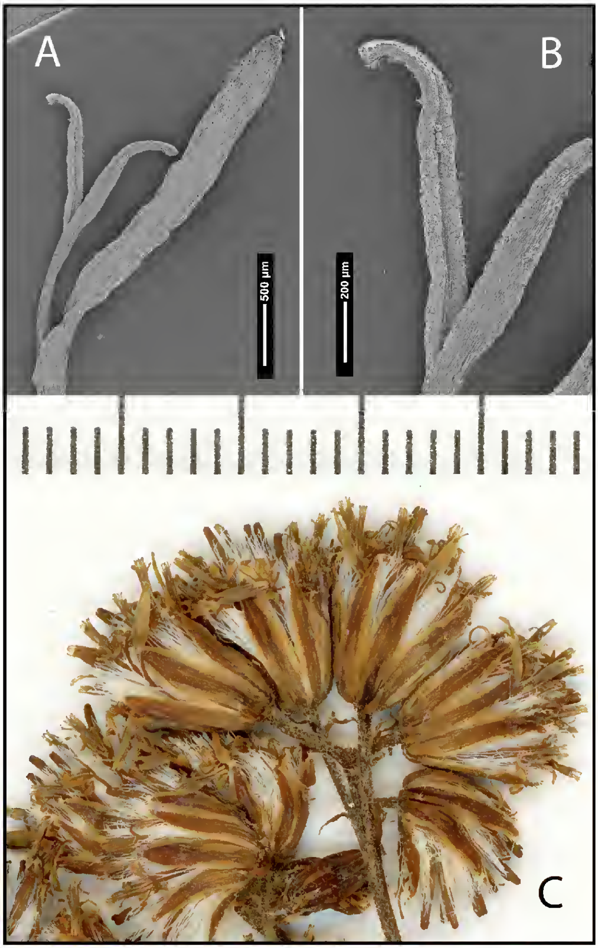


Figure 31. Florets and capitula of *Pentacalia tonduzii*. A. Distal portion of ray floret showing bifid style on left and corolla limb on right. The ray corolla limb of *P. tonduzii* is often 2-nerved, linear-lanceolate, and about the same width as a disk floret anther cylinder. B. Close up of ray floret style branches showing on left the 2-banded adaxial stigmatic surface. C. Capitula showing the uniseriate involucre of 8 subequal glabrous phyllaries, short calyculus, and short ray corolla limbs reaching to about the same height as the disk floret anther cylinders. (From *Alfaro 1546*, MO).

Figure 32. *Pentacalia tonduzii*, showing subcarnose leaves with arching pinnate venation and lateral bracteate capitulescences. (*Alfaro 1546*, MO).

Distribution and ecology. *Pentacalia tonduzii* is an infrequent regional endemic known only from Costa Rica and Panama. It occurs from 1500–2200(–2500) meters elevation, and has been collected in flower mostly in May, July, and September.

Figure 33. Post-anthesis isotype of *Senecio tonduzii* Greenm. (≡ *Pentacalia tonduzii*). (*Tonduz 12542*, B†).

Representative collections. COSTA RICA. *Alfaro 1546* (INB, MO); *Burger & Burger 7556* (F, MO, US); *Burger & Burger 7951* (NY); *Lankaster K146* (K; paratype); *Morales 6205* (INB, MO); *Wilbur & Almeda 16780* (US). **PANAMA.** *Correa et al. 2208* (MO, PMA); *Hammel 7476* (K, KSC, MO, NY, US; material is very robust, but the plant has the narrow ray limbs and large primary bracts, typical of the species).

Variation in ray limb size in *Pentacalia tonduzii* is noteworthy. The typical form has a short and narrow, 2-nerved ray corolla limb, but in some materials the limbs are larger and 4-nerved. At one point I considered using the epithet *leptopetala* for material with narrow ray corolla limbs, but I find no significant differences in other critical characters, and it seems best to simply circumscribe *P. tonduzii* broadly. Field studies are needed to study the range of variation in ray corolla limb lengths in this species, with the variation perhaps indicative of a relatively genetically flexible taxon.

Pentacalia tonduzii is notorious for having in many herbarium specimens collapsed, bent, simple trichomes. These bent trichomes are 0.15–0.3 mm long, curving, distal portion that is sometimes whitish and flattened (Fig. 10C), thereby superficially resembling pseudostellate-to-T-shaped trichomes of *Dresslerothamnus*. A very few trichomes appear nearly arachnoid with wispy apices. Nevertheless, in all specimens the trichomes are simple and the plants prove to be *Pentacalia*. Although the bent or broken trichome may hide its generic affinities, the trichomes as seen on much dried herbarium material nevertheless are basically diagnostic of the species.

Trichomes aside, *Pentacalia tonduzii* may be recognized most readily by large subsessile flowering bracts, corymbiform-paniculate capitulescences, and narrow ray corolla limbs, albeit overall the species is very similar to *P. streptothamna*. Although most specimens of *P. tonduzii* have moderate-sized, broad-tipped leaves, *Hammel 7476* seems different by its relatively long, narrower tipped leaves and corymbiform capitulescences. The subsessile-bracteate capitulescences and narrow ray corolla limbs of *Hammel 7476*, however, otherwise matches *P. tonduzii*. Costa Rican *Burger & Burger 7556* is intermediate in morphology between *Hammel 7476* and the more broad-tipped more typical leaf form of *P. tonduzii*. Several collections of *P. tonduzii* have linear-lanceolate ray corolla limbs (e.g., *Alfaro 1546*, Fig. 31A), somewhat atypical of *Pentacalia*, but never approaching the morphology of filiform-rayed *Dresslerothamnus*. On one hand, *P. tonduzii* seems like an overly narrowly circumscribed (simultaneously named) segregate of *P. streptothamna*, whereas at other times it seems atypical of *Pentacalia*. In technical characters, however, the species is shown to be both distinct from *P. streptothamna* and well-placed in *Pentacalia*.

12. **PENTACALIA WILBURII** H. Rob., Phytologia 40: 44. 1978. **TYPE: PANAMA. Chiriquí.** Above Cerro Punta towards Bajo Grande, about 6500 ft, 14 Jan 1970, *Wilbur et al. 10919* (holotype: DUKE; isotype: US). Figure 22A.

Woody vines; stems glabrous, sometimes with indurate ivory-white epidermal cells distally. **Leaves** petiolate; blade 3–6.5 × 1.5–3.3 cm, elliptic to obovate, carnose, with 2–3 fully immersed weakly visible ascending secondaries per side, without visible tertiary venation, surfaces concolorous, glabrous, base cuneate to somewhat attenuate, margins entire, apex acute; petiole 1–1.7 cm long. **Capitulescence** terminal on larger stems and held above leaves, broadly rounded corymbose-paniculate, without specialized large primary bracts, moderately dense, larger branchlets subtended by a small thin-chartaceous linear-oblanceolate bracteole to 10 mm long; peduncles 3–10 mm long, sparsely crisped puberulent, trichomes oblique-flagelliform, few-bracteolate, bracteoles 3–4 mm long, linear, spreading, glabrous or subglabrous, often nearly half as long as the phyllaries. **Capitula** radiate, 7–11(–14)-flowered, 8–10 mm long; involucre 3–4 mm diam., cylindrical to narrowly campanulate, disk florets slightly exserted; phyllaries 5(–8), 5–7 × 1–2 mm, linear-lanceolate to oblong, glabrous with apex ciliate-fimbriate; calycular bracteoles 3–4 mm long, linear. **Ray florets** 2–3; corolla yellow, glabrous, tube ca. 3.5 mm long, limb 3.5–4 × ca. 1.5 mm, elliptic-oblong, 3–6-nerved. **Disk florets** 5–8(–11); corolla 6.8–8.2 mm long, narrowly funnelform, yellow, glabrous, tube 3.5–4 mm long, lobes 1.3–1.7 mm long, much shorter than throat; anthers 2.5–3 mm long, tail longer (Robinson and Cuatrecasas 1978) or shorter (pers. obs.) than filament collar; style branch papillae to ca. 0.1 mm long. **Cypselae** 1.5–2 mm long, glabrous; pappus bristles 4–6 mm long, at maturity usually reaching to only about base of the disk corolla lobes.

Distribution and ecology. *Pentacalia wilburii* is an uncommon regional endemic known only from Costa Rica and adjacent western Panama. It occurs from 1900–3100 meters elevation, and flowers mostly from January to April.

Representative collections. COSTA RICA. *Alfaro 1582* (INB, MO); *Davidse & Pohl 1643* (US); *Davidse et al. 26141* (MO); *Santamaría & Monro 8848* (voucher of field photographs used in Fig. 22A, herbarium material not seen, and determination thus provisional; capitula radiate, pappus relatively short, and peduncular bracteoles relatively long as in *P. wilburii*). **PANAMA**. *Hammel et al. 6447* (MO); *Klitgaard et al. 734* (BM, MO, PMA).

Pentacalia wilburii may be recognized by its usually small leaves, peduncles with spreading linear-bracteoles, and radiate narrow capitula, typically with only five phyllaries, but which on occasion have eight phyllaries.

Excluded species

Pentacalia andicola (Turcz.) Cuatr., Phytologia 49: 252. 1981. ≡ **Monticalia andicola** (Turcz.) C. Jeffrey, Kew Bull. 47: 69. 1992.

Pentacalia firmipes (Greenm.) Cuatr., Phytologia 49: 254. 1981. ≡ **Monticalia firmipes** (Greenm.) C. Jeffrey, Kew Bull. 47: 70. 1992.

ZEMISIA B. Nord., Compositae Newslett. 44: 71. 2006. **TYPE:** *Cineraria discolor* Sw., Prodr. 114. 1788. (≡ *Zemisia discolor* (Sw.) B. Nord.).

Shrubs to trees; stems branched, subterete to weakly angled, costate-striate but not strongly angled, evenly and loosely leafy distally but never with leaves clustered distally in aerial rosettes, petiole base persistent; pith to 4+ mm diam., solid, not chambered; herbage (when pubescent) white-tomentose with simple eglandular trichomes without clear basal cells and with greatly elongated sinuous terminal cell (similar to Drury and Watson 1965 trichomes type 5 and Jeffrey 1987 trichome type 3d, but some seemingly longitudinally grooved as in Drury and Watson 1965 trichomes type 1). **Leaves** simple, alternate, petiolate or distal ones subsessile; blade stiffly chartaceous, midrib prominent abaxially, venation pinnate but secondaries forward arching, main secondaries 5–10 per side, tertiary reticulum occasionally prominent, surfaces obviously discolorous, eglandular, adaxial surface relatively dull-green, abaxial surface persistently white-tomentose, margins entire to denticulate, often slightly revolute. **Capitulescence** terminal, pluricapitulate and generally corymbiform to corymbiform-paniculate, rounded on top, individual capitula short-pedunculate; peduncle pluribracteolate; bracteoles linear, spreading. **Capitula** radiate, very loosely few-calyculate, sometimes fragrant; involucre narrowly campanulate, 1-seriate, subinvolucre obturbinate, often broad and sometimes inflated and indurate in fruit, with the few calycular bracteoles mostly proximal toward peduncle and resembling the peduncular-bracteoles; phyllaries (11–)12–13(–15), subequal, lanceolate, free or sometimes 1–2 pairs of adjacent phyllaries connate, margins stramineous-hyaline and relatively broad, midzone darkened, midnerve slightly resinous to obviously orange-resinous, at least some with margins usually scarious; calycular bracteoles linear-subulate; clinanthium solid, epaleate, convex, alveolate. **Ray florets** pistillate, uniseriate (3–)5–8; corolla white or yellow, glabrous, tube about as long as to shorter than limb. **Disk florets** bisexual; corolla narrowly funnelform, white or yellow, glabrous, shortly 5-lobed, resin ducts 10, tube dilated basally, as long as or longer than limb, lobes triangular, shorter than throat, 3-nerved, the medial resin duct sometimes obviously darkened, apical abaxial cells bulbous-thickened; anthers yellow, caudate, filament collar balusterform, basal cells slightly enlarged, endothecial tissue radial, tails of thecae narrow and elongate-pointed; style basically exappendiculate, stylopodium dilated, branches abaxially minute-papillose distally, stigmatic surfaces moderately discrete and 2-banded, abaxial collecting papillae short, sometimes a subapical abaxial crescent of a few slightly longer papillae present, apices convex. **Cypselae** oblong, terete in cross-section, (8–)10-costate, furrows scattered papillose-setose with myxogenic duplex trichomes, carpopodium distinct, annular, apical rim supporting pappus tan, ribs not decurrent onto carpopodium; pappus of many elongate, persistent but very fragile in dissected material, white, scabridulous bristles usually nearly as long as disk corollas.

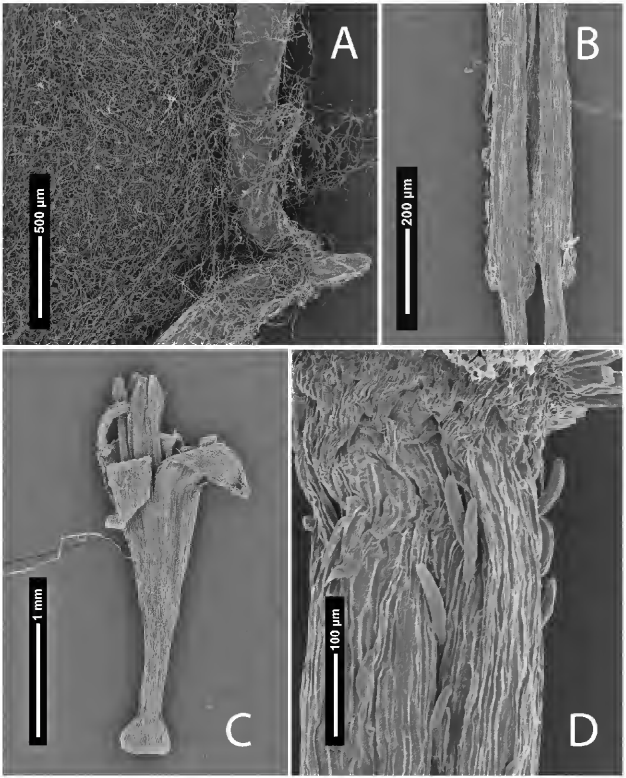


Figure 34. *Elekmania barahonensis* (Urb.) B. Nord., generitype. A. Abaxial leaf blade surface showing loose arachnoid-villous tomentum and marginal tooth. B. Anthers showing ecaudate thecae. C. Narrowly campanulate disk corolla showing relatively short tube. D. Cypsela showing papillose-setose surface with myxogenic duplex trichomes. From *Pruski & Ortiz 4068*, MO.

Senecio thomasii Klatt (syn. *S. deppeanus* Hemsl.), an arborescent Mexican and Central American plant with strongly discolorous leaves, was placed in *Senecio* sect. *Fruticosi* Greenm. by Greenman (1901, 1902, 1926) and Barkley (1985a), but was removed from *Senecio* by Pruski and Robinson (2018). Its balusterform filament collars (Figs. 36B, 37A) mark *S. thomasii* as a member of subtribe Senecioninae, but its caudate anther thecae (Fig. 36B) and convex-tipped (vs. truncate) style branches (Figs. 36C, 38A–C) are at odds with *Senecio* (Fig. 2F). *Senecio thomasii*, by woody habit, discolorous leaves, and caudate anthers, resembled continental *Monticalia*, but differed by (8–)10-costate, papillose-setose (vs. 5-costate, glabrous) cypselae with myxogenic duplex trichomes. Furthermore, *Senecio thomasii* never has ericoid-leaved habit nor holly-like leaves, thus differing from both *Monticalia* and *Scrobicaria*. In its myxogenic duplex trichomes (Fig. 36D), the cypselae of *S. thomasii* are similar to those of *Senecio* s. str., rather than to glabrous-fruited *Monticalia* (Fig. 8B). Pruski and Robinson (2018) though excluding it from *Senecio*, refrained from including the Klatt species in *Monticalia*, treating *S. thomasii* instead as "Género **A** sp. A," the only generically unplaced Mesoamerican Compositae. Because *Senecio thomasii* is unmatched in Mesoamerica, a home for it among the several endemic West Indian genera of Senecioneae was considered.

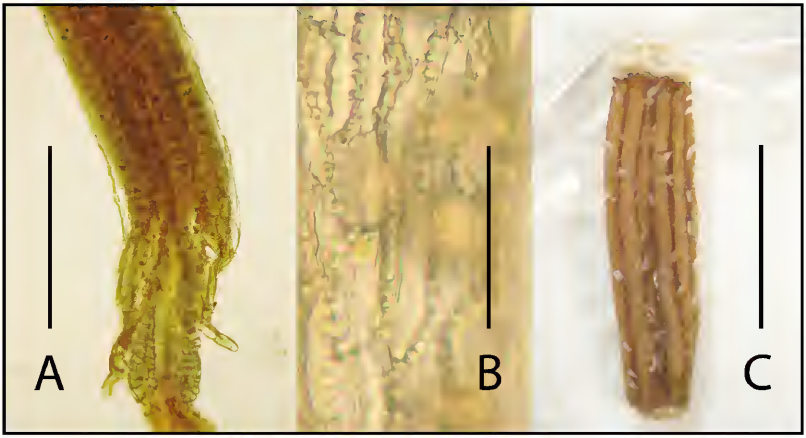


Figure 35. *Zemisia discolor*, generitype. A. Caudate stamen with balusterform filament collar, adaxial view. B. Radial endothecial tissue. C. Pluricostate papillose-setose cypsela showing myxogenic duplex trichomes. From *Gentry & Kapos 28324*, MO. [Scale bars: A 0.3 mm; B 20 µm; C 1 mm].

Nordenstam (2006) described seven new genera of West Indian Senecioneae. Six of these seven genera were sampled by Pelser et al. (2007 fig. 1K), and were recovered in a weakly supported clade (< 50% bootstrap support values) that mostly included other West Indian taxa. Two of these Nordenstam genera are exclusively vining, but several are shrubs to small trees. Included among the shrubs and small trees are three that are discolorous-leaved: *Antillanthus* B. Nord., *Elekmania* B. Nord. (Fig. 34), and *Zemisia* B. Nord. These three similar genera were initially presumed by the author to be *Monticalia*-like, but each has cypselae similar to those of *Senecio thomasii*, thereby differing from *Monticalia*. *Zemisia* is the only one of the three genera that is obviously caudate-anthered (Fig. 35A), but by its white-radiate capitula (Fig. 39) did not immediately match the so-called '*Senecio*' *thomasii* Klatt of Mexican and Central America.

Flower color aside, however, *Senecio thomasii* (Fig. 41) is nearly a dead ringer for *Zemisia discolor* (Fig. 39). Cypsela trichome characters are often significant generically in Senecioneae, but are not always so. For example, three species of Central American *Jessea* H. Rob. & Cuatr. (Senecioninae) have glabrous cypselae, but the fourth, *J. cooperi* (Greenm.) H. Rob. & Cuatr., has setose cypselae (Pruski and Robinson 2018). Koyama (1967) noted that in *Emilia* Cass. and *Gynura* Cass., cypsela pubescence characters are "of significance only at the specific level." Nevertheless, in the case of *Senecio thomasii*, cypsela characters are accepted as generic markers, precluding *Monticalia* from absorbing *Senecio thomasii*. *Senecio thomasii* (Figs. 36–37, 38A, 38C), by balusterform anthers, characteristic cypselae, and convex style branch tips, keys in Nordenstam's (2007) Senecioneae generic key to leads 177B and 181A. But, in the penultimate couplet (182) of the key, by yellow rays *S. thomasii* keys to Hispaniolan *Elekmania* B. Nord., rather than to white-rayed *Zemisia*. *Elekmania* (Fig. 34), however, has disk corollas narrowly campanulate with the tube shorter than limb, auriculate-based anthers, smaller dentate-serrate leaves, a different gestalt, and thus stands apart from *Zemisia*. All other woody continental and West Indian genera of Senecioneae with caudate anthers are distinct from *S. thomasii* and *Zemisia* in the stylar microcharacters of either continuous stigmatic surfaces, branch apices truncate or narrowed, stylar collecting papillae characters, or by lacking longitudinally grooved pubescent trichomes.

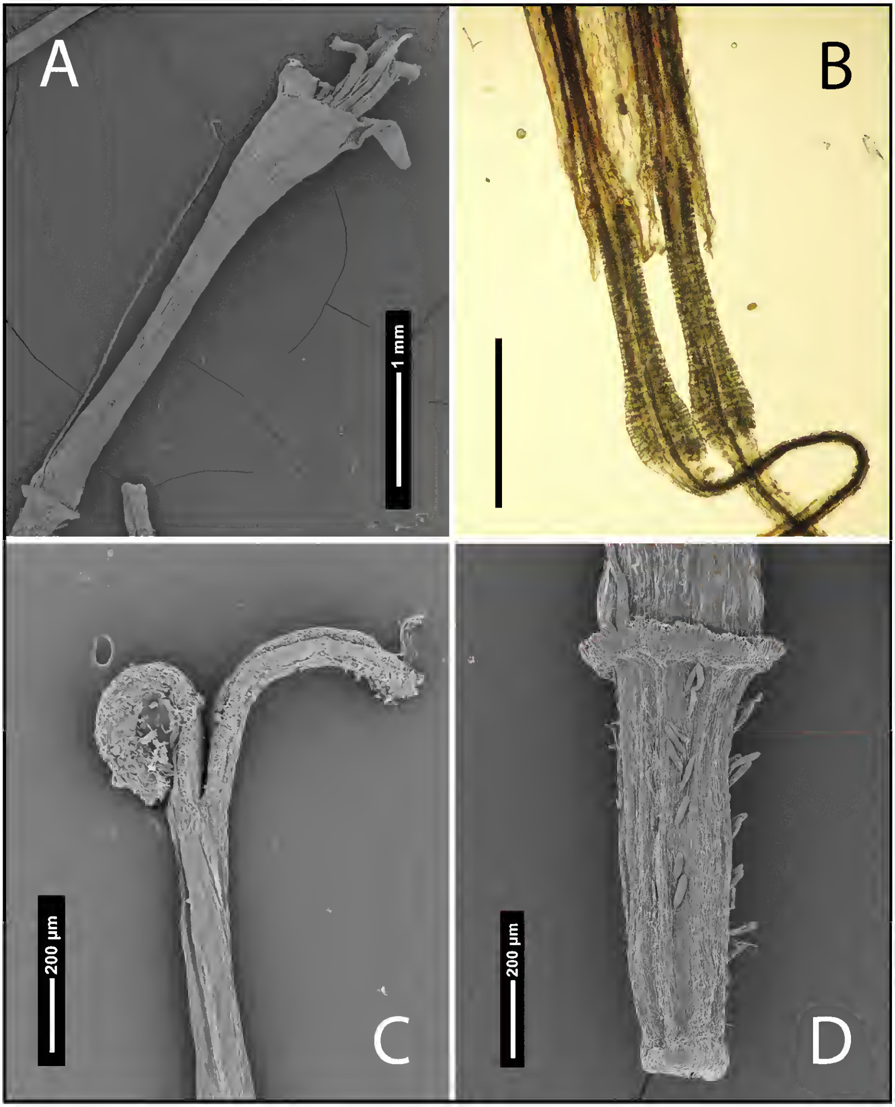


Figure 36. Floral morphology of *Zemisia thomasii*. A. Disk floret with narrowly funnelform corolla, one pappus bristle (on left) intact. B. Two stamens showing anther tails and balusterform filament collars. C. Disk floret style showing the two branches, each with a 2-banded stigmatic surface and convex branch apex. D. Immature cypsela showing papillose-setose surface with myxogenic duplex trichomes. (A, D *Breedlove 24567*, MO; B *Villacorta & Lara 2540*, MO; C *Monterrosa & Carballo 508*, MO). [Scale bar: B 0.25 mm].

Although white flowers are often associated with the Cacalioid Syndrome (Pippen 1968), they are not exclusive to subtribe Tussilagininae; conversely not all Tussilagininae are exclusively white-flowered. Nordenstam (1978, 2007) noted that *Brachyglottis* J.R. Forst. & G. Forst. (Tussilagininae in Bremer 1994) from New Zealand includes a handful of white-radiate species, but that most species are yellow-flowered. Bertil Nordenstam (1978) suggested that the white rays in these species may in part reflect the Insular Syndrome (Carlquist 1974). The Insular Syndrome which in part correlates white flowers and lack of fragrance, however, does not seem to apply to sweet-scented (Moore 1936) *Zemisia discolor* (Senecioninae). However, given the variation in flower color in *Brachyglottis* accepted by Nordenstam (1978, 2007), the yellow flowers of continental *Senecio thomasii* do not discourage its inclusion in formerly monotypic, formerly white-flowered, formerly West Indian endemic *Zemisia.* The similar gestalt, large discolorous leaves, caudate anthers, convex styles, disk corolla morphologies, and pubescent pluricostate cypselae suggest that *Senecio thomasii* is a second species of *Zemisia.*

Here, *Senecio thomasii* is treated as congeneric with formerly monotypic *Zemisia* B. Nord., typified by Jamaican *Z. discolor* (Sw.) B. Nord. *Zemisia* is monographed, the new combination *Zemisia thomasii* (Klatt) Pruski made, the genus boundaries are broadened, and the generic description is emended to reflect that both white-rayed and yellow-rayed plants are now included in *Zemisia.* Although most Senecioninae are yellow-flowered, by its balusterform filament collar (Fig. 35A) white-flowered *Zemisia discolor* is obviously Senecioninae. Robinson (in Proctor 1982) treated the generitype of then-unpublished *Zemisia* as *Pentacalia discolor* (Sw.) H. Rob., but I follow Jeffrey (1992a) and Nordenstam (2006, 2007) and recognize (8–)10-costate-fruited, woody American elements as distinct from pentagonal-fruited *Pentacalia* and *Monticalia.* *Zemisia* seems most similar to simultaneously validated *Elekmania*, but as mentioned above disk corolla and anther characters distinguish them. *Zemisia* is a new generic record for Mexico and Central America and is revised in conjunction with the Trees of Mexico project.

The penultimate lead in the key to genera of Senecioneae in Nordenstam (2007) may thus be modified as follows:

182. Capitula radiate; corollas white or yellow; disk corollas narrowly funnelform, tube as long as or longer than limb; anthers caudate; (2 spp.; Jamaica, Mexico, Central America) .... **477. Zemisia**
182. Capitula radiate or discoid; corollas yellow; disk corollas narrowly campanulate, tube shorter than limb; anthers auriculate-based; (9 spp.; Hispaniola) .... **479. Elekmania**

As treated here the two species of *Zemisia* each have equal-sized, strongly discolorous leaves. The leaves of *Z. discolor* are more broad-based, whereas the secondary venation is more prominent in *S. thomasii. Zemisia discolor* has much denser phyllary pubescence, and *Zemisia thomasii* has a prominent central resin duct abaxially in its phyllaries. Conversely, the phyllaries of *Zemisia thomasii* are loosely arachnoid at base, and in post fruiting involucres of *Zemisia discolor* a resin duct is apparent adaxially. Shrubby *Senecio cinerarioides* Kunth has a prominent central resin duct abaxially in its phyllaries similar to those of *Zemisia thomasii*, but the *Senecio* is not congeneric with *Zemisia.* In these two cases, the author does not take the value of this resin duct character as generically significant. Although vining Cuban *Leonis* B. Nord. has phyllaries with noticeable resin ducts, these resinous lines are thin, darkly staining, do not recall other genera, and in this example perhaps are generic significant. Many technical characters of disk corolla shapes and apical cells characters (less pronounced than those in *Scrobicaria*), anthers, style branches, and cypselae unit the two species of *Zemisia*, although the two differ so obviously in flower color and in turn presumably in pollinators. *Zemisia* is montane and mid elevational, as are many woody Neotropical tribe Senecioneae. The bulbous-thickened disk corolla lobe character of *Zemisia* is found also in several other woody Neotropical subtribe Senecioninae (e.g., *Monticalia* and *Scrobicaria*).

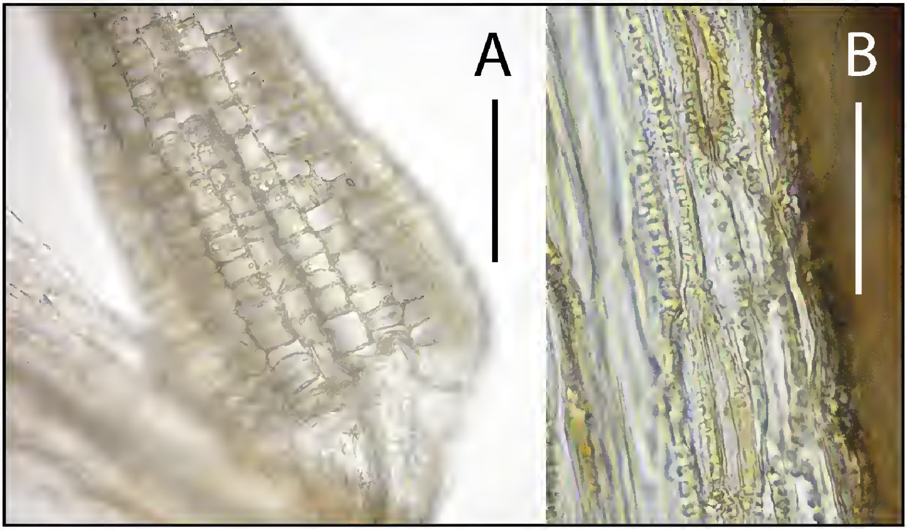


Figure 37. Floral microcharacters of *Zemisia thomasii*. A. Close-up of balusterform filament collar showing enlarged basal cells. B. Radial endothecial tissue showing the irregular thickenings arranged vertically. From *Villacorta & Lara 2540*, MO. [Scale bars: A 0.08 mm; B 15 µm].

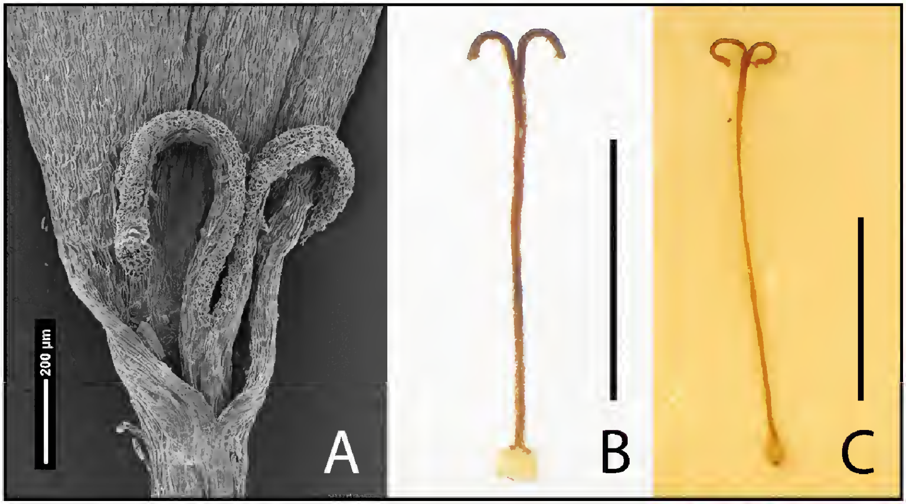


Figure 38. Ray floret and disk styles of *Zemisia*. The style branch apices are convex and the stylopodium enlarged. A. *Zemisia thomasii*, ray floret showing bifid style. The adaxial ligule epidermal cells are quadrangular, typical of yellow ray florets of Senecioneae. B. *Zemisia discolor*, disk style. C. *Zemisia thomasii*, disk style. (A *Breedlove 24567*, MO; B *Gentry & Kapos 28324*, MO; C *Villacorta & Lara 2540*, MO). [Scale bars: B 2.2 mm; C 3 mm].

Key to species of Zemisia

1. Ray corollas white; leaf blade base broadly obtuse to truncate or subcordate; peduncles mostly densely white arachnoid-tomentose; phyllaries densely white arachnoid-tomentose with glabrous tips, without obvious broad central resin duct abaxially; disk corollas 3–4 mm long; (Jamaica) .... **1. Zemisia discolor** (Sw.) B. Nord.

1. Ray corollas yellow; leaf blade base cuneate to narrowly obtuse; peduncles very loosely lanate to glabrous; phyllaries mostly glabrous or sometimes lingering arachnoid-villous, with a broad orange central resin duct abaxially; disk corollas 4.5–6.5 mm long; (Mexico, Guatemala, Honduras, El Salvador) .... **2. Zemisia thomasii** (Klatt) Pruski

1. ZEMISIA DISCOLOR (Sw.) B. Nord., Compositae Newslett. 44: 72. 2006. *Cineraria discolor* Sw., Prodr. 114. 1788. *Senecio discolor* (Sw.) DC., Prodr. 6: 412. 1837 [1838], non Desf. 1804. *Pentacalia discolor* (Sw.) H. Rob., J. Arnold Arbor. 63: 311. 1982. **TYPE: JAMAICA.** *Swartz s.n.* (lectotype, designated by Nordenstam 2006: S; isolectotype: S). Figures 35, 38B, 39.

Erect to scrambling shrubs 1–4 m tall; stems straight or sometimes deflected at the distal nodes, white-arachnoid-tomentose distally to glabrate. **Leaves** petiolate; blade (3–)5–13(–15) × (1–)1.5–4.5 cm, lanceolate or sometimes oblanceolate, adaxial surface (drying) finely reticulate otherwise nearly smooth, adaxial surface of immature leaves gray-arachnoid (infrequently densely so), adaxial surface of nearly mature leaves sometimes with midrib arachnoid, adaxial surface of mature leaves soon completely glabrous throughout, abaxial surface densely white-tomentose, base broadly obtuse to truncate or subcordate, margins typically denticulate or sometimes entire, apex nearly obtuse to more commonly narrowly acute to mucronate; petiole (0.5–)1–2(–2.5) cm long. **Capitulescence** to 20 cm diam., broad and slightly rounded on top with lateral branchlets nearly overtopping central axis; peduncles 1–4(–7) mm long, mostly densely white arachnoid-tomentose (infrequently glabrate in patches), several-bracteolate, bracteoles usually 1–2 mm long, linear, loosely lanate to often glabrous distally, the darker bracteoles often strongly contrasting in color with the peduncle. **Capitula** 5–8 mm long, sweet-scented (fide Moore 1936); involucre 3–3.5(–4) mm diam.; phyllaries (11–)13, adjacent ones occasionally fused, 3–4 × 0.6–1 mm, densely white arachnoid-tomentose but glabrate in patches and with glabrous tips, laterally spread phyllaries of post-fruiting capitula without obvious broad central resin duct abaxially, instead midzone dark green with an embedded dark resin duct (best seen adaxially), apex acuminate; calycular bracteoles 1–2 mm long; clinanthium ca. 1 mm diam. **Ray florets** (3–)5, short-exserted; corolla white, tube 2–2.5 mm long, limb 2–3.5 × 1–1.5 mm, oblong or obovate to infrequently nearly orbicular, 3–4(–6)-nerved, epidermal cells of adaxial surface weakly papillose. **Disk florets** (10–)12–13(–15); corolla 3–4 mm long, narrowly funnelform, supernumerary resin ducts mostly visible in lobes not in throat, tube 2–2.5 mm long, about as long as limb, lobes ca. 0.6 mm long; anthers ca. 1 mm long, tails of thecae half to nearly as long as filament collar, appendage ovate-lanceolate; style 3.5–4.5 mm long, branches 0.7–0.8 mm long. **Cypselae** 1.2–2.2 mm long, (8–)10-costate, papillose-setose; pappus bristles 3–4 mm long, very fragile.

Distribution and representative collections. Jamaica. *Alexander (Prior) s.n.* 25 Mar 1850 (GH, K, NY-2); *Anonymous s.n.* (perhaps Bertero) (MO-52609, fertile); *Anonymous s.n.* (perhaps Browne or Sloane) (LINN 1309.23); *Anonymous s.n.* (LD-2, one as Thunberg, who did not visit Jamaica); *Bertero s.n.* (P, sterile); *Bretting J-362* (IJ, MO, NY); *Britton 3129* (NY, US); *Clute 16* (MO, NY, P, US); *Eggers 3492* (C, MO, P, US); *Gentry & Kapos 28324* (MO); *Gillis 14974* (MO); *Harris 11068* (NY, US); *Harris 12854* (NY-2); *Houstoun s.n.* (BM n.v.); *Maxon & Killip 399* (GH, NY, US); *Maxon & Killip 1200* (GH, P, US); *Norman 72* (BM, MO, NY); *Oersted 8852* (C, MO); *Proctor 21901* (IJ, NY, US); *Purdie 416* (TCD); *Wunderlin & Gustafson 8868* (MO, UMO).

Figure 39. Color drawing of *Zemisia discolor*, generitype, showing white ray corollas and discolorous leaves. (Reproduced from Sims, Curtis's Bot. Mag. 53: Plate 2647. 1826 as *Cineraria discolor*).

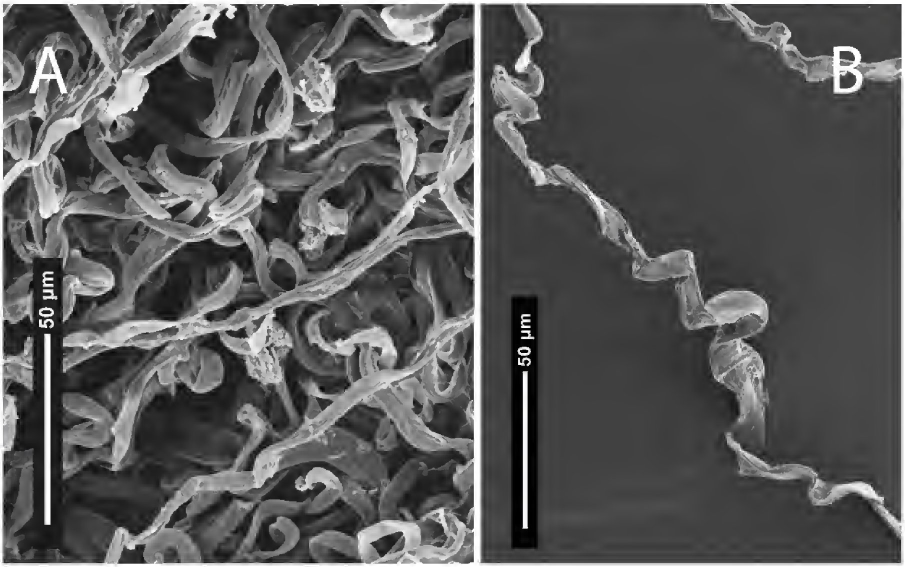


Figure 40. *Zemisia thomasii,* simple eglandular leaf trichomes with elongated sinuous terminal cells. A. Abaxial blade surface. B. Individual trichome. From *King & Renner 7134,* MO.

The protologue is four lines long and the description in Willdenow (1803) is the same as in the protologue, but more complete descriptions were given in Swartz (1806), Sims (1826), Candolle (1837), Grisebach (1864), Moore (1936), Adams (1972), and naturally in Nordenstam (2006). *Zemisia discolor* in its discolorous-leaves and tomentose phyllaries is superficially very similar to *Pentacalia subdiscolor* H. Rob. (Robinson in Proctor 1982). The two species, however, are not conspecific, despite my 1985 (in sched.) "looks same as discolor" annotation on *Proctor 35585* (NY), a paratype of the Robinson name. Recent study confirms this *Pentacalia* differs by dull-tomentose leaves, sometimes axillary (vs. always terminal) capitulescence, disciform (vs. radiate) capitula, 8 (vs. 13) phyllaries, and pentagonal, glabrous (vs. mostly (8–)10-costate, papillose-setose) cypselae, as noted by Robinson (in Proctor 1982). *Pentacalia subdiscolor* in generic features thereby is at odds with *Zemisia discolor.* Proctor (1982) cited *Zemisia discolor* as similar to *Antillanthus discolor* (Griseb.) J.-S. Girard, a different heterotypic plant from Cuba (Girard and Pruski 2012).

2. **ZEMISIA THOMASII** (Klatt) Pruski, **comb. nov.** *Senecio thomasii* Klatt, Abh. Naturf. Ges. Halle 15(2): 332. November 1881; Neue Compositen, in dem Herbar des Herrn Francaville p. 12. November 1881. [The simultaneous citation of the journal vol. 15 part 2 and of the preprint in Nat. Novit. 3(23): 185, 188. November 1881 established the date of effective publication. TL-2 item 3711 listing of the Klatt preprint stated "to be cited from the journal"]. **TYPE**: **MEXICO**. **Veracruz.** Orizaba, 1864, *Thomas s.n.* (holotype: herb. "Francaville," now P-Drake, Lanjouw and Stafleu 1957: 207; isotype: GH n.v., cited by Klatt 1888 as 'Herb. Klatt'). **EPITYPE (designated here)**: **MEXICO. Veracruz.** Bluffs of barrancas near Jalapa, 3000 ft, 24 Apr 1899, *Pringle 8121* (epitype: MO-3171798; isoepitypes: GH, MEXU, NY, P, US). Figures 36–37, 38A, 38C, 40–41.

Senecio deppeanus Hemsl., Biol. Cent.-Amer., Bot. 2(10): 239. December 1881. **LECTOTYPE**: (chosen here from among four syntype collections): **MEXICO. Veracruz.** Malpays de

Naulingo, Apr 1829, *Schiede & Deppe 243* (lectotype: K-Benth-497695, specimen on right; isolectotypes: B†, MO-3171769). [The collector names Schiede and Deppe were added to the original ticket of the K lectotype specimen of *Senecio deppeanus*, which apparently was distributed without a determination. The original label of Bernhardi herbarium specimen in MO gives only "243 *Senecio scytophyllus*," i.e., without collector and locality. Although lectotypification of taxonomic synonyms is usually not needed taxonomically, in this instance a lectotype is designated from among the four syntype collections because the lectotype collection is clearly radiate, matching the protologue, whereas at least some other authentic material is imperfect. The locality of *Schiede & Deppe 243* was given as Malpays de Naulingo, under the name *Senecio scytophyllus* Kunth by Schlechtendal (1835)].

Ascending to erect shrubs to trees 1–3(–5) m tall; stems densely white-tomentose, leaf base persistent. **Leaves** petiolate or distal-most leaves sometimes subsessile; blade 6–19 × 1–6 cm, usually lanceolate or elliptic-lanceolate, rarely linear-lanceolate, adaxial surface green, smooth to often rugulose, midrib appressed tomentulose, surface otherwise sparsely arachnoid to more commonly glabrous, abaxial surface densely white-tomentose, base cuneate to narrowly obtuse, margin entire to sinuous-denticulate, apex narrowly acute to acuminate; petiole (0–)1–2.5 cm long. **Capitulescence** 5–20+ cm diam., rounded on top with lateral branchlets not overtopping central axis; peduncles 3–11(–15) mm long, very loosely lanate to glabrous, several-bracteolate, bracteoles usually 2–7 mm long, very loosely lanate to glabrous. **Capitula** 7–9 mm long; involucre 3.5–5 mm diam., loosely arachnoid-pubescent basally; phyllaries 12–13(–15), 5.5–6 × 0.8–1.1 mm, mostly glabrous or sometimes lingering arachnoid-villous, with a broad orange central resin duct abaxially, sometimes two thin resinous lateral nerves present, apex acuminate; calycular bracteoles 2–4 mm long; clinanthium ca. 2 mm diam. **Ray florets** 6–8, short-exserted; corolla yellow, elongation sometimes delayed and later than disk corolla anther cylinder emergence, tube 3.5–4.5 mm long, limb (2.5–)3.6–5 × 1.2–2.2 mm, oblong, 4–8-nerved (broader rays tend to have more nerves), epidermal cells of adaxial surface indistinctly quadrangular, in early fruiting plants limb often destroyed but tube intact. **Disk florets** (13–)21–25; corolla 4.5–6.5 mm long, narrowly funnelform, yellow, supernumerary resin ducts visible in lobes and throat, tube 2.5–3.5 mm long, longer than limb, lobes ca. 0.7 mm long; anthers ca. 2 mm long, filament collar ca. 0.5 mm long, basal cells slightly enlarged, tails of thecae about 1/3 as long as collar, appendage lanceolate; style 5–7 mm long, branches 0.8–1 mm long, abaxially papillose in ca. distal 1/3; nectary low-cylindrical, ca. 0.2 mm long. **Cypselae** 1.2–2.4 mm long (8–)10-costate, papillose-setose; pappus bristles 4.5–6 mm long, very fragile.

Distribution and representative collections. EL SALVADOR. *Martínez 587* (B, EAP, K, LAGU, MO); *Monterrosa & Carballo 508* (B, LAGU, MO); *Rodriguez et al. 1278* (LAGU, MO); *Sandoval s.n.* 25 Apr 1998 (B, EAP, K, LAGU, MO); *Villacorta & Lara 2540* (B, K, LAGU, MO). **GUATEMALA.** *Fosberg 27236* (MO, US); *Greenman & Greenman 5911* (MO); *Heyde & Lux 3410* (MO, US); *Kellerman 4996* (MEXU, US); *King & Renner 7135* (MO, US); *Pittier 145* (US); *Ramírez & Cobar 614* (BIGU, MO); *Rojas 300* (MO, US); *Standley 62893* (MO, US); *Tuerckheim 1183* (P, US); *Tuerckheim II 2147* (MO, US). **HONDURAS.** *Blackmore & Chorley 4078* (BM, MO); *Clewell 3779* (MO, US); *Daniel & Molina 9257* (CAS, MO); *Elvir 139* (MO); *A. Molina 11695* (US); *D. Molina 156* (MO); *Nelson 4002* (MO); *Nelson & Vargas 2597* (MO-2); *Renfrow & Renfrow 62* (MO, UC); *Standley 56345* (US); *Williams & Molina 14014* (MO-2, US). **MEXICO. Chiapas**. *Breedlove 24567* (CAS, MO); *Breedlove 50145* (CAS, MEXU, MO); *Breedlove 50350* (CAS, MO); *Croat 47677* (KSC, MO, NO-LSU); *Linden 430* (GENT, K; syntype of *Senecio deppeanus*); *Morales 7* (HEM, MO); *Ton 5624* (MEXU, MO, US, XAL); *Ton 5631* (MO, TEX, XAL); *Ton 5866* (MEXU, MO, XAL); *Ventura & López 4469* (IEB, MEXU, MO). **Guerrero**. *Rico et al. 440bis* (MEXU, MO). **Oaxaca**. *Calzada 20868* (MEXU, MO, NY); *Liebmann 173/8862* (C; as *S. lindenii* Sch. Bip, as Macbride negative 22625); *Nelson 2569* (US; on web as 2589); *Quedensley et al. 7062* (MEXU, NY); *Rzedowski 34929* (ENCB, MEXU, MO); *Tenorio et al. 11128* (MEXU, MO). **Veracruz.** *Bilimek 559* (K, P-2, US); *Botteri 1120* (K; syntype of *Senecio deppeanus*); *Dorantes 558* (MEXU, MO); *Purpus 2368* (MO, UC, US); *Purpus 11600* (MO, UC); *Ventura 5277* (ASU, UNM); *Ventura 18330* (MEXU, MO). Without locality. *Jurgensen s.n.* (K n.v.; syntype of *Senecio deppeanus*). The citation of the plant in Costa Rica as Género A sp. A by Pruski and Robinson (2018: 473) was a clerical error. *Zemisia discolor* is unknown in Costa Rica.

Notes on the type of Senecio thomasii. The title of the Klatt (1881a, 1881b) protologue paper of *Zemisia thomasii* (Klatt) Pruski gives the type as herb. Francaville, i.e., herb. Albert comte de Franqueville, listed by Lanjouw and Stafleu (1957) as "P (herb. Drake)." Materials of these 1881 Klatt names that I have seen annotated by Klatt are, in each case, in P and labeled 'Herbier E. Drake,' in agreement with Lanjouw and Stafleu (1957). Material in P was not found on JSTOR for some 1881 Klatt names, including *Senecio thomasii.*

Type citations of some other 1881 Klatt names include: Díaz-Piedrahita and Cuatrecasas (1999: 51, 107) cited the lectotype of *Senecio semidentatus* Klatt and the holotype of *Senecio trianae* Klatt as in P, but holotypes of *Eupatorium exsertovenosum* Klatt and *Senecio polymerus* Klatt, each described in the same Klatt paper, were listed by Robinson (Eupatorieae, Fl. Ecuador 83: 25. 2007) and Díaz-Piedrahita and Cuatrecasas (1999: 192), respectively, as in W. A sheet of *Senecio caracasanus* Klatt in P not annotated by Klatt is marked as holotype (Cuatrecasas in sched., albeit thereafter marked 'isotype' in a red-typeface Paris annotation label), but an annotated-by-Klatt Drake herbarium holotype sheet (P-1816866) exists. Because Klatt (1881a, 1881b) clearly stated that his names are based on material in herb. Franqueville (i.e., P-Drake), holotypes or syntypes of each name should be expected in P-Drake.

Date and priority notes. Dating priority of *Senecio thomasii* Klatt over conspecific *S. deppeanus* by Greenman (1926) is followed here. The effective date of publication of *S. thomasii* as November 1881 was established by simultaneous citation of both the journal and of the preprint versions in Nat. Novit. 3(23): 185, 188. November 1881. The pagination of the preprint begins on page 1 (typical of preprints, whereas offprints and reprints use the journal paginations), and although preprints typically antedate journals, TL-2 item 3711 dated each as November 1881. The versions are basically identical, differing mainly in the preprint being signatures 1–2, and the journal version signatures 42–43. Indirect evidence that the preprint may antedate the journal version is that the 1881 literature review in Just's Bot. Jahresber. 9(2): 115. 1884 listed the preprint as item 393, whereas a full year later the initial listing of Abh. Naturf. Ges. Halle 15(2), as item 379, appeared (Just's Bot. Jahresber. 10(2): 100. 1885). Dating to month effective publication is drudgery and typically merely a bibliographic triviality, but in this case because the junior name was validated the same year, dating publications to month was needed and allows for the combination *Zemisia discolor* to be made.

The date of effective publication of taxonomic synonym *Senecio deppeanus* Hemsl., published in Flora Biol. Cent.-Amer., Bot. 2 part 10, is that given TL-2 item 2627, i.e., December 1881, one month after the date established for the Klatt name. The journal part 15(2) of Abh. Naturf. Ges. Halle––which includes the Klatt paper––has the printed date as 1881, but is sometimes miscited as 1882. This (incorrect) dating may be because the final part of Abh. Naturf. Ges. Halle 15(3–4) is dated 1882, as is vol. 15 title page. This perhaps explains the citation in the Royal Society of London (1894: 408) catalogue of Klatt's paper as published in 1882. The next year, Jackson (1895: 882) in Index Kewensis dated *S. thomasii* as 1882. A century thereafter, Clewell (1975) Williams (1976), and Barkley (1985a) recognized *S. deppeanus*, with *S. thomasii* dated 1882 and placed in synonymy. Redonda-Martínez and Villaseñor-Ríos (2011) gave the Klatt name as validated in Leopoldina in 1888, where no description is given. In addition to Nat. Novit. 3(23) and TL-2 dating the Klatt paper as 1881, thus having priority over *S. deppeanus*, the Klatt preprint was also listed in the "Neue Litteratur" listings in Bot. Zeitung (Berlin) 39(52): 868. 30 December 1881 as published in 1881.

Figure 41. Isolectotype of *Senecio deppeanus* Hemsl. (= *Zemisia thomasii*). (*Schiede & Deppe 243*, MO).

Species circumscription. Klatt (November 1881a, November 1881b) described *Senecio thomasii* as discoid and as having glabrous cypselae. The type material seen and described by Klatt as discoid is apparently imperfect. Hemsley (December 1881b) described *Senecio deppeanus* as radiate and as with puberulent cypselae. Seven years later, Klatt (1888) cited the following as *Senecio thomasii*: *Sartorius s.n.*, *Linden 430*, *Schiede & Deppe 243* (B), *Liebmann 173* (C), and "Thomas 1864 Herb. Klatt." The Linden and Schiede materials are syntype collections of *S. deppeanus*. The *Schiede & Deppe 243* sheet in front of me is radiate and has faintly papillose-setose cypselae. The citation of this collection--*Schiede & Deppe 243--as Senecio thomasii* serves to emend Klatt's protologue description of this species, described as discoid, but known instead to be radiate. Basically it appears most material seen by Klatt and Hemsley is imperfect as are many modern sheets that have ray corolla limbs damaged, but *Schiede & Deppe 243* is clearly radiate-capitulate. Moreover, *Zemisia thomasii* has delayed ray limb elongation (seen in many Senecioneae, but infrequent elsewhere in Compositae), and is thereby sometimes mistakenly characterized as discoid. Thus, *Schiede & Deppe 243* (K) is designated here as the lectotype of *Senecio deppeanus* Hemsley. A sheet from Veracruz that is obviously conspecific, similarly radiate-capitulate, widely distributed in herbaria, from a nearby locality from the same Mexican state, and annotated as *Senecio thomasii* by Jesse Greenman--i.e., *Pringle 8121* (MO)--is designated here to serve as the interpretive epitype of *Senecio thomasii* Klatt. *Senecio thomasii* Klatt is recognized as in Greenman (1926) in Standley's Trees and Shrubs of Mexico, i.e., with *S. deppeanus* Hemsl. in synonymy. *Zemisia thomasii* occurs from Mexico south to El Salvador and Honduras, and flowers from November to June from about 500 to 2200 meters elevation.

Each of the four collections of taxonomically synonymous *Senecio deppeanus* cited by Hemsley (1881b) is Mexican, and other than the lectotype the protologue cited syntype collection include: *Botteri 1120* (K) from Orizaba; *Linden 430* (K) from Cacaté and Ciudad Real (Chiapas); and *Jurgensen s.n.* (K) without specific locality. *Schiede & Deppe 243* was cited by Schlechtendal (1835: 591) as *Senecio scytophyllus* Kunth (now *Dendrophorbium scytophyllum* (Kunth) C. Jeffrey), a South American plant. The number *Schiede & Deppe 243* was also used by Schlechtendal and Chamisso (Linnaea 5: 121. 1830) for *Crescentia alata* Kunth (Bignoniaceae), and I do not know which usage of the number 243 is in reference to a taxon number and which is to the collection number. Hemsley (1887: 64) included *S. thomasii* in the supplement to Biol. Cent.-Amer., Bot., but listed no collections other than the Thomas type, and did not relate it to *S. deppeanus.*

Taxonomically, it seems clear that the now epitypified *Zemisia thomasii* and the now lectotypified *S. deppeanus* represent the same taxon. Clewell (1975), Williams (1976, 1984), and Berendsohn et al. (2009) each recognized *S. thomasii* as the only Central American shrubby *Senecio* with discolorous lanceolate leaves. Greenman (1926) gave the only two discolorous-narrow-leaved species of *Senecio* sect. *Fruticosi* Greenm. in Mexico as northern *Senecio cinerarioides* Kunth and southern *Zemisia thomasii.* Both species are radiate-capitulate and have pubescent cypselae; neither is discoid with glabrous cypselae as in Klatt's protologue of *S. thomasii.* These two species comingle on Orizaba, the type locality of *S. thomasii*, but although Klatt appears to have misdiagnosed *S. thomasii*, it seems unlikely that Klatt confused these two very different-leaved woody plants. *Senecio cinerarioides* has larger, persistently radiate capitula with more phyllaries and more flowers than Klatt described for *S. thomasii.* Moreover, the subsessile linear leaves (< 1.5 cm wide) of *Senecio cinerarioides* conflict with the protologue of *S. thomasii.* Shrubby discolorous lanceolate-leaved ecaudate-anthered *Senecio cinerarioides* Kunth remains in *Senecio* s. lat., and as such is not congeneric with *Zemisia thomasii.* Thus, the sole Compositae not placed generically by Pruski and Robinson (2018), i.e., Género **A** sp. A, is by all indications the second species of *Zemisia.* It is recognized here as *Zemisia thomasii* and epitypified by *Pringle 8121* (MO).

II. TUSSILAGININAE Dumort., Fl. Belg. 64. 1827. TYPE: *Tussilago* L.

Members of subtribe Tussilagininae have long been called cacalioids and have cacalioid/tussilaginoid microcharacters (e.g., Koyama 1967; Robinson & Brettell 1973a, 1973b, 1974; Nordenstam 1978, 2007; Wetter 1983; Jeffrey & Chen 1984; Jeffrey 1986; Bremer 1994; Nordenstam et al. 2009; Pruski 2012a; Pruski & Robinson 2018). The genus *Cacalia*, however, has been rejected nomenclaturally, and *Tussilago* is atypical of Tussilagininae in its functionally staminate disk florets. Nevertheless, the correct name for this cacalioid group is subtribe Tussilagininae, which includes in synonymy subtribes Blennospermatinae and Tephroseridinae (Bremer 1994; Pelser et al. 2007; Nordenstam et al. 2009).

Traditional characters associated with the group (discoid capitula with relatively deeply lobed white corollas) are readily seen, but the floral microcharacters that technically characterize the group require dissection to be seen. The cylindrical filament collar usually about the same diameter as the filament without enlarged basal cells character is one of the most consistent in the group (Figs. 4A, 4C, 4E, 48A; Jeffrey et al. 1977; Wetter 1983; Jeffrey 1992a). On occasion, the filament collars of Tussilagininae are somewhat wider than the filaments, but the basal cells are always relatively small. The second consistent character of Tussilagininae is found in essentially entire-continuous stigmatic surface (Figs. 4F, 9B). A large number of Tussilagininae, especially those of the Old World or temperate regions of the New World, have the presence together of palmate leaf venation, discoid capitula, white, deeply lobed corollas, and polarized endothecial tissue, but there are many exceptions to this character combination, and many yellow-radiate plants (e.g., *Telanthophora*, *Nordenstamia*) are cacalioid.

Treated here are two noteworthy Central American Tussilagininae: *Digitacalia,* a stereotypical white-flowered discoid-capitula genus of Tussilagininae, and the yellow-flowered radiate-capitulate *Telanthophora steyermarkii*, the placement of which is supported by floral microcharacters.

DIGITACALIA Pippen, Contr. U.S. Natl. Herb. 34: 378. 1968. TYPE: *Cacalia jatrophoides* Kunth (≡ *Digitacalia jatrophoides* (Kunth) Pippen).

Stiffly erect perennial leafy-stemmed herbs to 4 m; stems annual, lacking basal rosette at maturity, otherwise evenly leafy proximal to the capitulescence, subterete to less commonly angled; herbage bearing simple trichomes, eglandular. **Leaves** alternate, petiolate; blade usually 3–9-lobed, in *D. chiapensis* and *D. stevensii* about 2/3 distance to midrib, in other species sometimes more deeply so, pinnately or subpalmately lobed and veined, chartaceous, lobe margins entire to serrulate. **Capitulescence** large, often at least 30 cm tall and broad, terminal or terminating axillary branches, many capitulate, infrequently (only *D. stevensii*) with pyramidal thyrsoid-panicles, most species corymbiform-paniculate and broadly rounded to nearly flat-topped, lateral branches of the corymbiform-panicles sometimes overtopping central axis, branches generally subtended by bracteate leaves; peduncles minute-bracteolate. **Capitula** small, discoid, calyculate; involucre 1-seriate, turbinate to narrowly campanulate, only slightly longer than mature fruits, the often persistent corollas and pappus then nearly fully exserted; phyllaries 5–8, subequal, free; calycular bracts or bracteoles (1–)3–7, usually shorter than phyllaries; clinanthium +/- flat, foveolate, not fleshy-crested. **Ray florets** absent. **Disk florets** bisexual, 5-merous; corolla salverform, white or ochroleucous, never yellow, persistent on maturing fruits, glabrous, deeply 5-lobed nearly to tube, tube narrowly cylindrical to base, about as long as limb, throat nearly absent or short, lobes elongate, 3-nerved; anthers exserted, theca base obtuse, filament collar cylindrical, without enlarged basal cells, endothecial tissue pattern polarized, apical appendage lanceolate; style cylindrical to base, stylopodium without swollen basal node, branches each with a continuous stigmatic surface, but abaxially with dark-staining line, spreading to recurved, apex exappendiculate, truncate to obtuse, sometimes with lateral round-tipped papillae. **Cypselae** narrowly cylindrical to oblong, 8–12-costate, ribs broad and well-defined, glabrous or setulose when young, wider than the intermediate furrows; pappus bristles many, mostly about as long as corollas, white, capillary, scabrid, distal cell tips pointed. $x = 30$.

Leafy-stemmed *Digitacalia* (Tussilagininae) was described by Pippen (1968), who included five Mexican endemics, mostly from among species Rydberg (1924a, 1924b, 1927) treated within predominantly rosulate *Odontotrichum* Zucc. Prior to Rydberg, these five species were placed in either *Cacalia* (Candolle 1837; Gray 1883) and/or *Senecio* (Schultz-Bipontinus 1845; Bentham and Hooker 1873; Hemsley 1881a). Although the influential Benthamian synonymy and consequential broad definition of *Senecio* to include *Cacalia* in synonymy trivialized some subtribal and generic distinctions in Senecioneae, *Digitacalia* may nevertheless be considered a segregate of *Cacalia* L. Rydberg (1924a) and Pippen (1968) noted that the discoid-capitula with relatively deeply lobed white corollas––the "cacalioid condition" of Pippen (Figs. 42, 43A)––help distinguish the often ambiguous *Cacalia*. To better appreciate *Digitacalia* and cacalioids/tussilaginoids, we should understand why Rydberg (1924a) asked "to which group should the name *Cacalia* L. be applied?"

The name *Cacalia* is pre-Linnaean, and historically the name has been applied variously, with each of its three one-time proposed lectotypes affecting application of the name. Linnaeus (1753) included ten species in *Cacalia*, but at times each was excluded, and segregate genera from Eurasia, southern Africa, eastern Asia, and the Americas proposed. The ten Linnaean names of *Cacalia* are now recognized as belonging to nine genera in two families, Crassulaceae and Compositae. Rydberg (1924a) proposed *Cacalia alpina* L. (now *Adenostyles* Cass.) as the first generitype of *Cacalia*. Moreover, Rydberg (1924a, 1924b, 1927) took 4-merous, eupatorioid-styled, Eurasian *Cacalia alpina* as generically distinct from American so-called Cacalias, prompting him to exclude *Cacalia* from the Americas. Following Greene (1897), Rydberg and adopted *Mesadenia* (now *Arnoglossum*) for our familiar North American plants, albeit these on occasion still called *Cacalia* (e.g., Pippen 1978; Cronquist 1980; Antonio & Masi 2001). In tropical America Rydberg (1924a, 1924b, 1927) resurrected *Psacalium* Cass. and *Odontotrichum* for a group of rosulate cacalioids/tussilaginoids. Elsewhere in the Neotropics, more than a dozen cacalioid segregates have since been recognized (viz Cuatrecasas 1955, 1960, 1986; Pippen 1968; Robinson & Brettell 1973a, 1973b, 1974; Robinson & Cuatrecasas 1978, 1993; Nordenstam 1978, 2006, 2007; Barkley 1985a; McVaugh 1984; Turner 1990; Barkley et al. 1996; Clark 1996; Nordenstam 2007; Nordenstam et al. 2009; Pruski 2012a; Pruski & Robinson 2018).

After Rydberg's typification, from among the residue of the original Linnaean names, North American *Cacalia atriplicifolia* L. (now *Arnoglossum*) and Asian *C. hastata* (now *Parasenecio* W.W. Sm. & J. Small) were proposed as the second and third lectotype of the *Cacalia* (viz Gray 1883, 1884; Greene 1897; Hitchcock & Green 1929; Kitamura 1938, 1942; Shinners 1950; Cuatrecasas 1955, 1960; Pojarkova 1960, 2000; Vuilleumier & Wood 1969; Robinson & Brettell 1973b; Pippen 1968, 1978; Jeffrey 1979b, 1992b; Wetter 1983). Adoption as lectotype of any of the three Linnaean names could disrupt then current usage (Jeffrey 1992b; Wagenitz 1995), and Wagenitz formally proposed nomenclatural rejection of *Cacalia* L., which was subsequently finalized in the ICN. Even though *Cacalia* L. is nomenclaturally rejected, white-flowered discoid-capitulate genera and their allies (some yellow-flowered and radiate) are commonly still referred to as cacalioids (sometimes as tussilaginoids), albeit these genera treated in subtribe Tussilagininae by Pelser et al. (2007) and Nordenstam et al. (2009).

The species of *Digitacalia* are strict, leafy-stemmed, herbaceous perennials, discoid-capitulate, and most notably have deeply-lobed white corollas. *Digitacalia* by its cacalioid condition (viz Figs. 4A, 48A; Pippen 1968) and especially by its polarized endothecial tissue (Fig. 4B) fits comfortably in subtribe Tussilagininae. North American *Arnoglossum* (Fig. 42) resembles

Digitacalia by its leafy flowering stems without basal rosettes, discoid capitula with white corollas, and sometimes medially scarious-keeled phyllaries, but differs by its weakly calyculate capitula with convex, fleshy-crested (vs. flat, foveolate) clinanthia (Pippen 1968: 375 sub *Cacalia* sect. *Conophora* DC. 1837: 329; viz also Hooker 1829–1834: 332), a radial (vs. polarized) endothecial tissue pattern (Fig. 4B; Robinson and Brettell 1973b figs. 1–2; Wetter 1983 figs. 29, 31–32; Nordenstam 2007), and disk corolla lobes incised only partly (vs. nearly completely) to the corolla tube.

Among Mexican cacalioids/tussilaginoids, Pippen (1968) compared *Digitacalia* to leafy-stemmed, radiate-capitulate, pale-yellow-flowered short-lobed *Pericalia* Cass. (now *Roldana*), and to acaulescent, discoid, white-flowered, elongate-lobed *Psacalium* Cass. (and the now synonymous *Odontotrichum* Zucc.). From them, Pippen (1968) distinguished *Digitacalia* by its character combination of leafy stems, rhizomes lacking tubercules, and absence of a basal rosette at maturity. Robinson and Brettell (1974) summarized *Cacalia* segregates that were newly named or recognized subsequent to the Pippen (1968) treatment and segregated further genera. *Digitacalia* is the sole leafy-stemmed, discoid-capitulate Mexican and Central American cacalioid with deeply-lobed white corollas (Barkley et al. 1996; Pruski & Robinson 2018).

In Mesoamerica, *Digitacalia* is most similar to *Psacalium* by white deeply-lobed corollas. *Psacalium*, however is an acaulescent plant and as noted by Rydberg (1924a) often has filiform so-called Vernonioid style branches. *Digitacalia*, on the other hand, is leafy-stemmed (Figs. 44, 46–47) and has short obtuse-tipped style branches (Fig. 48B). Other regional acaulescent cacalioids/tussilaginoids include non-monophyletic *Psacaliopsis*, *Robinsonecio,* and on occasion *Roldana* (e.g., the species treated as *Pericalia* by Pippen 1968), but each differs from *Digitacalia* by their generally yellow flowers and generally radial endothecial tissue, with *Psacaliopsis* further differing by peltate leaves *and Robinsonecio* by small stature. Peltate leaves (excentrically so) also are frequent in *Roldana*, which however is generally leafy stemmed. Other caulescent-leaved Mesoamerican cacalioid genera differ from *Digitacalia* by yellow flowers and/or moderately short disk corolla lobes. Among caulescent cacalioid genera in Mesoamerica, *Pittocaulon* is the only pachycaulous seasonally leafless shrub, thus further distinguished from *Digitacalia.* Few South American cacalioids/tussilaginoids have discoid capitula with deeply-lobed white corollas in combination with a polarized endothecial pattern, and among them shrubby, branched-stemmed *Cacalia* segregate *Paracalia* Cuatr., except in habit, is somewhat reminiscent of *Digitacalia.*

In *Digitacalia*, Pippen (1968) noted four species central to his concept. However, he took *D. heteroidea* (Klatt) Pippen as anomalous and intermediate with *Pericalia* (now *Roldana*). The transfer of *D. heteroidea* to typically yellow-flowered *Roldana* La Llave (syn.: *Pericalia* Cass). by Robinson and Brettell (1974) effectively reduced to four, the number of species recognized in *Digitacalia.* Turner (1990) raised again to five, the species total in *Digitacalia* by proposing two new Mexican species, and by simultaneously sinking 8-phyllaried *D. tridactylitis* into 5-phyllaried *D. napeifolia.* However, neither of Turner's proposed new species is taken here as distinct; *D. tridactylitis* is here resurrected from synonymy; and the four Mexican species I recognize in *Digitacalia* are the four of Robinson and Brettell (1974), each of the four circumscribed here basically as by Pippen (1968).

Hitherto, *Digitacalia* was known as a genus endemic to Mexico. Three Mexican species occur in Oaxaca and further to the northwest, and two of them, *D. napeifolia* and *D. tridactylitis*, are typified by material from the Sierra San Felipe area of Oaxaca. None of these three species are known to occur east of the Isthmus of Tehuantepec. *Digitacalia chiapensis* is known presently from only Chiapas, Mexico and is the only Mexican species east of the Isthmus of Tehuantepec. It should be looked for in nearby Guatemala. The only Central American species of *Digitacalia* is *D. stevensii*, which is newly described from Honduras and nearby Nicaragua. As such, *Digitacalia* can no longer be taken as endemic to Mexico, and recognition of Central American endemic *D. stevensii* serves to extend to the southeast by more than 500 km the known distribution of the genus. The species are mostly mid-elevational or montane plants occurring from (540–)1400–2800 meters elevation in oak savannas, pine forests, and mixed forests, mostly on the Pacific watershed (Pippen 1968 map 1; Turner 1990 fig. 1).

Here, the genus *Digitacalia* is revised, and Central American *D. stevensii* Pruski is described as new. The five species I recognize in *Digitacalia* are a slightly different complement than either the five of Pippen (1968) or the five of Turner (1990). Specimen photographs and illustrations, and maps for a few species were given in Pippen (1968), McVaugh (1984), Turner (1990), and Redonda-Martínez & Villaseñor-Ríos (2011). Now, with the included specimen photographs (Figs. 44, 46–47), images of each of the five species are available. Among the five *Digitacalia* species, *D. chiapensis* has the smallest flowers, *D. napeifolia* is the only species typically with five phyllaries, and *D. stevensii* is the only species with a pyramidally thyrsoid-paniculate capitulescences. *Digitacalia jatrophoides*, *D. napeifolia*, and *D. tridactylitis* are each relatively widespread in Mexico.

Key to the species (and former species) of Digitacalia

1. Capitula ≥ 15 mm tall; florets 40+; corollas pale yellow, tube much longer than limb, lobes relatively short; (Mexico: Oaxaca); (syn.: *Digitacalia heteroidea* (Klatt) Pippen) .... **Roldana heteroidea** (Klatt) H. Rob. & Brettell

1. Capitula ≤ 15 mm tall; florets ≤ 13; corollas white to ochroleucous, tube and limb subequal or tube only slightly longer than limb, lobes relatively long.

    2. Phyllaries 5(–6), flat, except towards subsucculent base, margins narrowly scarious; florets 5(–6); (Mexico: Guerrero, Jalisco, Michoacán, Oaxaca, Puebla); (syn.: *Digitacalia hintoniorum* B.L. Turner) .... **3. Digitacalia napeifolia** (DC.) Pippen

    2. Phyllaries 7–8, at least the inner phyllaries usually finely or narrowly keeled in proximal half and with scarious margins broader than mid-zone; florets (7–)8–10.

        3. Capitula 5–6.5 mm long; corollas 3–4.5 mm long; cypselae glabrous or very sparsely setulose; pappus bristles 3–4 mm long; (Mexico: Chiapas) .... **1. Digitacalia chiapensis** (Hemsl.) Pippen

        3. Capitula 7–15 mm long; corollas 4–8 mm long; cypselae glabrous; pappus bristles (3.5–)4–7 mm long.

            4. Leaf blades deeply 5–7-subpalmately lobed, margins subentire; (Mexico: Guanajuato, Jalisco, Michoacán, Oaxaca, and possibly Zacatecas); (syn.: *Digitacalia jatrophoides* var. *pentaloba* B.L. Turner) .... **2. Digitacalia jatrophoides** (Kunth) Pippen

            4. Leaf blades trilobed or pinnately 5(–7)-lobed, margins subentire to infrequently coarsely serrate.

                5. Leaf blades pinnately 5(–7)-lobed; capitulescences pyramidally thyrsoid-paniculate, lateral branches not overtopping the central axis; (Honduras, Nicaragua) .... **4. Digitacalia stevensii** Pruski

                5. Leaf blades trilobed; capitulescences rounded corymbiform-paniculate, lateral branches nearly overtopping the central axis; (Mexico: Guerrero, México, Morelos, Oaxaca); (syn.: *Digitacalia crypta* B.L. Turner) .... **5. Digitacalia tridactylitis** (B.L. Rob. & Greenm.) Pippen

Figure 42. Capitulescences of cacalioid *Arnoglossum plantagineum*, generitype of North American *Arnoglossum*. A. Lateral view of involucres showing subequal, obviously-keeled phyllaries. B. View of capitula from above showing white disk corollas with relatively short recurved lobes and well-exserted anthers. [*Digitacalia* has similar white-flowered discoid capitula, but differs by its long-lobed corollas and crested clinanthia]. (*S. Turner 14-123*, photographs by Steve R. Turner).

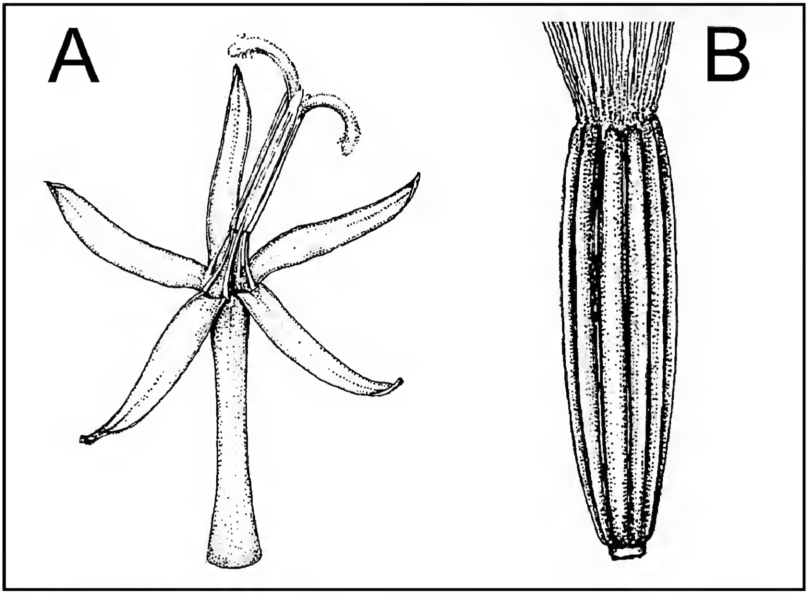


Figure 43. *Digitacalia jatrophoides*, generitype. A. Floret with corolla lobes cut to top of corolla tube and anthers fully exserted. B. Cypsela showing the prominent costae. (Modified from McVaugh 1984 figure 46).

1. **DIGITACALIA CHIAPENSIS** (Hemsl.) Pippen, Contr. U.S. Natl. Herb. 34: 379. 1968. *Senecio chiapensis* Hemsl., Biol. Cent.-Amer., Bot. 2: 238. 1881. *Cacalia chiapensis* (Hemsl.) A. Gray, Proc. Amer. Acad. Arts 19: 53. 1883. *Odontotrichum chiapense* (Hemsl.) Rydb., Bull. Torrey Bot. Club 51: 418. 1924. **TYPE: MEXICO. Chiapas.** Austro-Mexico, Chiapas etc., 1864–1870, *Ghiesbreght 537* (holotype: K; isotypes: GH-2, MO, NY, YU). [Gray (in sched.) referred the plant to *Cacalia*, and used the epithet "*ghiesbreghtii*" on each of the five cited full/complete sheets, these distributed prior to being described by Hemsley in *Senecio*; the Klatt herbarium sheet in GH is a drawing of the K holotype and an included fragment packet]. Figure 44.

Herbs to 3 m tall; stems striate, fistulose; herbage glabrous or nearly so. **Leaves** pinnately lobed to young leaves few-angulate, glabrous or abaxial face of larger veins puberulent; main stems leaves long-petiolate; blade (6–)10–15 × (4–)9–15 cm, pinnately 5-lobed about 2/3 distance to midrib, base cordate to truncate, sometimes slightly decurrent onto petiole, proximal pair of lobes sometimes each with a proximal lobule, lobes elliptic-ovate, 3–7 × 1.5–4 cm, margins entire or subentire, apex acute to acuminate, sinuses broadly rounded, narrower than to about as broad as lobes, capitulescence leaves abruptly reduced, short-petiolate, pinnately few-angulate, 2–5 × 1–3 cm, ovate to rhomboidal, base truncate to broadly obtuse, entire or subentire, apex acute to acuminate; petiole (1–)5–7 cm long. **Capitulescence** to 30 × 25 cm, corymbiform-paniculate, branches small-leaved, lateral branches not overtopping central axis; peduncles 5–8 mm long, slender, few-costate-sulcate, 1–4-bracteolate; bracteoles ca. 1 mm long, lanceolate. **Capitula** 5.5–7.5 mm long; involucre 3–4 mm diam.; phyllaries (6–)8, 4–5 × to ca. 1.5 mm, elliptic-ovate to oblong basally subgibbous, the narrow mid-zone green, margins stramineous, about as wide as mid-zone, acute, glabrous; calycular bracteoles ca. 3, 1–1.5 mm long, linear-lanceolate; clinanthium ca. 1 mm diam. **Disk florets** 7–11; corolla 3.5–5 mm long, tube 1.7–2.5 mm long, throat 0.2–0.5 mm long, more or less indistinct, lobes 1.5–2 mm long, lanceolate, spreading or recurved, nerves submarginal, rarely also with a medial resinous nerve; anthers ca. 1.4 mm long, theca apex abruptly appendaged, appendage elliptic-lanceolate; style branches ca. 0.8 mm long, recurved. **Cypselae** (immature) 1.2–1.4 mm long, setulose; pappus 3–4 mm long. $2n = 60$ (Strother 1983).

Figure 44. Isotype of *Senecio chiapensis* Hemsl. (≡ *Digitacalia chiapensis*). (*Ghiesbreght 537,* MO; the annotation label on the lower right is in the hand of Jesse Greenman).

Distribution and representative collections. **Mexico** (endemic to Chiapas): *Breedlove 23342* (CAS, MO, NY, TEX, US); *Breedlove 41140* (CAS, MO, TEX); *Breedlove 47010* (CAS n.v., cited by Strother 1983); *Laughlin 1932* (CAS, F); *Nelson 3467* (GH, US); *Raven & Breedlove 19954* (US); *Ton 1493* (CAS, F, NY).

Gray (1883), in his treatment of tussilaginoid species from Mexico, noted the uniqueness of this "singular species." The four other species of the genus differ from *Digitacalia chiapensis* by their taller capitula and longer pappus bristles. The Klatt herbarium sheet in GH has a faithfully rendered drawing of the holotype, as well as a fragment packet.

2. **DIGITACALIA JATROPHOIDES** (Kunth) Pippen, Contr. U.S. Natl. Herb. 34: 381. 1968. *Cacalia jatrophoides* Kunth, Nov. Gen. Sp. (folio ed.) 4: 132. 1818 [also quarto ed. 4: 169. 1820]. *Senecio jatrophoides* (Kunth) Sch. Bip., Flora 28: 498. 1845. (the Hemsley 1881a: 242 isonym is invalid). *Odontotrichum jatrophoides* (Kunth) Rydb., Bull. Torrey Bot. Club 51: 419. 1924. **TYPE: MEXICO. Michoacán.** "Prope lacum Cuiseo et montem Andaracuas, 900 hex, Sep" [1803], *Humboldt & Bonpland 4298* (holotype: P-HBK, as Macbride negative 37869, as IDC microfiche 6209 104.III.6; isotype: B-W 15074, as IDC microfiche 7400 1086.I.7). [The locality on the holotype is Cuiseo (i.e., Lake Cuitzeo); the Humboldt itineraries by Sprague (1924: 23; 1968: 97) give the protologue localities are numbers 106 and 108, and the date of collection as September 1803]. Figure 43.

Cacalia digitata Sessé & Moc., *Digitacalia jatrophoides* var. *pentaloba* B.L. Turner

Herbs to 3 m tall; stems fistulose, glabrous to tomentulose in the capitulescence. **Leaves** very deeply subpalmatilobed to subpalmatifid with 5–7 lobes or segments (central segment the longest), long-petiolate; blade 4–16 × 4–21 cm, nearly orbicular in outline, divided or lobed to midrib or nearly so, never decurrent onto petiole, surfaces sparsely pubescent along larger veins and margins, lobes or segments 3–12 × 0.8–1.8 cm, lanceolate, flat or sometimes conduplicate, margins subentire, apex attenuate; petiole 3–16 cm long. **Capitulescence** to 30 × 30 cm, corymbiform-paniculate, lateral branches not overtopping central axis, tomentulose to finely tomentulose; peduncles mostly 2–8 mm long, tomentulose. **Capitula** mostly 10–14 mm long; involucre 4–5 mm diam.; phyllaries 7–8, 4–5.5 × 1–1.5 mm, a few sometimes keeled, glabrous; calycular bracteoles 3–7, 2–5 mm long, subulate. **Disk florets** (5–)7–10; corolla 6–9 mm long, throat minute, lobes ca. 3 mm long; anthers ca. 2 mm long; style branches ca. 1 mm long. **Cypselae** 4–5 mm long, glabrous; pappus 5–7 mm long, sometimes becoming tawny when mature.

Distribution and representative collections. **Mexico** (Guanajuato, Jalisco, Michoacán, Oaxaca, and possibly Zacatecas): *Breedlove & Almeda 59818* (CAS, TEX; type of synonymous *Digitacalia jatrophoides* var. *pentaloba* B.L. Turner); *Koch & Fryxell 8963* (US); *McVaugh 17160* (MICH); *Pringle 4262* (GH, MO, NY, US); *Sessé & Mociño 2826* (MA-2; type of synonymous *Cacalia digitata* Sessé & Moc.); *Smith 388* (MO, NY, US); *Soule & Brunner 2464* (MO, TEX).

Digitacalia jatrophoides was illustrated in both McVaugh (1984) and Redonda-Martínez and Villaseñor-Ríos (2011) as synonymous *D. jatrophoides* var. *pentaloba*. Villaseñor (2016) cited this species as occurring in several other states (basically broadening its range from Sinaloa east to San Luis Potosí and southward), but I have not seen specimens or photographs from those localities. Among species that are at least partly sympatric with it, *Digitacalia jatrophoides* most closely resembles *D. tridactylitis*, differing from it by its subpalmatilobed-subpalmatifid leaves with blade not decurrent onto petiole.

3. **DIGITACALIA NAPEIFOLIA** (DC.) Pippen, Contr. U.S. Natl. Herb. 34: 382. 1968. *Cacalia napeifolia* DC., Prodr. 6: 328. 1837 [1838] (as "*napeaefolia*"). *Senecio napeifolius* (DC.) Sch. Bip., Flora 28: 498. 1845 (the Hemsley 1881a: 244 isonym is invalid). *Odontotrichum*

napeifolium (DC.) Rydb., Bull. Torrey Bot. Club 51: 418. 1924. **TYPE: MEXICO. Oaxaca.** Summo monte San Felipe ad glaciei, (April)July 1834, *Andrieux Pl. mexic. exsic. 280* (holotype: G-DC, as Macbride negative 33809, as IDC microfiche 800 1100.III.2; isotypes K-2). [The protologue, holotype, and one isotype gives the month of collection as July, whereas a second Kew isotype reads July on one label, but gives April on another label].

Digitacalia hintoniorum B.L. Turner

Herbs to 3 m tall; stems becoming fistulose; herbage subglabrous. **Leaves** deeply subpinnately 5–7-lobed, long-petiolate; blade mostly 6–15 × 7–24 cm, broadly ovate to orbicular in outline, lobes typically divided 2/3+ to midrib, lobes in proximal half or 1/3 of blade, base often truncate or sagittate, never decurrent onto petiole, adaxial surface green, glabrous, abaxial surface pale green, persistently puberulent to tomentulose (sometimes nearly glabrate), lobes 3.5–12 × 1–5 cm, lanceolate or rhomboid, margins serrulate to distinctly serrate, apex attenuate, basal two lobes lateral (each sometimes with a small proximal lobule), the distal 2–4 forward-directed lobes and terminal lobe arising from well above basal lobes; petiole 3–10 cm long. **Capitulescence** to 45 × 45 cm, corymbiform-paniculate, lateral branches not overtopping central axis, tomentulose; peduncles mostly 2–10 mm long, tomentulose. **Capitula** mostly 8–13 mm long; involucre mostly 3–4 mm diam.; phyllaries 5(–6), 4–5 mm long, flat except towards subsucculent base, glabrous or sparsely ciliate, margins narrowly scarious; calycular bracteoles 1.5–3 mm long, subulate. **Disk florets** 5(–6); corolla 6–8 mm long, throat minute, lobes 3–4 mm long; anthers 2–3 mm long; style branches 1–2 mm long. **Cypselae** 4–5 mm long, glabrous; pappus 5–7 mm long, sometimes becoming tawny when mature.

Distribution and representative collections. Mexico (Guerrero, Michoacán, Oaxaca, Puebla, and possibly Jalisco): *Calzada 20479* (MEXU, MO, NY); *Davidse & Davidse 9768* (MO); *Galeotti 2082* (K, n.v., cited by Hemsley 1881a: 244); *Gentry et al. 20392* (US; a flowering branch with single bracteate leaf, mixed with a species of *Verbesina*); *Gentry et al. 20435* (US); *Hinton 12572* (GH, MICH, NY, TEX, US; type of synonymous *Digitacalia hintoniorum* B.L. Turner); *Lorence et al. 3650* (CAS, MEXU, MO); *Nelson 1133* (GH, US); *Pringle 4778* (GH, MO, NY, US).

Digitacalia napeifolia is unique in the genus by its typically five (vs. eight) phyllaries. An illustration of *D. napeifolia* was provided by Turner (1990) under the name of *D. hintoniorum.* The Hinton collection cited above is the type of the synonymous *D. hintoniorum*, but was cited as *D. napeifolia* by Pippen (1968: 383) and McVaugh (1984: 298), who are followed here. My notes from the 1990s give *Rose 3040* (US) as having about five phyllaries, which if correct would imply the sheet would thereby match *D. napeifolia*, and apparently would be the sole voucher of the species from what seems to be Jalisco, albeit labeled as Zacatecas. *Rose 3040* was cited by Rydberg (1924b: 429) as *Odontotrichum jatrophoides* and by Pippen (1968: 382) as *D. jatrophoides*.

4. **DIGITACALIA STEVENSII** Pruski, **sp. nov. TYPE: NICARAGUA. Nueva Segovia.** 2 NW of Ocotal–Jalapa highway at km 269.5, along road into mountains, 13° 47' 11" N, 86° 13' 6" W, 621 m, 12 Mar 2016 (in flower), *Stevens & Montiel 37259* (holotype: MO; isotype: HULE). Figures 4A–B, 45–48.

Plantae herbaceae perennes 1–3 m altae, caule erecta foliata villosula vel arachnoidea a glabrata fistulosa; folia alterna petiolata, lamina (5–)9–19 × (3.5–)7–15 cm ovato-rhomboidea 5(–7)-pinnatilobata chartacea basi obtusa vel truncata; capitulescentia usque 25 × 13 cm dense thyrsoidea-paniculata pyramidalis pluricapitulata (20–50+ capitula), pedunculi 5–8 mm longi; capitula discoidea 7–8 mm alta, involucrum 4.5–5.5 mm latum, phyllaria 8 uniseriata 4.5–5.5 × 1–1.8 mm pallida glabra, clinanthium epaleaceum 0.5–1 mm latum; flosculi disci hermaphroditi 9–10, corolla 4.5–5.5 mm longa profunde quinquelobata alba glabra; cellulae endotheciales oblongo-hexagonales nodulis polaribus; lineae stigmaticae connatae; cypselae 1.6–2.3 mm longae; pappi setae numerosae 4–5 mm longae.

Erect, monopodial, leafy-stemmed herbs 1–3 m tall, presumably perennial based with annual stems, these evenly leafy throughout, but lacking basal rosette at maturity, rhizomes presumably without tubercules; stem striate-costate, subterete to less commonly somewhat angled, fistulose, sparsely villosulous grading distally to capitulescence branches moderately villosulous to villosulous-arachnoid; herbage bearing simple eglandular trichomes. **Leaves** alternate, pinnately 5(–7)-lobed, petiolate, with marginal petiole, never peltate; blade (5–)9–19 × (3.5–)7–15 cm, ovate-rhomboid in outline, marginally lobed about half to 2/3 distance to midrib, chartaceous, larger secondary veins about 3–5 per side, each with 1–2 faint ascending tertiary veinlets, lobes evenly spaced, forward-directed, the sinuses broadly rounded, about as wide as the lobes, surfaces more or less concolorous, sparsely villosulous-arachnoid to subglabrous, base obtuse to truncate, sometimes slightly decurrent onto petiole, the four primary marginal lobes subequal, proximal pair of lobes sometimes each with a lobule very near blade base, lobe margins few-denticulate or few-dentate with teeth 0.1–0.5 mm long, lobes 1–6 × 1–5 cm, triangular to elliptic-ovate, apex acute to obtuse, capitulescence leaves subtending lateral branches abruptly reduced; petiole (2–)5–7 cm long. **Capitulescence** large and moderately dense, pyramidally thyrsoid-paniculate, terminal or terminating axillary branches, elongate with the spreading, lateral branches not overtopping the central axis, to 25 × 13 cm, many-capitulate (20–50+ capitula), few-bracteolate; peduncles slender, 5–8 mm long, villosulous to villosulous-arachnoid, 0–2+-bracteolate; bracteoles ca. 1 mm long, lanceolate, ascending. **Capitula** discoid, 7–8 mm long, 9–10-flowered, weakly subcalyculate; involucre 4.5–5.5 mm diam., turbinate to narrow-campanulate, green at very base; phyllaries 8, free, 4.5–5.5 × 1–1.8 mm, nearly scarious and estriate except for narrowly herbaceous midrib and occasional pair of lateral veinlets, glabrous or nearly so, sometimes slightly medially narrow-keeled proximally, mostly whitish with a narrow green midrib-keel and pale hyaline margins, midrib continuing to the acute apex, the inner four phyllaries broader with broader margins; subcalycular bracteoles 1–3, loosely inserted, 1–2 mm long, much shorter than phyllaries, linear-lanceolate, green; clinanthium epaleate, 0.5–1 mm broad, flat and foveolate, neither convex nor obviously fleshy-crested. **Ray florets** none. **Disk florets** bisexual, 9–10, in early anthesis with corolla partly exserted from involucre, in mature fruit corolla presumably mostly exserted form involucre; corolla 4.5–5.5 mm long, deeply 5-lobed nearly to tube, salverform, white (ochroleucous), glabrous, tube 2.7–3.2 mm long, slightly longer than limb, weakly dilated or narrowly cylindrical to base, throat indistinct, ca. 0.2 mm long, lobes 1.6–2.1 mm long, linear-lanceolate, recurved, nerves submarginal, medial resin duct typically present; anthers exserted from throat, ca. 1.5 mm long (excluding collar), abruptly appendaged, collar ca. 0.4 mm long, cylindrical, about same diameter as filament, without enlarged basal cells, about as long as anther appendage and about as long as the short filament, thecae bases tapered to slightly sagittate, endothecial tissue pattern polarized, cells oblong-hexagonal, apical appendage 0.4–0.5 mm long, lanceolate, sometimes fragile-based and breaking; style exappendiculate, ca. 5.5 mm long, nearly cylindrical to base, without obvious swollen basal node, branches recurved, ca. 1 mm long, with a continuous stigmatic surface, apex obtuse, with a few round-tipped papillae. **Cypselae** (immature) 1.6–2.3 mm long, narrowly oblong in outline, dark brown, glabrous, 9–12-costate, ribs broad and well-defined, (presumably pale at maturity), carpopodium symmetrical, 0.2–0.3 mm long, stramineous; pappus bristles many, 4–5 mm long, white, capillary, scabrid, apical cells pointed.

Distribution and ecology. *Digitacalia stevensii* is known from three collections in north-central Honduras and Nicaragua along the western border with Honduras (Fig. 45). The Nicaraguan type locality is about 10 km southeast of the border with Honduras, and the paratype locality only about 3 km south of the border with Honduras. The type locality in Nicaragua is about 50 km east of the Nicaraguan paratype locality. *Digitacalia stevensii* is the only species of the genus not known from Mexico. It has been collected in bud in December and February, and flowering in March. The label of the holotype––*Stevens & Montiel 37259*, MO––reads "fleshy monopodial herb, 1–3 m tall, heads dull yellow." The pre-anthesis anthers appear to be yellow, and the corollas are white (ochroleucous). Although the yellow anthers make the capitula seem yellowish, the corollas are not yellow, as are the corollas in the somewhat similar genus *Roldana*. In any event, the new species is presumed to be pollinated by small insects. *Digitacalia stevensii* occurs between 540–974 meters elevation, and has been found along roadsides, in pine-oak forests, and in dry forests along rocky streams. It is by far the lowest elevational species. Doug Stevens (pers. comm.) has said the type locality is on weathered granite soil. The species was not relocated at either Nicaraguan locality by Doug Stevens in April 2018.

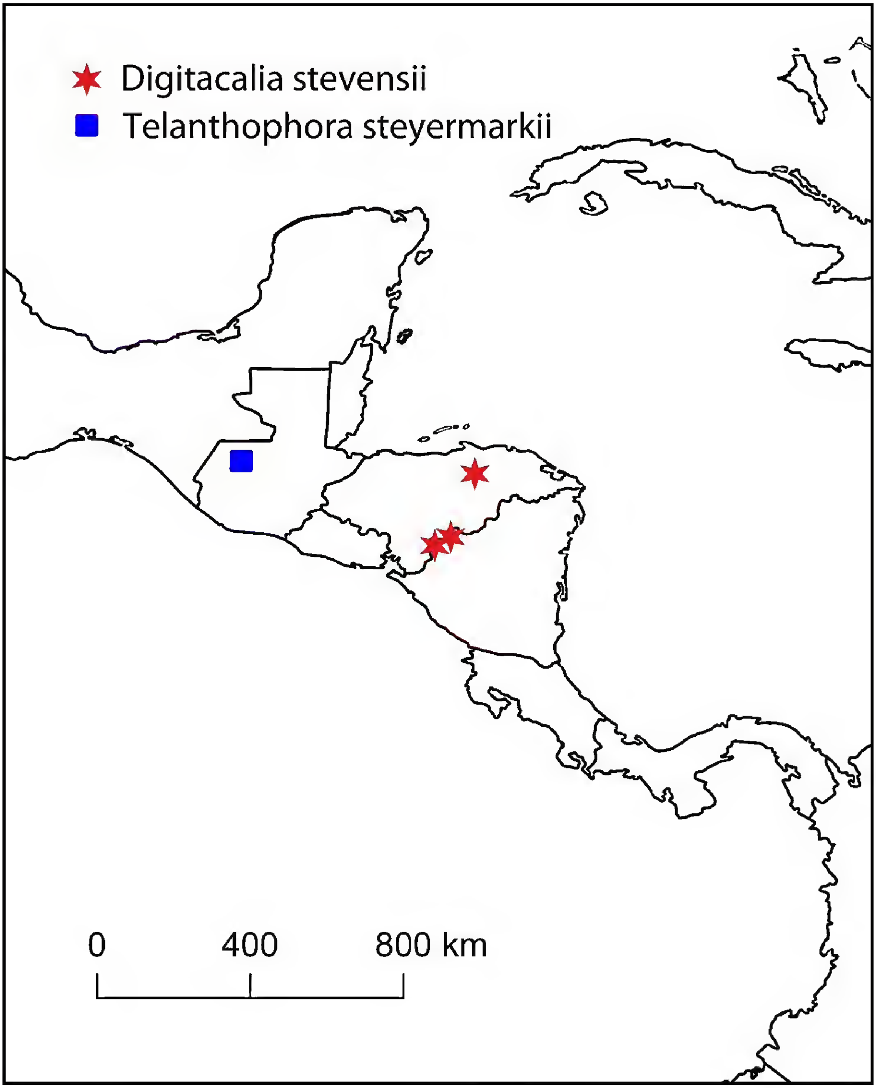


Figure 45. Distributions of *Digitacalia stevensii* and *Telanthophora steyermarkii*.

Figure 46. Holotype of *Digitacalia stevensii* Pruski. (*Stevens & Montiel 37259*, MO).

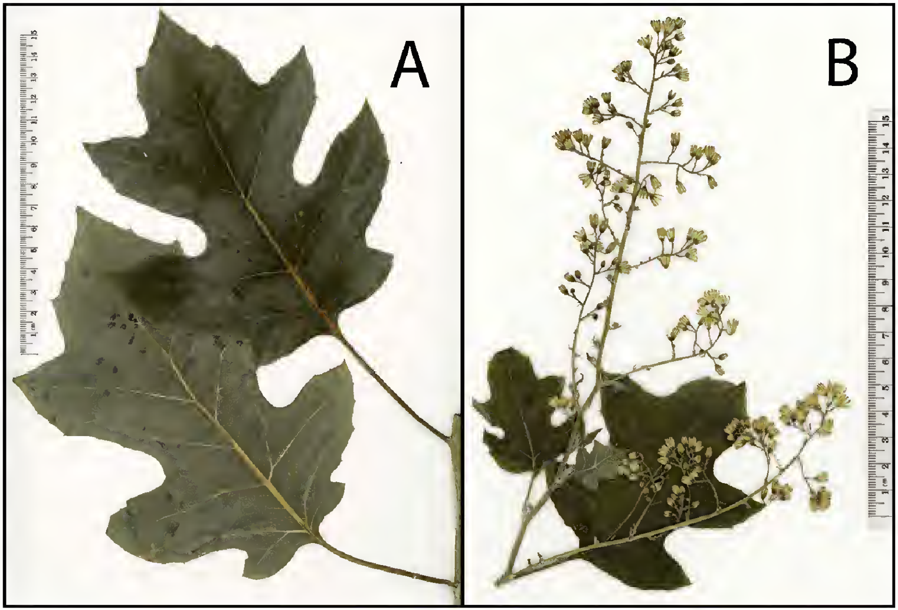


Figure 47. Paratype of *Digitacalia stevensii* Pruski. (*Stevens & Montiel 38871*, MO).

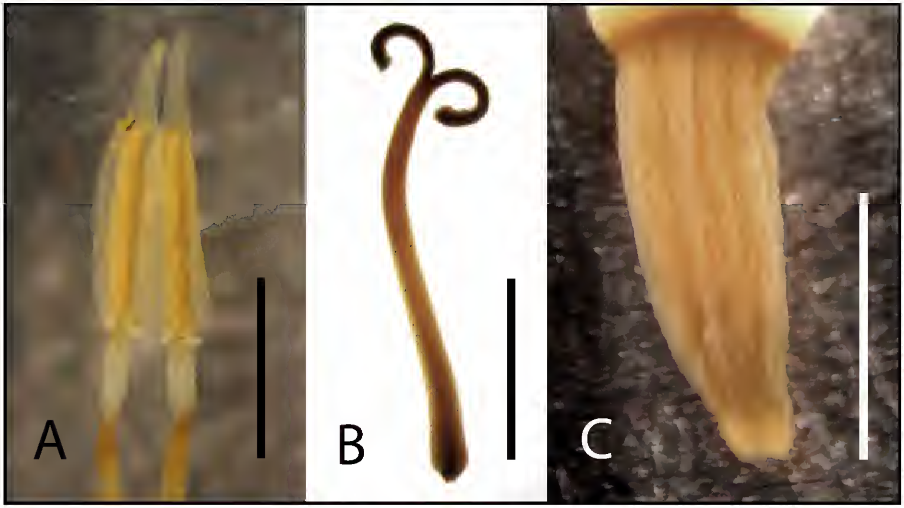


Figure 48. Floral microcharacters of *Digitacalia stevensii*. A. Two anthers, showing cylindrical filament collars and lanceolate apical appendages. B. Bifid style with short, obtuse-tipped branches. C. Immature cypsela showing several broad costae. (From the holotype, *Stevens & Montiel 37259*, MO). [Scale bars: A 0.9 mm, B 2 mm, C 1.5 mm].

Paratypes. **HONDURAS**. **Olancho.** Along Río Olancho, on road between Gualaco and San Bonito Oriental, 7.4 miles NE of San Estéban, 15° 20' N, 85° 42' W, 540 m, 7 Feb 1987 (in bud), *Croat & Hannon 64339* (MO, US; originally determined by Harold Robinson in 1987 as "*Roldana* ?"). **NICARAGUA. Nueva Segovia.** 10.8 km NW of Ococona along road to Santa María, 13° 45' 02" N, 86° 39' 48" W, 974 m, 30 Dec 2016 (in bud), *Stevens & Montiel 38871* (HULE, MO).

Eponymy. *Digitacalia stevensii* is named for Warren D. Stevens, collector of the type material and world authority of the flora of Nicaragua. Doug Stevens is the lead author of the three volume series "Flora de Nicaragua," published in 2001, and a specialist of Asclepiadoideae taxonomy.

Among the four previously recognized species, each a Mexican endemic, *Digitacalia stevensii* may be distinguished at a glance from *D. jatrophoides* and *D. napeifolia*, which differ by deeply-lobed leaves. Instead, *D. stevensii* is more similar to pinnatilobed *D. chiapensis* and trifid-leaved *D. tridactylitis*. *Digitacalia stevensii* seems to combine characters of the two, having the leaves of *D. chiapensis* and capitulum and floret sizes of *D. tridactylitis*. The elongate, narrow-pyramidal, thyrsoid-paniculate capitulescence of *D. stevensii*, however, serves to distinguish it from both species, and is unique in the genus. By geography, it is tempting to equate the new species with *D. chiapensis*, but *D. stevensii* differs from *D. chiapensis* by a more southerly distribution, moderately villosulous (vs. glabrous) stems, moderately dense, thyrsoidal-paniculate (vs. open, corymbiform) capitulescences, capitula 7–8 (vs. 5.5–7.5) mm long, corollas 4.5–5.5 (vs. 3–5) mm long, glabrous (vs. sometimes setulose) cypselae, and pappus bristles 4–5 (vs. 3–4) mm long.

Before seeing field photographs showing the type plants of *Digitacalia stevensii* to be white-flowered, I naively thought the plant was yellow-flowered and probably a species of *Roldana*. Indeed, by gestalt and thyrsoidal capitulescences, *D. stevensii* recalls top-snatch specimens of *Roldana greenmanii* H. Rob. & Brettell, which differs by solid stems, pubescent pluristriate merely narrowly scarious-margined phyllaries, yellow short-lobed corollas with elongate throat, and proximal stem leaves palmatilobed, albeit on occasion with a few pinnatilobed distal leaves resembling those of *D. stevensii*.

5. **DIGITACALIA TRIDACTYLITIS** (B.L. Rob. & Greenm.) Pippen, Contr. U.S. Natl. Herb. 34: 383. 1968. *Cacalia tridactylitis* B.L. Rob. & Greenm., Amer. J. Sci. Arts, ser. 3: 50. 159. 1895. *Odontotrichum tridactylitis* (B.L. Rob. & Greenm.) Rydb., Bull. Torrey Bot. Club 51: 419. 1924. TYPE: **MEXICO. Oaxaca.** Sierra de San Felipe, 6000 ft., 19 Nov 1894, *Pringle 5841* (holotype: GH, as Beaman color slide 7221, also as Pippen 1968 plate 1; isotype: VT). [The VT isotype on JSTOR is incorrectly numbered 5840, which page 158 of the protologue publication gives instead as collected 17 November 1894 and as the type number of *Cacalia obtusiloba* B.L. Rob. & Greenm. (= *Psacalium megaphyllum*); the GH holotype was not found in JSTOR].

Digitacalia crypta B.L. Turner

Herbs to 3 m tall; stems puberulent. **Leaves** very deeply proximally trilobed (nearly digitate) or proximal stem leaves only moderately trilobed from near midblade, petiolate; blade mostly 6–20 × 4–13 cm, trullate, rhombic or hastiform, lobed nearly to midrib or proximal leaves only about halfway to midrib, base shortly decurrent onto petiole, adaxial surface sparsely pubescent, abaxial surfaces tomentulose, lobes lanceolate to triangular, margins usually subentire but the type is coarsely serrate, apex attenuate; petiole 1–4 cm long. **Capitulescence** to 30 × 25 cm, corymbiform-paniculate, broadly rounded to nearly flat-topped, lateral branches sometimes overtopping central axis, tomentulose; peduncles mostly 3–7 mm long, tomentulose. **Capitula** 7–10 mm long; involucre 3–4 mm diam.; phyllaries (7–)8, 3.5–4(–5) × 1–1.5 mm, a few sometimes keeled, glabrous; calycular bracteoles few–several, 1.5–3.5 mm long, subulate. **Disk florets** 8–10; corolla 5–6 mm long, throat

0.1–0.5 mm long, lobes 2–3 mm long; anthers 2–3 mm long; style branches 1–1.5 mm long. **Cypselae** 3–5 mm long, glabrous; pappus 4–5.5 mm long, sometimes becoming tawny when mature. $2n = 60$ (Pippen 1968).

Distribution and representative collections. **Mexico** (Guerrero, México, Morelos, Oaxaca); *Barrie 722* (MEXU, TEX; type of synonymous *Digitacalia crypta* B.L. Turner); *Krause 1226* (MEXU, MO); *Martinez et al. 5734* (MEXU, MO); *McVaugh 21903* (MICH); *Nelson 2080* (US); *Pringle 6164* (CAS, CM, COLO, F, GH, MEXU, MO, NDG, NY, US); *Pringle 9877* (CAS, CM, F, GH, MO, NMC, NY, US); *Smith 380* (MICH, MO, NY).

The proximal leaves (often not present on herbarium specimens) of *Digitacalia tridactylitis* are very reminiscent of those of *Neurolaena lobata* (L.) Cass. The type collection has leaf margins coarsely serrate, but most material seen has subentire margins. The deeply digitate leaves of many collections are noteworthy, but on some plants they co-occur with moderately trilobed leaves. Robinson and Greenman (1895) described the species as having "about 7" phyllaries. Turner (1990) treated typically 8-phyllaried *D. tridactylitis* in synonymy of 5-phyllaried *D. napeifolia*. Although some individual Senecioninae as circumscribed here (e.g., *Dresslerothamnus angustiradiatus* and *Pentacalia wilburii*) may vary in phyllary number, individual cacalioid species are more consistent in phyllary number, and Turner's notion was considered but ultimately rejected here. The species is thereby interpreted broadly, more or less as by Pippen (1968).

An illustration of *Digitacalia tridactylitis* was provided by Turner (1990) under the name of *D. crypta*. The Pringle collections cited above are paratypes of the synonymous *D. crypta*, but were cited as *D. tridactylitis* by Pippen (1968: 383) and Wetter (1983: 21), who are followed here.

Excluded species.

Digitacalia heteroidea (Klatt) Pippen ≡ **Roldana heteroidea** (Klatt) H. Rob. & Brettell.

1. **TELANTHOPHORA STEYERMARKII** (Greenm.) Pruski, Flora Mesoamericana vol. 5, parte 2: 471. 2018. *Senecio steyermarkii* Greenm., Ceiba 1: 124. (1 April) 1950. [non *Senecio steyermarkii* Cuatr., Fieldiana, Bot. 27(1): 32 (8 June) 1950, hom. illeg.]. **TYPE: GUATEMALA. Huehuetenango**. Sierra de los Cuchumatanes, near cafetal of Finca Soledad, 5 km SE of Barillas, 1150 m, 26 Jul 1942, *Steyermark 49556* (holotype: MO; isotype: F). Figures 4E–F, 45, 49.

Pachycaulous shrubs 3–7 m tall; stems floccose-tomentose distally to irregularly subglabrate. **Leaves** petiolate; blade 10–22 × 4–10 cm, elliptic-ovate, stiffly chartaceous, venation pinnate with 10–12 secondary veins per side, surfaces obviously discolorous, adaxial surface green, sparsely arachnoid-tomentose along veins to glabrate, abaxial surface white-gray, densely and persistently arachnoid-tomentose throughout or sometimes glabrate in patches, never completely glabrate, base cuneate to obtuse, margins subentire to few-dentate (remotely and shallowly sinuous-lobulate), apex acuminate to obtuse; petiole 3–8 cm long. **Capitulescence** 6–15 cm diam., branches and peduncles tomentulose, bracteoles 3–5 mm long, linear-lanceolate. **Capitula** 6.5–8 mm long, short-radiate; involucre 3–4 mm diam., campanulate; phyllaries ca. 8, 4–5.5 mm long, tomentulose in the middle or only so basally; calycular bracteoles 1–2 mm long, linear-lanceolate. **Ray florets** 2–3; corolla limb ca. 3+ mm long, weakly exserted, 5–6-nerved. **Disk florets** 7–10; corolla ca. 5 mm long, tube shorter than limb, lobes 1.5–2 mm long, about as long as throat, long-lanceolate, with median resin duct; anthers short-caudate, collar 0.2–0.3 mm long, cylindrical, without enlarged basal cells, endothecial tissue radial; style branches 1.5–2 mm long, apex obtuse, stigmatic surfaces continuous. **Cypselae** (immature) 1–1.5 mm long; pappus bristles ca. 5 mm long.

Holotype of: Senecio steyermarkii Greenman
Ref. Ceiba 1: 124, 1950,
ver. John Pruski; 2012
Missouri Botanical Garden (MO)

No. 49556

NO. 49556
Senecio Steyermarkii Greenm., n. sp.
in Ceiba 1: 124, April 1, 1950
DET. BY J. M. GREENMAN.

Senecio steyermarkii Greenman.
Determined by Funston, 2003 (MO)

Studies for Flora of Guatemala
Senecio barba-johannis DC.
Louis O. Williams 1975

Type Specimen
HERB. M.B.G.

MISSOURI BOTANICAL GARDEN HERBARIUM
1254535

Telanthophora steyermarkii (Greenm.) Pruski
det. John Pruski (MO), 2012
MISSOURI BOTANICAL GARDEN HERBARIUM

PLANTS OF GUATEMALA
49556 Field Museum of Natural History Expedition, 1941-42
Senecio Steyermarkii Greenm., n. sp.
Shrub 20 ft. tall; flowers deep yellow; leaves deep green above, gray-white beneath.
Dept. Huehuetenango: Near cafetal of Finca Soledad, 5 miles southeast of ~~Sta~~ Barillas, Sierra de los Cuchumatanes, alt. 1,150 m.
~~Dept. Huehuetenango, between Finca San Rafael and Finca Providencia, alt. 800 m.~~
JULIAN A. STEYERMARK JULY 26, 1942

NO. 49556 Type
Senecio Steyermarkii Greenm. n. sp.
Sept 15, 1949
DET. BY J. M. GREENMAN.

Figure 49. Holotype of *Senecio steyermarkii* Greenm. (≡ *Telanthophora steyermarkii*). (*Steyermark 49556*, MO).

Distribution and ecology. *Telanthophora steyermarkii* is endemic to Guatemala (Fig. 45), where it was collected flowering in July at 1150 meters elevation. The species is known from only the type collection.

Microscopic study of floral details shows *Telanthophora steyermarkii* has cylindrical filament collars (Fig. 4E) and continuous stigmatic surfaces (Fig. 4F). By these characters it is thus a typical member of subtribe Tussilagininae. A question has arisen as to whether or not the species is distinct. Williams (1975) treated *Telanthophora* in synonymy of *Senecio*, recognized the species using the name *Senecio steyermarkii*, but did not mention subtribal placement. On the other hand, Clark (1996) recognized *Telanthophora* but treated *T. steyermarkii* in synonymy with *T. grandifolia.*

Among species in Mesoamerica, involucres of five phyllaries are characteristic of a group of four species that are sometimes discoid-capitulate: *Telanthophora cobanensis* (J.M. Coult.) R. & B., *T. molinae* R. & B., *T. sublaciniata* (Greenm.) B.L. Clark, and *T. uspantanensis* (J.M. Coult.) R. & B.. Involucres of eight phyllaries are found in *T. bartlettii* R. & B., *T. grandifolia* (Less.) R. & B., and *T. steyermarkii* (Greenm.) Pruski. In gestalt and oblong leaves, however, *T. bartlettii* otherwise resembles species of the first group. Thus by the process of elimination, *T. grandifolia* and *T. steyermarkii* may be close congeners, and indeed Clark (1996) treated *T. steyermarkii* in synonymy with *T. grandifolia.*

Telanthophora grandifolia, however, is typically pinnatilobed and concolorous-leaved, and does not match *T. steyermarkii. Telanthophora steyermarkii* was recently resurrected and is distinguished by its radiate capitula with eight phyllaries and by its leaf blade surfaces obviously discolorous, abaxially densely arachnoid-tomentose throughout or sometimes glabrate in patches, never completely glabrate. Nevertheless, *T. steyermarkii* is somewhat similar to *Senecio serraquitchensis* Greenm., which is loosely arachnoid-tomentose abaxially only along the midrib, and which proves to fit moderately comfortably in synonymy with *T. grandifolia*, which is widespread from Mexico to Costa Rica.

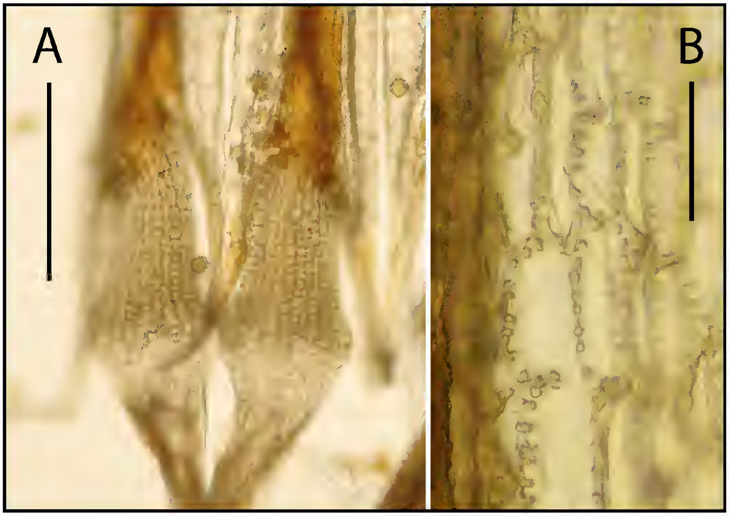


Figure 50. Floral microcharacters of *Dendrophorbium multinerve.* A. Balusterform filament collars and tails. B. Radial (approaching transitional) transitional endothecial tissue. (*Solomon 18723*, MO). [Scale bars: A 0.5 mm, B 30 μm].

III. NEW COMBINATIONS IN SOUTH AMERICAN DENDROPHORBIUM AND MONTICALIA (SENECIONINAE)

Dendrophorbium and *Monticalia* (Senecioninae) were segregated by Jeffrey (1992a) from *Senecio* and *Pentacalia*, respectively. These two segregates are recognized here more or less as circumscribed by Jeffrey (1992a) and Nordenstam (2007), and are distinguished by floral microfeatures and habit. The new combinations in South American *Dendrophorbium* and *Monticalia* proposed here are for names that mostly have been used informally for more than a decade. These names are validated here for further use in specimen determinations and various floristic projects, and those in *Dendrophorbium* are proposed preliminary to a revision of the Peruvian species underway by the author.

Dendrophorbium and *Monticalia* are centered in the Andes, but *Dendrophorbium lucidum* (Sw.) C. Jeffrey occurs in the Lesser Antilles, several species are known from Brazil, and two species of *Monticalia* were recognized in Central America by Pruski and Robinson (2018). *Dendrophorbium* (Fig. 50) and *Monticalia* each have moderately balusterform anther collars, exappendiculate style branches with 2-banded stigmatic surfaces, and radial(-transitional) endothecial patterns, typical of subtribe Senecioninae.

Dendrophorbium

The genus *Dendrophorbium* (keyed by the author with *Pentacalia* allies above) contains more than 90 species, these mostly Andean. *Dendrophorbium* was described by Cuatrecasas (1951) as a section of *Senecio*, and retained by Cuatrecasas (1981) in *Senecio*, which it resembles by 10-striate-costate cypselae. *Dendrophorbium* differs from *Senecio* in habit, however, being shrubby herbs or pachycaul trees. The leaves in *Dendrophorbium* may be relatively well-spaced along the distal half of the stem, but at other times are clustered apically. The species are mostly dentate-leaved (Figs. 51A, 52–55) and the capitulescence broadly corymbiform, but the plants may be entire-leaved and in several species the capitulescence is pyramidally thyrsoid-paniculate (Figs. 51B, 52). The genus is often characterized as having sagittate anthers, but the anthers in some species are caudate (viz Fig. 50A; Jeffrey 1992a). As is typical of subtribe Senecioninae, the endothecial tissue is typically radial (sometimes transitional with both radial and polar thickenings) (Fig. 50B).

Cuatrecasas (1951) gave leaf texture as a distinguishing feature between *Senecio* sect. *Dendrophorbium* Cuatr. and now synonymous *Senecio* sect. *Macbrideus* Cuatr. Cabrera (1985: 136) keyed Bolivian material under the name *Senecio* ser. *Myriocephali* (Cabrera) Cabrera, and gave *Senecio* sect. *Pluricephali* Cabrera in synonymy. These aforementioned *Senecio* infragenera are now treated as the genus *Dendrophorbium*.

Dendrophorbium was characterized by Jeffrey (1992a), Bremer (1994), and Díaz-Piedrahita and Cuatrecasas (1999) as having cypselae 5-costate, and *Senecio* ser. *Myriocephali* was said to be "generalmente pentcostados" by Cabrera (1985). Nordenstam (2007: 233) described the cypselae of *Dendrophorbium* as "5-ribbed," but keyed the genus (Nordenstam 2007: 214 lead 164b) by cypselae "8–10-ribbed." In the author's above key to genera centering about *Pentacalia*, the cypselae in *Dendrophorbium* are described as "8–10-striate-costate," supernumerary rib on each face initially less-pronounced than the costae on the angles, but at maturity the cypselae of *Dendrophorbium* become subterete and 8–10-striate-costate.

Figure 51. Habit (A) and close-up of capitulescence details (B) of typical member of the *Dendrophorbium reflexum* species group. The group is characterized by closely serrate leaf margins, rigid-chartaceous leaf blades, and narrowly pyramidal capitulescences. (Peru, San Martín, Tocache, entre Metal y Manan, 1900 m, 4 Jul 2014, *Pruski et al. 4687*).

Figure 52. Holotype of *Senecio castaneifolius* DC. (≡ *Dendrophorbium castaneifolium*). (*Haenke s.n.*, PR-377362).

1. **DENDROPHORBIUM CASTANEIFOLIUM** (DC.) Pruski, **comb. nov.** *Senecio castaneifolius* DC., Prodr. 6: 425. 1837 [1838], as "*castaneaefolius.*" **TYPE:** presumably **Peru. [?Cusco].** "America meridionalis montibus Oronocensibus" in protologue, "Peruano montano oronocenses" [sic] on holotype label, [1790s–1810s], *Haenke s.n.* (holotype: PR; isotype: G, as Macbride negative 8255 labelled as in G-DEL, not seen in G-DC in IDC microfiche 800 card 1140). Figure 52.

[As stated in the protologue, the name was based on the holotype in PR: "v. s. in h. Haenke à cl. de Sternberg miss." The G sheet is merely a fragment of the PR holotype. Elsewhere in Prodromus, Candolle often indicated when Haenke material was given to him (now mostly G-DC) as "v. s. in h. Haenk. ab ill. de Sternberg comm.," which is not the case with *Senecio castaneifolius,* the holotype of which is in PR.].

Dendrophorbium castaneifolium (DC.) Pruski is characterized by thin-chartaceous elongate leaves with the many secondary veins closely spaced, narrow-pyramidal open axillary or terminal capitulescences of 15+ large radiate capitula closely subtended by several linear bracteoles, 7–8 mm tall involucres composed of 10–12 phyllaries, 12 ray florets, 25–30 disk florets, and slightly bulbous-tipped pappus bristles. The collector of the type––Thaddaeus Haenke––visited Lima, Arequipa, Cusco (Peru), and for 20 years used as a home base Cochabamba (Bolivia), where he died in 1816 or 1817 (Gicklhorn 1966, viz map 2). The type locality of *D. castaneifolium* thereby could be in either Bolivia or southern Peru.

The citation by Candolle (1837) of *Dendrophorbium castaneifolium* as from "Amer. meridionalis" differs from the locality of another regional plant collected by Haenke, i.e., *Senecio oronocensis* DC. (1837: 423), which was given by Candolle as "Amer. australis." Cabrera (1954: 595) suggested that Haenke material labeled as "Oronocensibusis" is likely from the Serranía de Orinoca, Oruro, Bolivia, west of Lago de Poopó, and at about 3000 meters elevation. Although Cabrera (1954) suggested the type of *S. oronocensis* may be from Oruro, Bolivia, Cabrera (1985: 103) listed no material of the species from Oruro, and instead gave it as known only from La Paz, Bolivia north to Huánuco, Peru. Similarly, *D. castaneifolium* is unknown in Oruro, which is very high-elevational, dry, and poor in *Dendrophorbium* species. All contemporary material of *D. castaneifolium* (e.g., *Boeke & Boeke 3246*, *Calatayud et al. 2039*, *Valenzuela et al. 487*, *Valenzuela et al. 7292*) in front of me is Peruvian, suggesting the type locality of the species is in Peru, perhaps in Cusco where the plant is centered and most frequently encountered between 900–2300 meters elevation.

Cabrera (1985) did not treat *D. castaneifolium* as Bolivian, but simply noted its similarity to *D. cabrerae* (Cuatr.) C. Jeffrey and *D. peregrinum* (Griseb.) C. Jeffrey, which are similarly thin-leaved but small-capitulate Bolivian species. Another Bolivian *Dendrophorbium* with similar leaves is *D. coroicense* (Rusby) C. Jeffrey, which also has smaller capitula than those of *D. castaneifolium.* Bolivian *D. medullosum* (Sch. Bip. ex Greenm.) C. Jeffrey and *D. yungasense* (Britton) C. Jeffrey are large-capitulate radiate-flowered species, but differ by their much fewer, well-spaced secondary leaf veins. Peruvian and Bolivian *D. biacuminatum* (Rusby) C. Jeffrey is similar to the Greenman and Britton species, and differs from them and *D. castaneifolium* by its winged-petiolate leaves. In its narrowly pyramidal capitulescences, *D. castaneifolium* is similar to the common northern *D. reflexum* (Peru to Venezuela), but differs by its thin-textured narrow leaves that are not prominently veined, more open capitulescences with long peduncles, and shorter and broader phyllaries. Another somewhat similar regional species is *D. vargasii* (Cabrera) H. Beltrán from Cusco, which differs in its oblong leaves and rounded capitulescences. The relatively uncommon *D. castaneifolium* basically combines the leaf texture character of the Bolivian species and the capitulescence form of the more northern species, and is accepted by me as endemic to Peru.

Figure 53. Holotype of *Senecio elatus* Kunth (≡ *Dendrophorbium elatum*). The MO photograph of the holotype is labeled as though it is a print from Macbride negative 37886 and this number is given as this species on the F web site, but that number is not seen in the photograph. (*Humboldt & Bonpland 3572*, P-HBK).

2. **Dendrophorbium elatum** (Kunth) Pruski, **comb. nov.** *Senecio elatus* Kunth, Nov. Gen. Sp. (folio ed.) 4: 141. 1820 [1818] [also quarto ed. 4: 180. 1820]. **Type: PERU.** [?**Cajamarca**]. Páramo de Yamoca, inter Colasey et Chontaly, 2468 m [as 1350 hex], Aug [1802], *Humboldt & Bonpland 3572* (holotype: P-HBK, as Macbride negative 37886, as IDC microfiche 6209. 105.III.7). The binomial on the holotype does not seem to be in Kunth's handwriting. The Depto. for Páramo de Yamoca (Humboldt and Bonpland locality 194 in Sandwith 1968: 93) is not known with certainty to me, but is between Pomahuaca (locality 193) and Passo de Pucara (locality 197), both in Cajamarca southwest of Jaen. Figure 53.

Dendrophorbium elatum (Kunth) Pruski is a shrubby herb to 2 m tall occurring in Loja, Ecuador and northern Peru (Deptos. Amazonas, Ancash, Cajamarca, and La Libertad). The species was not previously reported in Ecuador. *Dendrophorbium elatum* has been collected above 2000 meters elevation. It flowers year-round with an apparent flowering peak from June to August. Contemporary collections (e.g., *Jorgensen et al. 733* from Ecuador; *Campos et al. 5021* from Peru) confirm that *D. elatum* is characterized by oblong leaf blades often with obtuse tips, broadly rounded capitulescences, pilosulose peduncles, few calycular bracts often only about half as long as the involucre, and (8–)10-costate glabrous cypselae. *Dendrophorbium elatum* is similar to north Peruvian *D. usgorense* (Cuatr.) C. Jeffrey, which differs by its acute-tipped leaf blades, nearly subglabrous peduncles, and calycular bracts nearly as long as the involucre. Another similar regional species is *D. vanillodorum* (Cabrera) H. Beltrán, which is a much denser pubescent plant.

3. **Dendrophorbium gritense** (Lapp, T. Ruíz & Torrec.) Pruski, **comb. nov.** *Pentacalia gritensis* Lapp, T. Ruíz & Torrec., Ernstia 23(1): 18. 2013. **Type: VENEZUELA. Táchira.** Páramo El Batallón, vía a la Laguna Grande, 3279 m, 24 Oct 2012, *Lapp et al. 616* (holotype: MY; isotype: VEN). Figures 54–55.

Shrubs 1–1.5 m tall, leafy only distally; stems sericeous to puberulent distally, leaf scars ca. 0.5 cm diam., prominent; distal internodes much shorter than the leaves. **Leaves** simple, alternate, subsessile; blade 5–10.5 × 1.7–3 cm, narrowly elliptic to oblong, subcoriaceous or stiffly chartaceous, pinnately veined usually with 8–10 secondary veins per side, arching strongly towards apex, tertiary veins immersed, surfaces glabrous or glabrate, base cuneate to attenuate and tapering into a petiolariform base, distal margins shallowly dentate-serrate, apex acute; petiolar base 0.5–1.5 × ca. 0.3 cm, stout. **Capitulescence** corymbiform, to 9 × 7 cm, nearly flat-topped, few-branched, bracteolate; peduncles 2.5–5 cm long, glabrous, few-bracteolate, bracteoles ca. 2 mm long, lanceolate, glabrous or weakly ciliolate. **Capitula** 11–13 mm tall, radiate; involucre 9.5–11 × 10–12 mm, campanulate, loosely calyculate; phyllaries ca. 13, subequal, persistent, 9.5–11 × 2–2.4 mm, lanceolate, broad-margined, apex acuminate, densely papillose at apex, otherwise glabrous, rarely sparingly arachnoid throughout; calycular bracteoles ca. 6, ca. 3.5 mm long, lanceolate, subherbaceous throughout, papillose at apex; clinanthium 4–6 mm diam., flat, ridged-areolate. **Ray florets** 11–13; corolla 17.3–19.3 mm long, yellow, glabrous, limb 5–7-nerved, 12–14.5 × 2–2.3 mm. **Disc florets** 45–50, bisexual; corolla 7.6–8.4 mm long, tubular-funnelform, shortly 5-lobed, yellow, glabrous; anthers ca. 3 mm long, short-caudate, endothecial tissue pattern radial; style 8.5–10 mm long, basal node ca. 0.5 mm tall, branches ca. 1.8 mm long, stigmatic surfaces 2-banded, apex obtuse, exappendiculate, weakly papillose. **Cypselae** ca. 2.6 mm long; obconic, (8–)10-costate, brown, glabrous, carpopodium symmetric, non-sculptured; pappus of 50+ bristles 6–7.2 mm long.

Additional collections examined. VENEZUELA. Trujillo (limité con Lara). Mun. Carache, P.N. Dinira, arriba de Mesa Arriba, cumbre del pico Cendé y laderas, 9° 32' N, 70° 07' W, 3330–3350 m, 2 Apr 1999, *R. Duno & Riina 796* (US; post-fruit); Mun. Carache, P.N. Dinira, arriba de Mesa Arriba, camino del páramo de Jabón al Pico Cendé, 9° 33' N, 70° 07' W, 3000 m, 30 Dec 1999, *R. Duno, Riina, & Meier 1132* (US, VEN).

For a more than a decade, *Dendrophorbium gritense* was in fertile condition known to me from only *Duno et al. 1132* (US), and in 2000 I annotated this sheet as *Pentacalia dunoi* mihi (Fig. 55). However, by (8–)10-costate cypselae (Fig. 54G) *Duno et al. 1132* proves to be a *Dendrophorbium*, as noted by Bertil Nordenstam (pers. comm. 2000). In 2013 the species was described as *Pentacalia gritensis*, and the needed new combination in *Dendrophorbium* is proposed here. Venezuelan *Monticalia greenmaniana* (Hieron.) C. Jeffrey has similar veined leaves but is a densely pubescent plant with pilose corollas and is retained provisionally in *Monticalia.* It seems likely that *D. gritense* occurs in páramos between the two known, moderately distant localities, which are nearly at opposite ends of the Venezuelan. The description provided shows that the Venezuelan materials are conspecific and that the plant is best placed in *Dendrophorbium.*

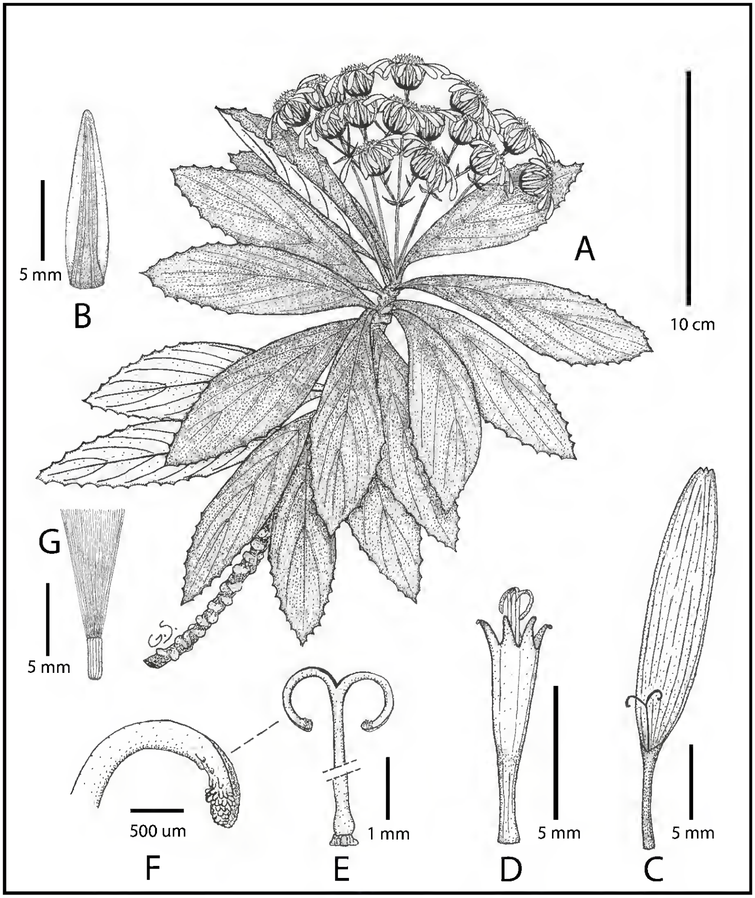


Figure 54. *Dendrophorbium gritense*. A. Flowering branch. B. Phyllary. C. Ray floret, ovary and pappus removed. D. Disk floret, ovary and pappus removed. E. Style from disk floret. F. Close-up of style branch from disk floret. G. Disk cypselae, showing several costae. (Drawn by Gisela Sancho from *Duno et al. 1132*, US).

Figure 55. *Dendrophorbium gritense*. Photograph taken in 2000 of intended type of unpublished *P. dunoi*, a taxon subsequently validated in 2013 as *Pentacalia gritensis*. *Duno et al. 1132*, US.

4. **Dendrophorbium huasense** (Cuatr.) Pruski, **comb. nov.** *Senecio huasensis* Cuatr., Brittonia 8: 187. 1956. **Type: PERU. Junin.** Huasa Huasi, [1778–1784], *Dombey s.n.* (holotype: P).

Dendrophorbium huasense (Cuatr.) Pruski, endemic to Peru, is distinctive in its broad-based leaves, arachnoid-tomentulose abaxial leaf blade surfaces, and closely spaced small radiate capitula with 13 phyllaries.

5. **Dendrophorbium munchiquense** (S. Díaz & Cuatr.) Pruski, **comb. nov.** *Pentacalia munchiquensis* S. Díaz & Cuatr., Revista Acad. Colomb. Ci. Exact. 19(72): 21. 1994. **Type: COLOMBIA. Cauca.** Parque Nacional Munchique, El Tambo, vereda La Romelia, La Gallera, 2000 m, 26 Jul 1993, *Ruiz et al. 309* (holotype: COL; isotype: COL, MA, US).

Dendrophorbium munchiquense (S. Díaz & Cuatr.) Pruski, known to me from only a few collections in Cauca, was by its caudate anthers treated by Díaz-Piedrahita and Cuatrecasas (1999) within *Pentacalia*. It is characterized by its long lanceolate entire glabrous leaves and radiate capitula with eight phyllaries. *Dendrophorbium moscopanum* (Cuatr.) C. Jeffrey, also from Cauca, Colombia, is somewhat similar to *D. munchiquense* but differs by its smaller, arachnoid-tomentulose dentate leaves.

6. **Dendrophorbium vallecaucanum** (Cuatr.) Pruski, **comb. nov.** *Senecio vallecaucanus* Cuatr., Fieldiana, Bot. 27(1): 23. 1950. **Type: COLOMBIA. Valle del Cauca.** Cordillera Occidental, Los Farallones, extremo N, vertiente oriental, Alto del Buey, 3300–3450 m, 13 Oct 1944, *Cuatrecasas 18062* (holotype: F; isotypes: COL-2, F, P, US).

Dendrophorbium vallecaucanum (Cuatr.) Pruski is characterized by its large strongly reticulate finely serrate leaves, narrow capitulescence, disciform (practically discoid Cuatrecasas 1950) capitula with eight phyllaries, and conical style appendage. It was keyed by Díaz-Piedrahita and Cuatrecasas (1999) as "claramente radiatos," but by its very small pistillate floret limbs it is disciform, as noted by Cuatrecasas (1950). It recalls several Colombian species, including the common *D. americanum* (L.f.) C. Jeffrey, which is obviously radiate-capitulate. Instead, it is similar to weakly-radiate to disciform *D. kleinioides* (Kunth) B. Nord., which differs by smaller serrulate leaves.

Monticalia

Shrubby often ericoid-leaved *Monticalia* was treated earlier as *Pentacalia* subgen. *Microchaete* (Benth.) Cuatr. by Cuatrecasas (1981) and Díaz-Piedrahita and Cuatrecasas (1999) but maintained at generic rank by Nordenstam (1999, 2007). *Monticalia* resembles *Pentacalia* in technical feature of caudate anthers and 5-costate cypselae, but differs in habit.

The new combination proposed here for Peruvian *Monticalia barbourii* (M.O. Dillon & Sagást.) Pruski (Senecioninae) reflects acceptance of the segregation (Jeffrey 1992a) of shrubby elements from *Pentacalia*, where they were treated by Cuatrecasas (1981). Pending further study, the genus is maintained as proposed by Jeffrey (1992a), although several distinct species groups (weakly supported lineages) are known in *Monticalia*.

1. **Monticalia barbourii** (M.O. Dillon & Sagást.) Pruski, **comb. nov.** *Pentacalia barbourii* M.O. Dillon & Sagást., Brittonia 40: 225. 1988. **Type: PERU. Amazonas.** Prov. Bagua, Cordillera Colán NE of La Peca, ca. 3290 m [as 10800 ft], 9 Sep 1978, *Barbour 3450* (holotype: F; isotypes: LSU, MO). Figure 56A.

Figure 56. A. *Monticalia barbourii*, showing solitary subsessile capitula. B. *Monticalia verticillata*, showing cymose capitulescences with pedunculate capitula. (A *Vega et al. 288*, MO; B *Bussmann et al. 16624*, unmounted duplicate).

Distribution and ecology. *Monticalia barbourii* is a rare endemic of Andean north Peru (Deptos. Amazonas, La Libertad, and San Martín), where it has been collected flowering in May, September, and November from 3290–3550 meters elevation. The species was known previously from only the type collection, but two more recent collections have been seen, extending its range about 200 km to the south. The label coordinates of the two recent collections are in Depto. San Martín within two km of the border, but the departments cited in the exsiccatae below are those given on specimen labels. The recent collections are from near the corner of Amazonas, La Libertad, and San Martín, and the species may reasonably be expected to occur in each of these three departments.

Additional collections examined. PERU. Amazonas (border with San Martín). Leimebamba, Tablacha, 6° 55' 52" S, 77° 43' 09" W, 3414 m, 23 May 2015, *Vega et al. 288* (HAO, MO). **La Libertad** (border with San Martín). Uchumarca, Chivane, subida a Conga de Yonan, 7° 04' 02" S, 77° 43' 35" W, 3550 m, 21 Nov 2013, *Paniagua et al. 8857* (MO).

Monticalia barbourii (M.O. Dillon & Sagást.) Pruski is a revolute-margined, discolorous-leaved, radiate-capitulate, much-branched microphyllous ericoid shrub (Fig. 56A). Dillon and Sagástegui (1988) related *M. barbourii* to *M. peruviana* (Pers.) C. Jeffrey, *M. vernicifolia* (Cuatr.) C. Jeffrey, *M. verticillata* (Klatt) C. Jeffrey, and Ecuadorean endemic *M. empetroides* (Cuatr.) C. Jeffrey. Each of these five species is a shrub with 5-costate cypselae and recognized by me in *Monticalia*. Small-leaved *M. myrsinites* (Turcz.) C. Jeffrey has similar hirsute stems but may be distinguished from the five former species by its flat leaves that are glabrous throughout. *Monticalia barbourii* is distinguished by its very small (3.5–4.5 mm long), lanceolate to triangular-ovate, truncate-cordate-based, adaxially subglabrous (sometimes sparsely lingering arachnoid adaxially near margins) leaves, subglabrous petioles, distal stems patent-pubescent hirsute, and solitary subsessile radiate capitula with 13 phyllaries. *Monticalia barbourii* occurs south and east of the Huancabamba deflection in the deep upper Río Marañón basin (Pruski 2012c). The type locality is about 100 km northwest of Chachapoyas, the two newer collections are about 100 km south of Chachapoyas, and the species should be expected at high elevations between the three known localities.

Monticalia barbourii resembles, by very small leaves, *M. empetroides*, which is centered near Cuenca, Azuay, Ecuador, about 200+ km north of Cordillera Colán. *Monticalia empetroides* differs by arachnoid-lanate stems lacking hirsute indument. Longer-leaved *M. peruviana* (syn. *Senecio ericifolius* Benth.) is from northern Peru, Ecuador, and southern Colombia, and typical (but not all) forms of this variable species similarly differ from *M. barbourii* in stem indument. Although *M. vernicifolia* is heterotrichous with a mixed hirsute and arachnoid-lanate stem indument partly resembling *M. barbourii*, it is geographically isolated from it and occurs west of the Río Marañón in Piura. Moreover, *M. vernicifolia* is relatively broad-leaved, ochraceous-pubescent, and characterized by capitula with eight phyllaries.

Monticalia barbourii appears most similar to *M. verticillata* (Fig. 56B) (Dillon & Sagástegui 1988), which it resembles in subglabrous petioles and usually patent-pubescent hirsute distal stems. *Monticalia verticillata* was described as glabrous-stemmed but provisionally includes in synonymy *Senecio verticillatus* var. *trichophorus* Greenm., based on material of the more common hirsute-stemmed morphotype of the species. *Monticalia verticillata* is a longer-broader-leaved plant having cuneate-obtuse leaf blade bases, gray-pubescent leaves, and on occasion nearly glabrous-stems (Greenman 1938); it has 8–13 (vs. 8) ray florets, cymose (Fig. 56B) (vs. monocephalous Fig. 56A) capitulescences with pedunculate (vs. subsessile) capitula, but nevertheless by discolorous leaves and hirsute stems it is similar to *M. barbourii*. *Monticalia verticillata* occurs in Amazonas and Cajamarca, Peru, and is slightly more widely distributed than is the narrowly endemic *M. barbourii*. Dillon and Sagástegui (1988 figure 3) provided a fine drawing of *Monticalia barbourii*.

ACKNOWLEDGEMENTS

I thank Aaron Floden, Kanchi Gandhi, Gordon McPherson, Guy Nesom, Bertil Nordenstam, Rosa Ortiz, Harold Robinson, and Doug Stevens for helpful comments on various parts or drafts of the manuscript; Rosa Ortiz for help with the maps; Ota Sida for sending me photographs of the holotype of *Senecio castaneifolius*; Christine Niezgoda for permission to use the *Senecio streptothamnus* and *S. tonduzii* type images; Bruno Manara, Gisela Sancho, and Alice Tangerini for their drawings; Alfredo Cascante, Alex Monro, Olga Martha Montiel, and Steve Turner for use of their field photographs; Mike Blomberg and Stephanie Keil for their photographs of the type specimens of *Senecio angustiradiatus*, *S. brenesii*, *S. chiapensis*, *S. deppeanus*, *S. schizotrichus*, and *S. steyermarkii*; Rodrigo Duno for submitting material of Senecioneae for determination; and Susan K. Hunter (US) for her photograph of *Dendrophorbium gritense*.

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NEW COMBINATIONS IN *CENCHROPSIS, DICHANTHELIUM,* AND *STAPFOCHLOA* (POACEAE)

JOSEPH K. WIPFF
3512 25th Court SE
Albany, Oregon 97322
jkwipff@gmail.com

ROBERT B. SHAW
Department of Ecosystem Science and Management
Texas A&M University
College Station, Texas 77842
rbshaw10@gmail.com

ABSTRACT

As part of ongoing work on the grasses of Texas, we propose the following taxonomic changes and nomenclatural updates –– **Cenchropsis myosuroides** (Kunth) Nash var. **longiseta** (Caro & E.A. Sánchez) Wipff & Shaw, **comb. nov.**; **Cenchropsis ekmaniana** (A.S. Hitchcock) Wipff & Shaw, comb. **nov.**; **Dichanthelium ovinum** (Scribn. & J.G. Sm.) Wipff & Shaw, **comb. nov.**; **Stapfochloa parodiana** (Roseng. & Izag.) Wipff & Shaw, **comb. nov.**; and **Stapfochloa grandiflora** (Roseng. & Izag.) Wipff & Shaw, **comb. nov.**

As part of ongoing work on the *Guide to Texas Grasses* (Shaw & Wipff, in prep.) and on the grasses of Texas in general, it is necessary to discuss aspects of the taxonomy that we are adopting –– changes in rank, generic transfers to allow for the use of generic concepts, new or old, reinstatement of genera and species previously lost to synonymy, and clarification of characters used to delineate difficult genera or species complexes.

Chemisquy & al. (2010) proposed the unification of *Cenchrus* and *Pennisetum* based on their phylogenetic analysis of morphological, plastid, and nuclear data. Respectfully, we find this very broad interpretation to be a difficult taxonomic tool. We are in congruence with Pohl (1980), Wipff (2001), and Denadío et al. (2009) that the morphological, cytological, cytogenetic and molecular data (Denadío et al. 2009) does support the delimitation of *Cenchrus,* in a strict sense, from *Pennisetum,* and the recognition of *Cenchrus myosuroides* in *Cenchropsis.* As stated, "*We use all techniques and types of evidence we can to make the best decisions we can now. Ecology, biogeography, phenology, cytology, and other information, as available, pertains to the task. Molecular evidence is no silver bullet, and still requires just as much interpretation from all available evidence in order to make best possible taxonomic decisions*" Weakley et al. (2017).

Delisle (1963) published a broad circumscription and taxonomy of the genus *Cenchrus* and its species. This taxonomy included species that were traditionally treated in *Pennisetum.* The broad treatment, however, was found to be a difficult and confusing taxonomic tool. Pohl (1980) and Wipff (2001) published a taxonomic treatment recognizing *Cenchrus* sensu stricto, from *Pennisetum.* Denadío et al. (2009) published a preliminary molecular phylogeny of *Pennisetum* and *Cenchrus.* In their discussion they state,

> "If *Cenchrus ciliaris* and *C. setigerus* are treated under *Pennisetum,* based on a common basic chromosome number x = 9, and the presence of antrorsely scabrous and not spiny bristles (Wipff 2003), the name *Cenchrus* s. str. could be restricted to a core group of species (clades A5 + A6; Fig. 2). Monophyly of *Cenchrus* s. str. is neither confirmed nor rejected by our results, but optimization of non-molecular characters such as the geographic origin (America), basic number of

chromosomes (x = 17, except in *C. myosuroides* with x = 9; Brown, 1950; Morrone & et al. 2006), the degree of fusion of bristles (up to the middle of the bristles, except in *C. myosuroides*), the stiffness of internal bristles (stiff bristles) and the presence of retrorsely barbed bristles (except in *C. pilosus*) all could be used to support the delimitation of *Cenchrus* in a strict sense …" (p. 400).

Link (1827) was the first to treat *Cenchrus ciliaris* in *Pennisetum* and followed by Chase (1921), Hitchcock (1931, 1935), Hitchcock and Chase (1951), Pohl (1980), and Wipff (2001, 2003). Based on chromosomal and morphological characteristics, Wipff (2001) transferred the entire *C. ciliaris* complex to *Pennisetum*. The chromosomal and genomic characteristics combined with phylogenic relationship favor the inclusion of *C. ciliaris* within the genus *Pennisetum* (Martel & al. 2004; Robert & al. 2010).

The unique and distinct fascicle morphology, and basic chromosome number [x=(9),10)] place *Cenchrus myosuroides* and related taxa outside of the generic limits of *Cenchrus* sensu stricto and warrant their recognition within *Cenchropsis* Nash.

1. **CENCHROPSIS** Nash, in J.K. Small, Fl. S.E. U.S. 109, 1327. 1903 (22 Jul 1903). **TYPE**: *Cenchropsis myosuroides* (Kunth) Nash. *Cenchrus myosuroides* Kunth, Nov. Gen. Sp. (quarto ed.) 1 (pts. 1-2): 115–116, t. 35. 1816 (29 Jan 1816). *Pennisetum myosuroides* (Kunth) Spreng., Sys. Veg. ed. 16. 1: 303. 1824 "1825." **LECTOTYPE** (McVaugh 14: 113. 1983): **CUBA**. Cayo Flamingo, 1801, *Humboldt & Bonpland 1361* (P-image!; isolectotypes: B-W-1480-image!; US-865730-image! -fragm. ex P-Bonpl.).

Coarse perennials in large clumps. Culms (50) 70–200 cm long, more or less woody. Inflorescences 8–25 cm long, 6–15 mm wide, 60–150 fascicles densely arranged on the central axis. Primary panicle branches accrescent to a central axis; with sessile scars on axis. Panicle axis angular; puberulous; bearing deciduous fascicles. Fascicles and spikelets disarticulate as a unit. Bristles of the fascicle are all terete, free, connate only on an obconical base, not fused forming a cupule. The bristles of the fascicle are stiff, flexible, not rigid or spine-like, retrorsely scabrous. The terete bristles are 3–8 mm long, 0.2–0.6 mm wide, in 2–4 rows around the spikelet(s), shorter to longer than the spikelet(s), increasing in size towards the center, the inner bristles glabrous or short pubescent on the lower 1/2–2/3. The axis of the fascicles terminates in a spikelet (no primary bristle subtending the terminal spikelet). Spikelets per fascicle 1 (–3). Chromosome numbers $2n$=54 (Brown 1950), ~68 (Bowden & Senn 1962), =70 (Avdulov 1931; Parodi 1946, Delisle 1964, Gould 1965, Reeder 1968), ~72 (Morrone & et al. 2006); most records, $2n$=70. Basic chromosome number, x=(9),10

Cenchropsis myosuroides (Kunth) Nash var. **longiseta** (Caro & E.A. Sánchez) J.K. Wipff & R.B. Shaw, **comb. nov.** *Cenchrus myosuroides* Kunth var. *longisetus* Caro & E.A. Sánchez, Kurtziana 4: 112. 1967. **TYPE**: **ARGENTINA**. **Prov. Entre Ríos**: Paraná, Pueblo Brugo. 1 Nov 1962, *A. Burkart 23603* (holotype: SI-image!).

Cenchropsis ekmaniana (A.S. Hitchcock) J.K. Wipff & R.B. Shaw, **comb. nov.** *Cenchrus ekmanianus* A.S. Hitchcock, Man. Grasses W. Ind., 361. 1936. **TYPE**: **DOMINICAN REPUBLIC**. **Monte Cristi**: Monte Chico, Los Siete, sandy open soil, 14 Jul 1929, *E.L. Ekman 13172* (holotype: US-1502107- image!; isotype: US-1538622-image!)

2. **DICHANTHELIUM sect. ANGUSTIFOLIA** (Hitchc.) Freckmann & Lelong, Sida 20(1):166. 2002 (19 Jul 2002). *Panicum* [unranked] *Angustifolia* Hitchc., in B.L. Rob & Fernald, Manual (Gray), ed. 7, 106. 1908 (as *Angustifolia*). **TYPE**: *Panicum angustifolium* Elliott

Dichanthelium ovinum (Scribn. & J.G. Sm.) Wipff & Shaw, **comb. nov.** *Panicum ovinum* Scribn. & J.G. Sm., Circ. Div. Agrostol. U.S.D.A. 16: 3. 1899. **TYPE**: **TEXAS**. Waller Co.: 25 May 1898, *F.W. Thurow s.n.* (holotype: US-2808967-image!).

Described by Lamson-Scribner (1899) from a Waller Co., Texas collection, *Panicum ovinum* was recognized by Hitchcock and Chase (1910, 1915, 1951) and Silveus (1933, 1942). *Panicum ovinum* was treated as a synonym of *Dichanthelium aciculare* in the broad interpretation of *Dichanthelium* sect. *Angustifolia* by Gould and Clark (1978). In recent years, taxa in this section have again been recognized at the species rank (Weakley & al. 2011, 2017; LeBlond 2016), closely reflecting the taxonomy of Hitchcock and Chase (1910, 1915, 1951) and Silveus (1933,1942). In contrast, LeBlond (in Weakley & al. 2011) reinstated *D. neuranthum* at specific rank and treated *P. ovinum* as a synonym of *D. neuranthum.* We, however, agree with Hitchcock and Chase (1910, 1915, 1951) and Silveus (1933, 1942) in treating *P. ovinum* as distinct from *P. neuranthum.* Our assessment is supported by our examination of the type specimens of *P. neuranthum* and *P. ovinum,* which revealed that the two taxa are distinct and readily separated from one another, as in the following couplet.

a. Vernal panicles open, branches flexuous spreading 45–90° from panicle axis; panicle 3–6 cm wide; the spikelets not subsecund, pedicels short to long; spikelets 2.1–2.2 mm long .... **Dichanthelium ovinum**

a. Vernal panicles with branches strongly erect-ascending to appressed; panicles less than 2 cm wide; the spikelets subsecund (appearing 1-sided), pedicels short; spikelets 1.8–2 mm long .... **Dichanthelium neuranthum**

Freckmann (1967) reported that *Dichanthelium ovinum* occurs inland in dry to moist open areas, prairies, and swales from southern Arkansas and Louisiana west to eastern Texas and south along the Gulf coast into Mexico to about Veracruz. A few specimens with the diagnostic features of this species have been collected in Florida. Whereas *D. neuranthum* is found chiefly in southern Florida and the West Indies, and specimens from Louisiana, Arkansas, and Texas are rare. It is found in open pinelands on very dry, sandy ground and on wet ground in glades of the Everglades.

Weakley & al. (2011) reported *Dichanthelium neuranthum* as occurring in savannas and open areas from North Carolina to Florida (south to the Bahamas, Cuba and Belize), west to east Texas and Arkansas. Along the Atlantic and Gulf coasts it is found primarily in maritime wet grasslands and wet pinelands savannas near the coast, especially those with a calcareous influences. Thomas (2017) reported *D. neuranthum* from prairies in southwestern Missouri in Newton County.

3. STAPFOCHLOA H. Scholz, Willdenowia 34: 131. 2004 (25 Aug 2004). **TYPE**: *Stapfochloa lamproparia* (Stapf) H. Scholz, Willdenowia 34: 131. 2004. *Chloris lamproparia* Stapf, Bull. Soc. Bot. France 58 (Mém. 8d): 220. 1912.

Peterson & al. (2015), based and molecular data and morphological characters, proposed that the five taxa treated in the *Chloris ciliata* complex (Anderson 1974) should be placed in *Stapfochloa,* viz., *S. berroi* (Arechav.) P.M. Peterson, *S. canterae* (Arechav.) P.M. Peterson, *S. ciliata* (Sw.) P.M. Peterson, *S. elata* (Desv.) P.M. Peterson, and *S. parvispicula* (Caro & E.A. Sánchez) P.M. Peterson.

Molina and Rúgolo De Agrasar (2004), in their taxonomic revision of the genus *Chloris* in South America, recognized two additional species in the *C. ciliata* complex that had either been previously synonymized under *C. canterae* Arechav. or recognized at infraspecific rank: *C. parodiana* Roseng. & Izag. and *C. grandiflora* Roseng. & Izag. As in the case of Peterson & al. (2015), we assign the two South American *Chloris* to *Stapfochloa* and make two new combinations.

Stapfochloa parodiana (Roseng. & Izag.) Wipff & Shaw, **comb. nov.** *Chloris parodiana* Roseng. & Izag., Bol. Soc. Argent. Bot. 12: 128 (f. 4). 1968. **Type: PARAGUAY. Dpto. Paraguarí:** costado de la vía férrea y cruce carretera, 7 Apr 1950, *Rosengurtt B-5979* (holotype: MVFA-image!; isotype: BAA).

Stapfochloa grandiflora (Roseng. & Izag.) Wipff & Shaw, **comb. nov.** Chloris *grandiflora* Roseng. & Izag., Bol. Soc. Argent. Bot. 12: 124 (f. 3). 1968. *Chloris canterae* var. *grandiflora* (Roseng. & Izag.) D.E. Anderson, Brigham Young Univ. Sci. Bull., Biol. Ser. 19: 32. 1974. **TYPE: URUGUAY. Dpto. Florida**: Estancia Rincón de Santa Elena, Picada de Castro, Arroyo Mansavillagra, Nov 1946, *Gallinal & Rosengurtt PE- 5790* (holotype: MVFA-image!).

ACKNOWLEDGEMENTS

We are grateful for reviews of the manuscript by Kanchi Gandhi, David Rosen, and Guy Nesom, which significantly improved it.

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FURTHER NEW COMBINATIONS IN *ANEMONASTRUM* (RANUNCULACEAE) FOR ASIAN AND NORTH AMERICAN TAXA

SERGEI L. MOSYAKIN
M.G. Kholodny Institute of Botany
National Academy of Sciences of Ukraine
2 Tereshchenkivska Street
Kiev (Kyiv), 01004 Ukraine
s_mosyakin@hotmail.com

ABSTRACT

Following the proposed re-circumscription of genera in the group of *Anemone* L. and related taxa of Ranunculaceae (Mosyakin 2016, Christenhusz et al. 2018) and based on recent molecular phylogenetic and partly morphological evidence, the genus *Anemonastrum* Holub is recognized here in an expanded circumscription (including *Anemonidium* (Spach) Holub, *Arsenjevia* Starod., *Tamuria* Starod., and *Jurtsevia* Á. Löve & D. Löve) covering members of the "*Anemone*" clade with *x*=7, but excluding *Hepatica* Mill., a genus well outlined morphologically and forming a separate subclade (accepted by Hoot et al. (2012) as *Anemone* subg. *Anemonidium* (Spach) Juz. sect. *Hepatica* (Mill.) Spreng.) within the clade earlier recognized taxonomically as *Anemone* subg. *Anemonidium* (sensu Hoot et al. 2012). The following new combinations at the section and subsection ranks are validated: **Anemonastrum** Holub sect. **Keiskea** (Tamura) Mosyakin, **comb. nov**. (*Anemone* sect. *Keiskea* Tamura); **Anemonastrum** [sect. **Keiskea**] subsect. **Keiskea** (Tamura) Mosyakin, **comb. nov**.; **Anemonastrum** [sect. **Keiskea**] subsect. **Arsenjevia** (Starod.) Mosyakin, **comb. nov**. (*Arsenjevia* Starod.); and **Anemonastrum** [sect. **Anemonastrum**] subsect. **Himalayicae** (Ulbr.) Mosyakin, **comb. nov.** (*Anemone* ser. *Himalayicae* Ulbr.). The new nomenclatural combination **Anemonastrum deltoideum** (Hook.) Mosyakin, **comb. nov**. (*Anemone deltoidea* Hook.) is validated for a North American species related to East Asian ***Anemonastrum keiskeanum*** (T. Ito ex Maxim.) Mosyakin, **comb. nov**. (*Anemone keiskeana* T. Ito ex Maxim.). The following new combinations are also proposed for Asian taxa belonging to two sections: [sect. *Keiskea*] **Anemonastrum baicalense** (Turcz.) Mosyakin, **comb. nov**. (*Anemone baicalensis* Turcz.), **Anemonastrum flaccidum** (Fr. Schmidt) Mosyakin, **comb. nov**. (*Anemone flaccida* Fr. Schmidt), **Anemonastrum prattii** (Huth ex Ulbr.) Mosyakin, **comb. nov**. (*Anemone prattii* Huth ex Ulbr.); [sect. *Anemonastrum* subsect. *Himalayicae*] **Anemonastrum coelestinum** (Franch.) Mosyakin, **comb. nov**. (*Anemone coelestina* Franch.), **Anemonastrum geum** (H. Lév.) Mosyakin, **comb. nov**. (*Anemone geum* H. Lév.), **Anemonastrum obtusilobum** (D. Don) Mosyakin, **comb. nov**. (*Anemone obtusiloba* D. Don), **Anemonastrum obtusilobum** subsp. **megaphyllum** (W.T. Wang) Mosyakin, **comb. nov**. (*Anemone obtusiloba* subsp. *megaphylla* W.T. Wang), **Anemonastrum obtusilobum** subsp. **nepalense** (Chaudhary) Mosyakin, **comb. nov**. (*Anemone obtusiloba* subsp *nepalensis* Chaudhary), **Anemonastrum patulum** (C.C. Chang ex W.T. Wang) Mosyakin, **comb. nov**. (*Anemone patula* C.C. Chang ex W.T. Wang), **Anemonastrum polycarpum** (W.E. Evans) Mosyakin, **comb. nov**. (*Anemone polycarpa* W.E. Evans), **Anemonastrum rockii** (Ulbr.) Mosyakin, **comb. nov**. (*Anemone rockii* Ulbr.), **Anemonastrum rupestre** (Wall. ex Hook. f. & Thoms.) Mosyakin, **comb. nov**. (*Anemone rupestris* Wall. ex Hook. f. & Thoms.), **Anemonastrum rupestre** subsp. **gelidum** (Maxim.) Mosyakin, **comb. nov**. (*Anemone gelida* Maxim.), **Anemonastrum subindivisum** (W.T. Wang) Mosyakin, **comb. nov**. (*Anemone subindivisa* W.T. Wang), **Anemonastrum subpinnatum (**W.T. Wang) Mosyakin, **comb. nov**. (*Anemone subpinnata* W.T. Wang), **Anemonastrum trullifolium** (Hook. f. & Thoms.) Mosyakin, **comb. nov**. (*Anemone trullifolia* Hook. f. & Thoms.), and **Anemonastrum yulongshanicum** (W.T. Wang) Mosyakin, **comb. nov**. (*Anemone yulongshanica* W.T. Wang).

In earlier articles (Mosyakin 2016, 2018; Mosyakin & de Lange 2018) we already discussed and justified the phylogenetically natural and taxonomically rational circumscription of the genus *Anemone* L. and related taxa of Ranunculaceae Juss. tribe Anemoneae DC., following interpretations of recent molecular phylogenetic results (Hoot et al. 1994, 2012; Hoot 1995; Ehrendorfer 1995; Ehrendorfer & Samuel 2000, 2001; Schuettpelz & Hoot 2000; Schuettpelz et al. 2002; Wang et al. 2009; Meyer et al. 2010; Pfosser et al. 2011; Xie et al. 2011; Cossard et al. 2016; Lehtonen et al. 2016; Jiang et al. 2017a, 2017b, etc.) and available morphological and biogeographic evidence (Ulbrich 1905, 1906; Juzepczuk 1937; Starodubtsev 1989, 1991, 1995; Tamura 1993; 1995; Dutton et al. 1997; Luferov 2001, 2004; Tzvelev 2001, 2012; Wang et al. 2001; Malyshev 2005, 2012; Ehrendorfer et al. 2009; Ziman et al. 2004, 2005, 2006a, 2006b, 2007, 2008; Zhang et al. 2015; Mosyakin 2016; Mosyakin & de Lange 2018, etc.). In the present article, I propose further nomenclatural transfers to *Anemonastrum* Holub, re-circumscribed to include the segregate genera *Anemonidium* (Spach) Holub, *Arsenjevia* Starod., *Tamuria* Starod., and *Jurtsevia* Á. Löve & D. Löve. In that circumscription, *Anemonastrum* covers the taxa placed by Hoot et al. (2012) in *Anemone* subg. *Anemonidium* (Spach) Juz. sect. *Keiskea* Tamura, sect. *Anemonidium* Spach, and sect. *Omalocarpus* DC. [with subsect. *Omalocarpus* (DC.) Tamura and subsect. *Himalayicae* (Ulbr.) Tamura], all having the base chromosome number *x*=7. However, *Hepatica* Mill. (accepted by Hoot et al. 2012 as *Anemone* subg. *Anemonidium* sect. *Hepatica* (Mill.) Spreng.), also with *x*=7, is recognized here as a separate genus because it is well outlined morphologically and forms a separate subclade sister to the *Anemonastrum* subclade. In my opinion (see also discussion in Mosyakin & de Lange 2018), an alternative proposal (Jiang et al. 2017a) to recognize the whole clade with *x*=7 as one genus, *Hepatica* sensu latissimo (including *Anemonastrum* sensu lato), should not be recommended because the resulting broadly circumscribed genus will be difficult to outline morphologically; that taxonomic decision will also disrupt the currently accepted nomenclature and will require numerous nomenclatural transfers to *Hepatica* of many taxa here recognized in *Anemonastrum* (for which far less nomenclatural changes are still needed).

Christenhusz and Byng (in Christenhusz et al. 2018) recently supported a narrow circumscription of genera in Anemoneae and proposed many nomenclatural novelties (mainly new species-rank combinations and several new names) in genera *Anemonidium*, *Eriocapitella* Nakai, and *Knowltonia* Salisb. In general, their generic concept in the group corresponds well to the generic outline proposed by Mosyakin (2016); however, they additionally recognized *Eriocapitella*, which has not been considered as a potentially separate genus (Mosyakin 2016). When making nomenclatural transfers of taxa of the subclade with *x*=7, Christenhusz and Byng (in Christenhusz et al. 2018), however, used the generic name *Anemonidium* (Holub 1974) and did not notice that in their circumscription this genus should be called *Anemonastrum* (Holub 1973) because they included in *Anemonidium* the species that is the type of *Anemonastrum* (*Anemonastrum narcissiflorum* (L.) Holub ≡ *Anemone narcissiflora* L. ≡ *Anemonidium narcissiflorum* (L.) Christenh. & Byng). Consequently, the taxa that they transferred to *Anemonidium* should be properly placed in *Anemonastrum.* Of their new combinations in *Anemonidium, A. demissum* (Hook. f. & Thomson) Christenh. & Byng and *A. tetrasepalum* (Royle) Christenh. & Byng already have relevant combinations in *Anemonastrum* –– *Anemonastrum demissum* (Hook. f. & Thomson) Holub and *A. tetrasepalum* (Royle) Holub (see Holub 1973: 165).

As already noted (Mosyakin & de Lange 2018: 112–113), "Judging from the available morphological, taxonomic, biogeographic, and molecular phylogenetic data, *Anemonastrum* (in the circumscription accepted here) most probably initially diversified somewhere in East Asia and/or the Beringian region. From that hypothetical center of origin and early diversification, some representatives of the genus migrated westward to western and partly southern Asia (forming secondary centers of diversity, e.g. the Himalayas: see Ziman et al. 2007; Elliott 2016) and other regions of Eurasia (Ziman et al. 2005, 2006a), while another ancestral stock migrated eastward to North America. From North America some taxon (or taxa?) dispersed to the mountains of South America, and then from southern South America to New Zealand, possibly via Antarctica."

East Asian – North American (amphi-Beringian) disjunctions are evident in the species pairs *Anemonastrum keiskeanum* – *A. deltoideum* (see the new combinations below) and *A. dichotomum*

(L.) Mosyakin – *A. canadense* (L.) Mosyakin (see Mosyakin 2016 and references therein). The mainly North American group of *Anemonastrum canadense* and *A. richardsonii* (Hook.) Mosyakin (the latter also occurring in northeastern Asia: Starodubtsev 1991, 1995, etc.) shows the link to the southern South American species *A. antucense* (Poepp.) Mosyakin & de Lange, while the southern South America–New Zealand disjunction is manifested by *A. antucense* and *A. tenuicaule* (Cheeseman) de Lange & Mosyakin (see Mosyakin & de Lange 2018 and references therein). Further morphological and molecular studies are needed to demonstrate better the possible pathways of morphological evolution in these taxa of *Anemonastrum*. The disjunctive distribution patterns in the mainly South Hemisphere genus *Knowltonia*, as re-circumscribed in Mosyakin (2016) and Christenhusz et al. (2018), also present intriguing questions of the historical dispersal pathways and morphological evolution in that group.

In general, we may assume that the processes of evolution of some of the most morphologically distinct and geographically isolated taxa and groups of *Anemone* sensu lato, such as South African *Knowltonia* sensu stricto, South American *Barneoudia* Gay and *Oreithales* Schltdl. (now placed in *Knowltonia* sensu lato: see Christenhusz et al. 2018), Tasmanian *Anemone crassifolia* Hook. (now also placed in *Knowltonia* as *K. crassifolia* (Hook.) Christenh. & Byng: see Christenhusz et al. 2018), and the geographically outlier taxa of *Anemonastrum* discussed above, were initiated and greatly shaped by long-distance and/or step-stone dispersal events, with subsequent geographical isolation. In contrast to that, taxa and groups of taxa of *Anemonastrum* and other genera of Anemoneae occurring in their supposed centers of origin and/or primary or secondary diversification are often represented by many closely related and often intergrading entities that are taxonomically complicated and are often treated by various authors as species with numerous subspecies, varieties, or just as synonyms.

VALIDATION OF NEW COMBINATIONS

Anemonastrum Holub sect. **Keiskea** (Tamura) Mosyakin, **comb. nov**. *Anemone* sect. *Keiskea* Tamura, Sci. Rep. Coll. Gen. Educ. Osaka Univ. 16: 26. 1967. TYPE: *Anemone keiskeana* T. Ito ex Maxim. ≡ **Anemonastrum keiskeanum**, see below.

Tamuria Starod., Vetrenitsy: sist. evol.: 122. 1991.

Anemone keiskeana was originally included in this section by Tamura (1967), who evidently used its epithet for the name of the section.

Anemonastrum Holub sect. **Keiskea** (Tamura) Mosyakin subsect. **Keiskea** (Tamura) Mosyakin, **comb. nov**. *Anemone* sect. *Keiskea* Tamura, Sci. Rep. Coll. Gen. Educ. Osaka Univ. 16: 26. 1967. TYPE: *Anemone keiskeana* T. Ito ex Maxim. ≡ **Anemonastrum keiskeanum**, see below.

Anemonastrum keiskeanum (T. Ito ex Maxim.) Mosyakin, **comb. nov.** *Anemone keiskeana* T. Ito ex Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 32: 478. 1888. *Tamuria keiskeana* (T. Ito ex Maxim.) Starod., Vetrenitsy: sist. evol., 122. 1991. *Anemonidium keiskeanum* (T. Ito ex Maxim.) Christenh. & Byng, Global Fl. 4: 73. 2018.

Anemonastrum keiskeanum was originally described (as *Anemone keiskeana*) from the former Tosa Province (now in Kōchi Prefecture), Shikoku, Japan (Maximovicz 1888), and is now reported from the main islands of Honshu, Shikoku, and Kyushu of Japan (see Ohwi 1965; Tamura 1967; Starodubtsev 1991, etc.).

Anemonastrum deltoideum (Hook.) Mosyakin, **comb. nov.** *Anemone deltoidea* Hook., Fl. Bor.-Amer. 1: 6. 1829. *Tamuria deltoidea* (Hook.) Starod., Vetrenitsy: sist. evol., 122. 1991.

This North American species occurring in California, Oregon, and Washington states (also reported for British Columbia in Canada, but probably erroneously; see Dutton et al. 1997) was omitted in my earlier article dealing with North American taxa (Mosyakin 2016). It is also a member of *Anemonastrum* in its expanded circumscription, related to the East Asian *A. keiskeanum.* Starodubtsev (1991) placed these two species in *Tamuria*, while Ziman et al. (2004) considered them the only two members of *Anemone* sect. *Keiskea*. For *A. deltoidea*, Ziman et al. (2004: 49) established a separate series, *Anemone* [sect. *Keiskea*] ser. *Deltoidea* Ziman, Kadota & Bulakh.

Anemonastrum Holub sect. **Keiskea** (Tamura) Mosyakin subsect. **Arsenjevia** (Starod.) Mosyakin, **comb. nov**. *Arsenjevia* Starod., Bot. Zhurn. (Moscow & Leningrad) 74(9): 1344. 1989. *Anemone* sect. *Arsenjevia* (Starod.) U.C. La, Fl. Coreana 2: 201. 1996. *Anemone* subgen. *Arsenjevia* (Starod.) Luferov, Byull. Glavn. Bot. Sada (Moscow) 182: 54. 2001. *Anemone* sect. *Arsenjevia* (Starod.) Luferov, Byull. Glavn. Bot. Sada (Moscow) 182: 54. 2001, comb. superfl. *Anemone* subsect. *Arsenjevia* (Starod.) Luferov, Byull. Glavn. Bot. Sada (Moscow) 182: 54. 2001. TYPE: *Arsenjevia flaccida* (Fr. Schmidt) Starod. ≡ *Anemone flaccida* Fr. Schmidt ≡ **Anemonastrum flaccidum**, see below.

Anemone subsect. *Baicalenses* Luferov, Byull. Glavn. Bot. Sada (Moscow) 182: 54. 2001. TYPE: *Anemone baicalensis* Turcz. ≡ **Anemonastrum baicalense**, see below.

Starodubtsev (1989: 1345) recognized in his genus *Arsenjevia* the following five species: *Arsenjevia baicalensis* (Turcz.) Starod., *A. flaccida* (Fr. Schmidt) Starod., *A. glabrata* (Maxim.) Starod., *A. prattii* (Huth ex Ulbr.) Starod., and *A. rossii* (S. Moore) Starod. (see also Starodubtsev 1991). Wang et al. (2001) and Ziman et al. (2004) applied a wider species concept to taxa of this group, which they recognized within *Anemone*. In particular, Ziman et al. (2004) recognized in this group only two species, *Anemone baicalensis* Turcz. (with five varieties) and *A. prattii* Huth ex Ulbr.

The infrageneric names *Anemone* subsect. *Stoloniferae* Ulbr. (1905, as "*Stolonifera*", pro parte, excl. typo) and *Anemone* sect. *Stolonifera* (Ulbr.) Juz. (1937, pro parte, excl. typo) were occasionally applied to taxa of this group. Ziman et al. (2004: 48) elevated the rank of Ulbrich's subsection to the subgenus level, *Anemone* subg. *Stolonifera* (Ulbr.) Ziman, Kadota & Bulakh (as "*Stolonifera***e** (Ulbr. **ex Juz.**) Ziman, Kadota & Bulakh") and indicated its type as *Anemone baicalensis* Turcz. (as "lectotype"). However, according to Art. 10.8 of the *ICN* (Turland et al. 2018) "When the epithet in the name of a subdivision of a genus is identical with or derived from the epithet in one of the originally included species names, the type of the higher-ranking name is the same as that of the species name, unless the original author of the higher-ranking name designated another type." Consequently, the type of *Anemone* subsect. *Stoloniferae* is *Anemone stolonifera* Maxim. (which was originally included in that group by Ulbrich 1905), a member of the clade that houses taxa of *Anemone* sensu stricto, having $2n=16$ (Yang 2002). Thus, infrageneric names based on *Anemone* subsect. *Stoloniferae* Ulbr. should not be used in *Anemonastrum*, and the different type designation in Ziman et al. (2004: 48, 49, 294) has no standing.

Anemonastrum baicalense (Turcz.) Mosyakin, **comb. nov**. *Anemone baicalensis* Turcz., Bull. Soc. Imp. Naturalistes Moscou 15(1): 40. 1842. *Anemonoides baicalensis* (Turcz.) Holub, Folia Geobot. Phytotax. 8(2): 166. 1973. *Arsenjevia baicalensis* (Fisch. ex Turcz.) Starod., Bot. Zhurn. (Moscow & Leningrad) 74(9): 1345. 1989.

Anemone baicalensis ver. *glabrata* Maxim., Prim. Fl. Amur., 18. 1859. *Anemone glabrata* (Maxim.) Juz., Fl. URSS 7: 254. 1937. *Anemone baicalensis* subsp. *glabrata* (Maxim.) Kitag., Rep. Inst. Sci. Res. Manchoukuo 4: 81. 1940. *Anemonoides glabrata* (Maxim.) Holub, Folia Geobot. Phytotax. 11(1): 81. 1976. *Arsenjevia glabrata* (Maxim.) Starod., Bot. Zhurn. (Moscow & Leningrad) 74(9): 1345. 1989.

Anemone kansuensis W.T. Wang, Acta Phytotax. Sin. 12: 163. 1974. *Anemone baicalensis* var. *kansuensis* (W.T. Wang) W.T. Wang, Fl. Reipubl. Popularis Sin. 28: 20. 1980.

Anemone rossii S. Moore, J. Linn. Soc., Bot. 17: 376, tab. 16, fig. 1, 2. 1879 ["1880", publ. 1879]. *Anemone baicalensis* var. *rossii* (S. Moore) Kitag., Lin. Fl. Manshur., 213. 1939. *Anemonoides rossii* (S. Moore) Holub, Folia Geobot. Phytotax. 8(2): 166. 1973. *Anemone baicalensis* subsp. *rossii* (S. Moore) Starod., Bot. Zhurn. (Moscow & Leningrad) 68(8): 1018. 1983. *Arsenjevia rossii* (S. Moore) Starod., Bot. Zhurn. (Moscow & Leningrad) 74(9): 1345. 1989.

Anemone saniculiformis C.Y. Wu ex W.T. Wang, Acta Phytotax. Sin. 12: 164. 1974. *Anemone baicalensis* var. *saniculiformis* (C.Y. Wu ex W.T. Wang) Ziman & B.E. Dutton, Fl. China 6: 312. 2001.

The epithet of this species was occasionally cited in *Anemone* and *Arsenjevia* as "*bai**k**alensis*" (e.g., Starodubtsev 1989: 1345, etc.). However, Turczaninow (1842, 1845) in both versions (journal issue and book) of his *Flora Baicalensi-Dahurica* used the original spelling "*baicalensis,*" which should be followed (Art. 60.1 of the *ICN*: Turland et al. 2018).

The following varieties were accepted in *Anemone baicalensis* by Ziman et al. (2004): var. *baicalensis*, var. *glabrata*, var. *kansuensis*, var. *saniculiformis*, and var. *rossii* (see above the list of heterotypic synonyms). Here *Anemonastrum baicalense* is accepted in a wide sense. Further nomenclatural transfers in *Anemonastrum* will be needed if some of those entities are formally recognized as infraspecific taxa or separate species.

Anemonastrum flaccidum (Fr. Schmidt) Mosyakin, **comb. nov**. *Anemone flaccida* Fr. Schmidt, Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 7, 12(2): 103. 1868 [alternative title: Reis. Amur-Land., Bot., 103. 1868; see Schmidt 1868]. *Anemone baicalensis* Turcz. subsp. *flaccida* (Fr. Schmidt) Ulbr., Bot. Jahrb. Syst. 37(2): 232. 1905. *Anemonoides flaccida* (Fr. Schmidt) Holub, Folia Geobot. Phytotax. 8(2): 166. 1973. *Arsenjevia flaccida* (Fr. Schmidt) Starod., Bot. Zhurn. (Moscow & Leningrad) 74(9): 1345. 1989. *Anemonidium flaccidum* (Fr. Schmidt) Christenh. & Byng, Global Fl. 4: 73. 2018.

Anemone anhuiensis Y.K. Yang, N. Wang, & W.C. Ye, J. Wuhan Bot. Res. 7: 327. 1989. *Anemone flaccida* var. *anhuiensis* (Y.K. Yang, N. Wang, & W.C. Ye) Ziman & B.E. Dutton, Fl. China 6: 311. 2001.

Anemone hofengensis W.T. Wang, Acta Phytotax. Sin. 29: 463. 1991. *Anemone flaccida* var. *hofengensis* (W.T. Wang) Ziman & B.E. Dutton, Fl. China 6: 311. 2001.

Anemone tagawae Ohwi, Bot. Mag. (Tokyo) 45: 387. 1931. *Anemone flaccida* var. *tagawae* (Ohwi) Tamura, Acta Phytotax. Geobot. 46(2): 210. 1996.

Ziman et al. (2004) recognized the following varieties within *Anemone flaccida*: var. *flaccida*, var. *hirtella* W.T. Wang, var. *hofengensis*, and var. *anhuiensis* (see the list of heterotypic synonyms above). If those entities are preferred to be recognized taxonomically, further nomenclatural transfers in *Anemonastrum* will be needed.

Anemonastrum prattii (Huth ex Ulbr.) Mosyakin, **comb. nov**. *Anemone prattii* Huth ex Ulbr., Bot. Jahrb. Syst. 36(3, Beibl. 80): 4. 1905. *Arsenjevia prattii* (Huth ex Ulbr.) Starod., Bot. Zhurn. (Moscow & Leningrad) 74(9): 1345. 1989.

According to Ziman et al. (2004), this species is closely related to *A. baicalense.*

Another species, *Anemone delavayi* Franch. (including *A. oligocarpa* C. Pei ≡ *A. delavayi* var. *oligocarpa* (C. Pei) Ziman & B.E. Dutton), most probably also belongs to *Anemonastrum*, but its relationships and proper taxonomic (subsectional) placement within the genus remain problematic (more closely related to *A. flaccidum* or to *A. baicalense*? See Wang et al. 2001: 311, and especially discussion in Ziman et al. 2004: 299–300). Earlier it was transferred by Holub (1973: 166) to *Anemonoides*, as *A. delavayi* (Franch.) Holub. However, because of the remaining uncertainty in its phylogenetic position, I refrain here from any nomenclatural actions affecting this taxon.

Anemonastrum Holub sect. **Anemonastrum** subsect. **Anemonastrum**

This subsection houses taxa earlier placed mainly in *Anemone* sect. *Omalocarpus* DC. (in the strict sense). Corresponding nomenclatural combinations in *Anemonastrum* for almost all species and several infraspecific entities of that group already exist (see Holub 1973, 1974; Löve & Löve "1975" [published 1976]; Starodubtsev 1989, 1991; Ziman et al. 2005, 2006a; Raus 2011a, 2011b; Tzvelev 2012; Mosyakin 2016, etc.). Additional new combinations (mostly for infraspecific taxa) can be expected in the future following further research.

Anemonastrum Holub sect. **Anemonastrum** subsect. **Himalayicae** (Ulbr.) Mosyakin, **comb. nov.** *Anemone* ser. *Himalayicae* Ulbr., Bot. Jahrb. Syst. 37(2): 201. 1905. *Anemone* sect. *Himalayica* (Ulbr.) Juz., Fl. URSS 7: 256. 1937. *Anemone* subsect. *Himalayicae* (Ulbr.) Tamura, Sci. Rep. Coll. Gen. Educ. Osaka Univ. 16: 27. 1967. *Pulsatilloides* (DC.) Starod. sect. *Himalayica* (Ulbr.) Starod., Vetrenitsy: sist. evol., 124. 1991. TYPE: *Anemone obtusiloba* D. Don ≡ **Anemonastrum obtusilobum**, see below.

Starodubtsev (1991) placed this group in the genus *Pulsatilloides* (DC.) Starod., together with *Pulsatilloides capensis* (L.) Starod. (which should be now recognized as *Knowltonia tenuifolia* (L. f.) Mosyakin = *K. pulsatilloides* Christenh. & Byng; see Mosyakin 2018), *P. glaucifolia* (Franch.) Starod. (*Anemone glaucifolia* Franch. ≡ *Pulsatilla glaucifolia* (Franch.) Huth, now properly accepted as *Anemoclema glaucifolium* (Franch.) W.T. Wang; see Zhang et al. 2015a, Lehtonen et al. 2016, Jiang et al. 2017b), and *P. begoniifolia* (H. Lév. & Vaniot) Starod. (which is *Anemone begoniifolia* H. Lév. & Vaniot; see Zhang et al. 2015b). This motley arrangement of taxa is very unnatural phylogenetically and has not been confirmed by molecular, morphological, and karyological evidence.

In the present circumscription, the subsection *Himalayicae* houses taxa geographically restricted to mountain regions of Asia, mainly in the Himalayas: from Pakistan through Nepal, northern India, and Bhutan to several regions of China (Ziman et al. 2007). One species (*Anemone obtusiloba* ≡ **Anemonastrum obtusilobum**, see below) is also reported from a few scattered localities in eastern Kyrgyzstan, eastern Afghanistan, northernmost Myanmar, and southwestern Mongolia (Ziman et al. 2007). Phylogenetically this group is sister to the "core" subclade of *Anemonastrum* (subsect. *Anemonastrum*) (Hoot et al. 2012; Jiang et al. 2017a, etc.). Additional information on morphology, geography, and nomenclature of taxa of *Anemonastrum* subsect. *Himalayicae* (including extensive synonymy) can be found in Ziman et al. (2007) and in references cited in that publication. The known chromosome numbers of the species listed below are mainly summarized in Ziman et al. (2007) and Goldblatt & Johnson (1979–onward).

The taxonomic circumscription of species placed here in this subsection mainly follows the *Flora of China* (Wang et al. 2001) and our treatment (Ziman et al. 2007). I decided not to transfer here to *Anemonastrum* the numerous infraspecific entities (except three subspecies) described and/or recognized by various authors (see an overview in Ziman et al. 2007) because the status and rank of many such taxa, especially those treated as varieties, remain disputable. Three series (ser. *Obtusilobae* Ziman, Ehrend. & Bulakh, ser. *Trullifoliae* Ziman, Ehrend. & Bulakh, and ser. *Rupestres*

Ziman, Ehrend. & Bulakh) were recognized by Ziman et al. (2007) within sect. *Himalayica* (as "*Himalayicae*"). Further transfers of additional species and infrageneric and infraspecific taxa will be possible following additional research. The species below are listed alphabetically.

Anemonastrum coelestinum (Franch.) Mosyakin, **comb. nov**. *Anemone coelestina* Franch., Bull. Soc. Bot. France 32: 4. 1885. *Anemone obtusiloba* D. Don subsp. *coelestina* (Franch.) Brühl, Ann. Roy. Bot. Gard. Calcutta 5: 78. 1896. *Anemone trullifolia* Hook. f. & Thoms. var. *coelestina* (Franch.) Finet & Gagnep., Bull. Soc. Bot. France 51: 61. 1904.

Anemonastrum geum (H. Lév.) Mosyakin, **comb. nov**. *Anemone geum* H. Lév., Bull. Géogr. Bot. 25: 25. 1915. *Anemone bonatiana* H. Lév. var. *geum* (H. Lév.) H. Lév., Cat. Pl. Yun-Nan: 219. 1917.

Anemonastrum obtusilobum (D. Don) Mosyakin, **comb. nov**. *Anemone obtusiloba* D. Don, Prodr. Fl. Nepal.: 194. 1825. *Pulsatilloides obtusiloba* (D. Don) Starod., Vetrenitsy: sist. evol., 124. 1991. *Anemonidium obtusilobum* (D. Don) Christenh. & Byng, Global Fl. 4: 73. 2018.

Anemonastrum obtusilobum (D. Don) Mosyakin subsp. **megaphyllum** (W.T. Wang) Mosyakin, **comb. nov**. *Anemone obtusiloba* D. Don subsp. *megaphylla* W.T. Wang, Fl. Reipubl. Popul. Sin. 28: 350. 1980.

Anemonastrum obtusilobum (D. Don) Mosyakin subsp. **nepalense** (Chaudhary) Mosyakin, **comb. nov**. *Anemone obtusiloba* D. Don subsp *nepalensis* Chaudhary, Bot. Zhurn. (Moscow & Leningrad) 73: 1188. 1988.

Anemonastrum patulum (C.C. Chang ex W.T. Wang) Mosyakin, **comb. nov**. *Anemone patula* C.C. Chang ex W.T. Wang, Acta Phytotax. Sin. 12: 169. 1974.

Anemonastrum polycarpum (W.E. Evans) Mosyakin, **comb. nov**. *Anemone polycarpa* W.E. Evans, Notes Roy. Bot. Gard. Edinburgh 13: 154. 1921. *Anemone rupestris* subsp. *polycarpa* (W.E. Evans) W.T. Wang, Fl. Reipubl. Popul. Sin. 28: 43. 1980.

Anemonastrum rockii (Ulbr.) Mosyakin, **comb. nov**. *Anemone rockii* Ulbr., Notizbl. Bot. Gart. Berlin-Dahlem 10: 876. 1929. *Anemone obtusiloba* D. Don subsp. *rockii* (Ulbr.) Lauener, Notes Roy. Bot. Gard. Edinburgh 23: 188. 1960.

Anemonastrum rupestre (Wall. ex Hook. f. & Thoms.) Mosyakin, **comb. nov**. *Anemone rupestris* Wall. ex Hook. f. & Thoms., Fl. Ind. 1: 21. 1855. [*Anemone rupestris* Wall., Numer. List (Wallich) n. 4696. 1831, nom. inval.] *Anemonidium rupestre* (Wall. ex Hook. f. & Thoms.) Christenh. & Byng, Global Fl. 4: 73. 2018.

Anemonastrum rupestre (Wall. ex Hook. f. & Thoms.) Mosyakin subsp. **gelidum** (Maxim.) Mosyakin, **comb. nov**. *Anemone gelida* Maxim., Acta Hort. Petropol. 11: 21. 1890. *Anemone rupestris* Wall. ex Hook. f. & Thoms. subsp. *gelida* (Maxim.) Lauener, Notes Roy. Bot. Gard. Edinburgh 23: 199. 1960. *Pulsatilloides gelida* (Maxim.) Starod., Vetrenitsy: sist. evol., 124. 1991.

Anemonastrum subindivisum (W.T. Wang) Mosyakin, **comb. nov**. *Anemone subindivisa* W.T. Wang, Acta Phytotax. Sin. 12: 173. 1974.

Anemonastrum subpinnatum (W.T. Wang) Mosyakin, **comb. nov**. *Anemone subpinnata* W.T. Wang, Acta Phytotax. Sin. 12: 170. 1974.

Anemonastrum trullifolium (Hook. f. & Thoms.) Mosyakin, **comb. nov**. *Anemone trullifolia* Hook. f. & Thoms., Fl. Ind. 1: 22. 1855. *Anemone obtusiloba* D. Don subsp. *trullifolia* (Hook. f. & Thoms.) Brühl, Ann. Bot. Gard. Calcutta 5: 78. 1896. *Pulsatilloides trullifolia* (Hook. f. & Thomson) Starod., Vetrenitsy: sist. evol., 124. 1991. *Anemonidium trullifolium* (Hook. f. & Thomson) Christenh. & Byng, Global Fl. 4: 73. 2018.

Anemonastrum yulongshanicum (W.T. Wang) Mosyakin, **comb. nov**. *Anemone yulongshanica* W.T. Wang, Bull. Bot. Res., Harbin 16(2): 159. 1996

ACKNOWLEDGEMENTS

I am grateful to Svetlana N. Ziman (Svitlana M. Zyman in Ukrainian transliteration; M.G. Kholodny Institute of Botany of the National Academy of Sciences of Ukraine, KW, Kiev, Ukraine) for her valuable comments and long-term cooperation on *Anemone* sensu lato; to Elena (Olena) V. Bulakh (KW) and Alexander N. Sennikov (Finnish Museum of Natural History, University of Helsinki, Finland & V.L. Komarov Botanical Institute, Russian Academy of Sciences, St. Petersburg, Russia) for providing copies of some publications; to Samuli Lehtonen (University of Turku, Turku, Finland) and Peter J. de Lange (Environment and Animal Sciences, Unitec Institute of Technology, Auckland, New Zealand) for their comments and discussion; to Svitlana I. Antonenko (KW) for cross-checking the references in the text, and to Guy Nesom for his editorial work.

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Patiño-Siciliano, A., S. Zamudio, y J.I. Cohen. 2018. Dos nuevas especies de *Lithospermum* (Boraginaceae) de Michoacán y Querétaro, México. Phytoneuron 2018-56: 1–10. Published 13 August 2018. ISSN 2153 733X

DOS NUEVAS ESPECIES DE *LITHOSPERMUM* (BORAGINACEAE) DE MICHOACÁN Y QUERÉTARO, MÉXICO

ALFREDO PATIÑO-SICILIANO
Departamento de Botánica
Escuela Nacional de Ciencias Biológicas, IPN
apsiciliano@hotmail.com

SERGIO ZAMUDIO
Apartado Postal 293
61600 Pátzcuaro, Michoacán, México
szamudioruiz@gmail.com

JAMES I. COHEN
Kettering University, Applied Biology
Flint, Michigan 48504
jcohen@kettering.edu

RESUMEN

Se describen e ilustran dos especies nuevas de *Lithospermum* L. (Boraginaceae s. str., Lithospermae) de Michoacán y Querétaro, México. ***Lithospermum elenae*** Pat.-Sicil., J.I. Cohen, & Zamudio, **sp. nov.**, que se asemeja a *L. calcicola* B.L. Rob., de la que difiere por la corola amarilla de mayor tamaño, el estilo más largo, las anteras unidas 10 a 11 mm de la base de la corola y por el fruto más chico. ***Lithospermum ireneae*** Pat.-Sicil., J.I. Cohen, & Zamudio, **sp. nov.**, estrechamente relacionada con *L. distichum* Ortega, de la que difiere por las hojas sésiles con la base abrazadora, el haz estrigoso, las ramas floríferas en ternas y por las corolas amarillas.

ABSTRACT

Two new species of *Lithospermum* L. (Boraginaceae s. str., Lithospermae) are described from Michoacán and Querétaro, México. **Lithospermum elenae** Pat.-Sicil., J.I. Cohen, & Zamudio, **sp. nov.**, is similar to *L. calcicola* B.L. Rob. but differs by larger yellow corollas, a longer style, anthers borne 10-11 mm from the corolla base, and smaller fruits. **Lithospermum ireneae** Pat.-Sicil., J.I. Cohen, & Zamudio, **sp. nov.**, is morphologically close to *L. distichum* Ortega, from which it differs by sessile and clasping leaves, strigose leaf upper surfaces, ternary inflorescences, and yellow corollas.

Lithospermum L. (Boraginaceae) es un género que se distribuye en las regiones templadas y áridas del mundo, con mayor diversificación en el SW de Estados Unidos y México, en donde se presentan aproximadamente 75 % del total de especies. Este grupo no se había revisado desde la década de los 50, del siglo pasado, cuando Johnston (1952, 1954), estudió el género y la tribu Lithospermeae, a la que se había asignado. Recientemente, Cohen (2018) hizo una revisión del grupo para México.

En 2009 Cohen y Davis, expandieron la circunscripción de *Lithospermum* para incluir las especies reconocidas tradicionalmente como miembros del género, además de todas las especies de los géneros americanos de la tribu Lithospermeae, que son *Lasiarrhenum* I.M. Johnst., *Macromeria* D. Don, *Nomosa* I.M. Johnst, *Onosmodium* Michx., *Perittostema* I.M. Johnst., y *Psilolaemus* I.M. Johnst.

Bajo esta nueva circunscripción, *Lithospermum* está formado por cerca de 80 especies, 43 de ellas ocurren en México, de éstas 32 son endémicas de este país y 21 han sido registradas en los estados de Guanajuato, Michoacán y Querétaro. El género se caracteriza por las clusas lisas, blancas, lustrosas, rectas y por las corolas amarillas, verde amarillentas, anaranjadas o blancas (Cohen & Davis, 2009). Pero debe decirse que presentan variación considerable en los caracteres florales y vegetativos, incluyendo la forma de la corola, inserción del estilo, longitud de los tricomas, forma de las hojas y patrón de la venación foliar.

Las especies de *Lithospermum*, se presentan en todo México, con excepción de Baja California y la Península de Yucatán. La mayoría se distribuyen en la parte oriental de México más que en la occidental y tienden a estar restringidas a las regiones montañosas correspondientes a la Sierra Madre Oriental, Sierra Madre Occidental y Eje Neovolcánico, en un intervalo altitudinal de entre 1300 y 3200 m s.n.m. Pocas especies de este género crecen en la parte sur de México. Frecuentemente se encuentra en bosques de pino y encino y es raro observarlas en bosques tropicales húmedos; algunas especies se localizan en comunidades primarias, pero la mayoría se presentan en hábitats de moderados a extremadamente perturbados. Dado que la mitad de las especies del género se encuentran en México, y que existe gran variación morfológica entre las especies, no resulta sorprendente que parte de la diversidad existente en el país no esté descrita, particularmente la localizada en regiones pobremente conocidas. El presente estudio trata de la descripción de dos de estas nuevas especies.

Métodos

Como resultado del trabajo de recolección de plantas en los estados de Michoacán y Querétaro, que se realiza para el estudio de la Flora del Bajío y de Regiones Adyacentes y de la revisión del material herborizado del género *Lithospermum*, que se localiza en el herbario del Centro Regional del Bajío (IEB), del Instituto de Ecología A.C. en Patzcuaro, Michoacán, se encontraron ejemplares a los que no se les pudo asignar nombre con la literatura especializada, por sus características morfológicas difieren de las especies reconocidas para esa región (Johnston 1952; Nash 1981; Lira-Charco 2012; Cohen 2018). De manera complementaria, y con el fin de contar con mayor información al respecto, se consultaron ejemplares en los herbarios ENCB y MEXU.

Con esta observación, se procedió a realizar un análisis más detallado de las características de las hojas, del gineceo y del androceo, de los ejemplares diferentes, y a compararlos con especies semejantes. Posteriormente, se realizaron viajes de recolecta para obtener ejemplares de estos organismos y examinarlos de forma más detallada.

La revisión de los ejemplares consistió en la medición de los órganos vegetativos y reproductivos y la caracterización de los mismos. Con los datos que se obtuvieron de estas mediciones se elaboraron tablas que incluyen las principales diferencias con los taxones semejantes (Cuadros 1 y 2). Después de la revisión se concluyó que se trata de entidades que no han sido descritas y que por lo tanto resultan nuevas para la ciencia, las que se presentan en este documento.

LITHOSPERMUM ELENAE Pat.-Sicil., J.I. Cohen, & Zamudio, **sp. nov.** TIPO: **MÉXICO. Querétaro.** Mpio. Jalpan: 4 km al N de La Parada, cerro Los Bancos, 30 mar 1990, bosque de pino y encino, alt. 1300 m, *B. Servin 87* (holotipo: IEB; isotipos por distribuirse). Figura 1.

Planta herbacea perennis interdum suffruticosa; radix lignosa; caules herbacei hirsuti vel strigosi glabrescentes; folia sessilia lanceolata ad longe elliptico-lanceolata 2-5(7.5) cm longa, 4-6(13) cm lata, utrinque moderate strigosa, costa subtus prominenti, venis secundariis non evidentibus; inflorescentiae cymosae bracteatae 5-8(12) cm longae, pedicellis 3-5 mm longis in fructificatione accrescentibus; calyx 5-partitus segmentis lanceolatis vel lineari-lanceolatis 5-10 mm longis; corolla lutea tubuloso-hypocraterimorpha extus strigosa, intus glabra, sine appendicibus faucialibus, annulo basali 8-10-plicato, tubo 12-18(20) mm longo, lobulis suborbicularibus 2.5-3.5 mm longis reflexis; stamina inclusa, 10-11 mm supra corollae basem inserta, filamentis 0.3-0.5 mm longis leviter laminaribus, antheris inclusis ellipsoideis 2-2.5 mm longis; stylus 12-16(19) mm longus, stigma terminale; fructus schizocarpicus, 2-4 clusis 3.5 mm longis nitidis lucidis pallide brunneis, apice acutis, superficie ventrali usque ad apicem canaliculata, cum 2 vel 3 cavis minutis respectu canaliculo lateralibus, base late triangulari, gynobasis plana.

Planta herbácea perenne, a veces sufruticosa, de 30 a 60 cm de altura, raíz leñosa; tallos herbáceos, de 2 a 4 mm de diámetro, algo lignificados en la base, de verdes a pardos, con manchas de color café obscuras, distribuidas irregularmente, la parte basal de los tallos lisa y de color negro, hirsutos o estrigosos a glabrescentes, tricomas blancos, simples, erectos, de 1 a 1.5 mm de largo; hojas sésiles, lanceoladas a largamente elíptico-lanceoladas, de 2.5 a 5.5(7.5) cm de largo, de 4 a 6(13) mm de ancho, ápice agudo, con un pequeño mucrón, base de atenuada a trunca, ligeramente amplexicaule, margen entero, ligeramente revoluto, haz verde obscuro, envés verde pálido, ambas caras moderadamente estrigosas, tricomas adpresos, con la base discoidea mineralizada, más grandes en el haz, notables sobre todo en las hojas maduras, nervadura central hundida en el haz, prominente en el envés, las secundarias no evidentes; inflorescencias en cimas, terminales y axilares, 1 a 3 por tallo, bracteadas, de 5 a 8(12) cm de largo, con 8 a 10 flores por inflorescencia, brácteas foliáceas, lanceoladas, de 1 a 2.5 cm de largo, de 0.3 a 0.5 cm de ancho, disminuyendo en tamaño hacia el ápice de la inflorescencia; flores con pedicelos de 3 a 5 mm de largo, acrescentes en la fructificación hasta 1 cm de largo, cáliz 5 partido, segmentos lanceolados a linear-lanceolados, de 5 a 8 mm de largo en la antesis, 1 cm de largo en la fructificación, de 1 a 2 mm de ancho, ápice agudo, borde entero, estrigosos por fuera, por dentro esparcidamente estrigosos; corola amarilla, tubular-hipocraterimorfa, estrigulosa por fuera, glabra de la parte media hacia la base, glabra por dentro, apéndices fauciales ausentes, aunque con glándulas dispersas en la base de los lóbulos y en las venas que llegan a los filamentos, anillo basal de 8 a 10 pliegues, glabros, tubo de la corola de 12 a 18(20) mm de largo, de 4 a 5 mm de diámetro, lóbulos suborbiculares, de 2.5 a 3.5 mm de largo, de 1 a 2 mm de ancho, reflejos, ápice redondo, externamente estrigulosos, internamente glabros; estambres inclusos, ubicados 10 y 11 mm arriba de la base del tubo de la corola, filamentos de 0.3 a 0.5 mm de largo, glabros, ligeramente laminares, anteras inclusas, dorsifijas, elipsoides, libres, de 2 a 2.5 mm de largo, estilo de 12 a 16(19) mm de largo, exserto hasta 2 mm del ápice de tubo de la corola, estigma terminal, geminado, de 0.3 mm de diámetro; fruto esquizocárpico, con 2 a 4 clusas, de 3.5 mm de largo, lisas, brillantes, de color café-claro, ápice agudo, cara ventral con un canal que se prolonga hasta el ápice, con 2 o 3 pequeñas concavidades laterales al canal, base anchamente triangular, ginobase plana.

La nueva especie tiene similitudes morfológicas con *Lithospermum calcicola* B.L. Rob. (1892), ya que presentan en común el hábito sufrutescente, la forma y tamaño de las hojas, el tipo de pubescencia, el tipo de inflorescencia. No obstante, al revisar de manera detallada las características de uno y otro taxón, las diferencias de la corola, del androceo y del gineceo son significativas. De manera puntual, las diferencias se presentan en los siguientes aspectos: en *L. elenae* el tubo de la corola mide de 12 a 18(20) mm de largo, mientras que en *L. calcicola* mide 3.5 a 7(9) mm, los estambres en *L. elenae* se encuentran insertos 10 y 11 mm de la base del tubo de la corola y en *L. calcicola* se ubican entre 3 y 4 mm de la base; en *L. elenae* el estilo mide entre 12 y 19 mm, mientras que en *L. calcicola* el estilo es menor de 7 mm de largo.

Distribución y hábitat. *Lithospermum elenae* es una especie endémica del noreste de Querétaro. Solo se ha colectado en el cerro Grande, cerca de San Juan de los Duran y en el cerro Los Bancos, cerca de La Parada (ahora Valle Verde), en el municipio de Jalpan. Es un elemento propio del bosque de pino-encino y menos frecuente en el matorral esclerófilo. Estas comunidades vegetales, en los estados de Guanajuato y Querétaro, se ubica en laderas de rocas calizas con pendientes pronunciadas, de la vertiente occidental de la Sierra Madre Oriental, en altitudes entre 1300 y 2700 m, sobre suelos del tipo Luvisol y en climas templados subhúmedos.

Además, la distribución geográfica es diferente, ya que *Lithospermum calcicola* se ha registrado desde el NE de México, hasta Oaxaca, en tanto que *L. elenae* solo se conoce de la porción sur de la Sierra Madre Oriental en el NE de Querétaro. Así, las principales diferencias se anotan en el Cuadro 1.

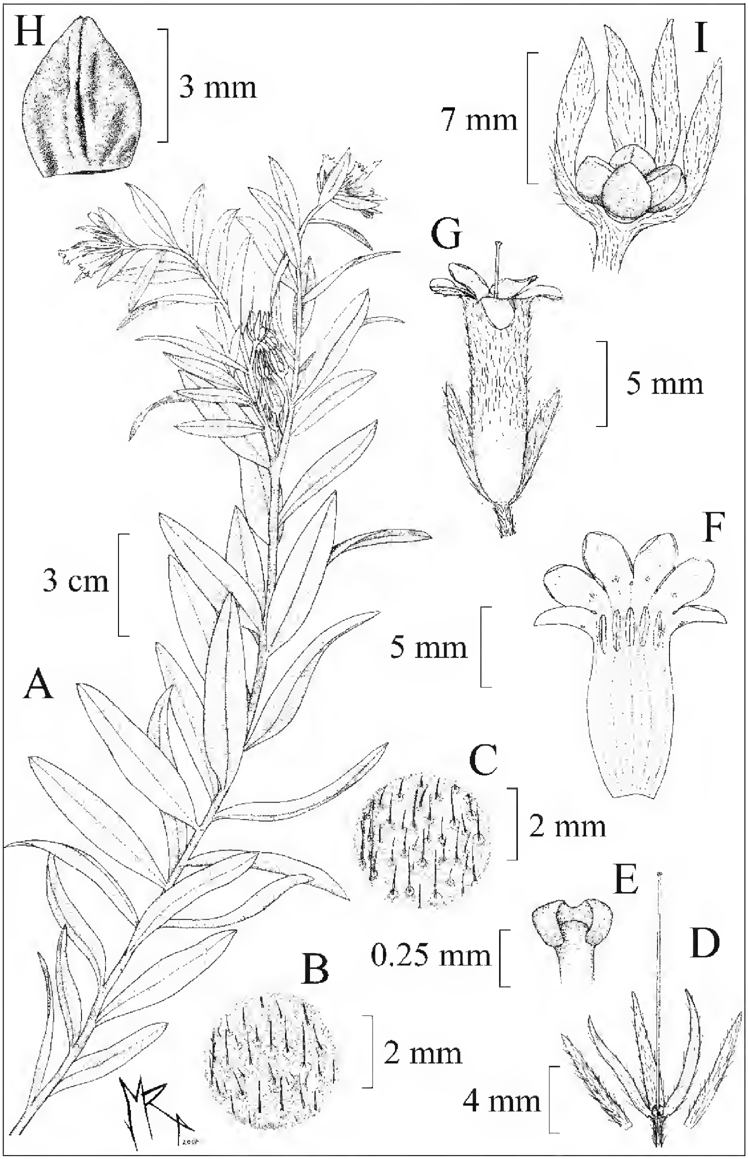

Figura 1. *Lithospermum elenae*. A. Aspecto general de la planta. B. Detalle de superficie estrigosa del haz de la hoja. C. Detalle de la superficie estrigosa del envés de la hoja. D. Vista lateral de los sépalos y del estilo, con dos sépalos separados. E. Vista lateral del estigma. F. Disposición de los estambres en un corte longitudinal de la corola. G. Vista exterior de la corola, con un sépalo retirado; H, vista lateral de la clusa. I. Vista lateral del fruto tetralobado, con un sépalo retirado. Ilustrado por Manuel Ramírez.

Fenología. De acuerdo con el material revisado, *Lithospermum elenae* florece y fructifica de marzo a septiembre.

Material adicional revisado. MÉXICO. Querétaro. Mpio. Jalpan: ladera NW del cerro Grande, 8 km al SE de San Juan de los Durán, encinar arbustivo, alt. 2600 m, 13 mar 2014, *Zamudio, Guzmán y Servín 16703* (IEB); cerro Grande, 27 abr 2012, *Servín 3168* (IEB); aproximadamente 5 km al SE de San Juan de los Durán, rumbo al cerro Grande, al E del manantial, cañada de cerro con bosque de pino-encino, algo mesófilo, alt.1890 m, 24 may 2012, *Carranza 7698* (IEB); pie del cerro Grande, ladera NW, matorral esclerófilo, alt.1900 m, 25 ago 2010, *Zamudio, H. Von Thaden, y J.J. Von Thaden 14841a* (IEB); ibíd., alt. 2600 m, 14 oct 2011, *Zamudio, Aguilar y Servín 15332* (IEB); ladera NW del cerro Grande, 8.5 km al SW de San Juan de los Durán, encinar arbustivo, alt. 2600 m, 23 jun 2011, *Zamudio et al. 15156a* (IEB); 9-10 km al S de San Juan de los Durán, cerro Grande, 13 jun 1991, *Servín 1104* (IEB).

Estado de conservación. Planta escasa ya que únicamente se conoce de la región de San Juan de Los Durán y La Parada (Valle Verde), en el municipio de Jalpan, Querétaro, por lo que se considera que la especie se puede incluir en la categoría "En Peligro", con fundamento en el criterio B, subcriterio 1a y el criterio D (EN, B1a + D) de la propuesta de la IUCN (2012).

Etimología. El epíteto está dedicado a la Señora Elena Siciliano, madre de uno de los autores.

Caracteres		***Lithospermum elenae***	***Lithospermum calcicola***
Hojas caulinares	Forma	Largamente elíptico-lanceoladas	De elípticas, ovadas a lanceoladas, raramente obovadas
	Base/margen	Atenuada a ligeramente amplexicaule / ligeramente revoluto	Redondeada a aguda / plano
Inflorescencia	Tipo	Cimas terminales y axilares	Dicasios terminales o monocasios axilares
	Longitud	5 a 8(12) cm	Hasta 15 cm
	Flores/inflorescencia	6 a 10	6 a 16
Cáliz	Longitud	5 a 10 mm	3 a 6 mm
Corola	Forma/color	Tubular-hipocraterimorfa, amarilla	Hipocraterimorfa, blanca a blanco-amarillenta, o blanca con el centro amarillo
	Tubo	12 a 18(20) mm de largo, de 4 a 5 mm de diámetro	3.5 a 7(9) mm largo, de 2 a 3 mm diámetro
	Lóbulos	3 a 4 mm de largo, reflejos	1 a 3 mm largo, acampanados

Caracteres		***Lithospermum elenae***	***Lithospermum calcicola***
Estambres		Ubicados entre 10 y 11 mm de la base de la corola	Ubicados entre 3 y 4 mm de la base de la corola
Estilo	Longitud	12 a 16(19) mm de largo, exserto hasta 2 mm del ápice del tubo de la corola	2 a 7 mm de largo, inserto, algunas veces exserto
Fruto	Longitud	3.5 mm de largo	3.9 a 4.9 mm largo
	Color	Clusas lisas, brillantes, de color café claro	Clusas lisas, brillantes, de color café obscuro
	Ornamentación	Con 2 o 3 pequeñas concavidades laterales al canal, base anchamente triangular	Con muchas concavidades pequeñas, base redonda

Cuadro 1. Diferencias morfológicas significativas entre *Lithospermum elenae* y *L. calcicola.*

LITHOSPERMUM IRENEAE Pat.-Sicil., J.I. Cohen, & Zamudio **sp. nov. Tipo: MÉXICO. Michoacán.** Mpio. Hidalgo: ladera SW del cerro San Andrés, ± 1.3 km de la cima, bosque de *Abies religiosa,* altitud 3440 m, 12 jun 2011, *G. Aguilar y S. Zamudio 320* (holotipo: IEB; isotipos por distribuirse). Figura 2.

Planta herbacea perennis decumbens; radix axonomorpha: caules simplices dense hirsuto-strigosi; folia caulina sessilia, laminis lanceolatis vel oblongo-lanceolatis 2-5(7) cm longis, 0.3-1.2 cm latis, utrinque strigosis, costa prominenti, venis secundariis evidentibus; inflorescentia cymosa compacta terminalis bracteata 4-8 cm longa, floribus axillaribus subsessilibus; calyx segmentis lineari-lanceolatis 4-7 mm longis, utrinque strigosis; corolla hypocraterimorpha lutea 8-11 mm longa, extus villosa vel villosula, intus glabra, appendicibus faucialibus 1 mm diametro, annulo basali 6-7-plicato, lobulis suborbicularibus 2-3 mm diametro, tubo 6-8 mm longo, ad faucem constricto; stamina inclusa 6-7 mm supra corollae basem inserta, filamentis minus quam 1 mm longis, antheris ellipsoideis 1-2 mm longis dorsifixis; stylus inclusus 5-7 mm longus, stigma geminatum minus quam 0.5 mm diametro; fructus 3 vel 4 clusis 2-3 mm longis, 1.5-2 mm crassis, albis nitidis lucidis cum carina dorsali evoluta, base circulare, gynobasis plana.

Planta herbácea perenne, decumbente, de 15 a 40 cm de altura; raíz pivotante, leñosa, 1 a 4 tallos simples, de 2 a 4 mm de diámetro, densamente hirsuto-estrigosulos, hojas inferiores (pseudobasales) sésiles, en mayor densidad y más largas que las superiores, con los entrenudos muy cortos, laminas lanceoladas, de 3 a 9 cm de largo, de 0.8 a 1 cm de ancho, las caulinares sésiles, con entrenudos notables, lamina de lanceolada a oblongo-lanceolada, de 2 a 5(7) cm de largo, de 0.3 a 1.2 cm de ancho, ápice agudo, a veces cortamente mucronado, base ligeramente abrazadora, borde entero a ligeramente revoluto, haz verde, estrigoso, pelos de menos de 0.5 mm, adpresos, blanquecinos, con la base mineralizada, notables sobre todo en las hojas maduras, vena central hundida, envés pálido, estrigoso, con la vena central prominente; inflorescencia en cimas apretadas, terminales, bracteadas, de 4 a 8 cm de largo, con 10 a 14 flores por cima, brácteas foliáceas, disminuyendo en tamaño hacia el ápice de la inflorescencia, estrigosas, flores axilares, casi sésiles; cáliz dividido en 5 segmentos linear-lanceolados, de 4 a 7 mm de largo, menos de 1 mm de ancho, externa e internamente

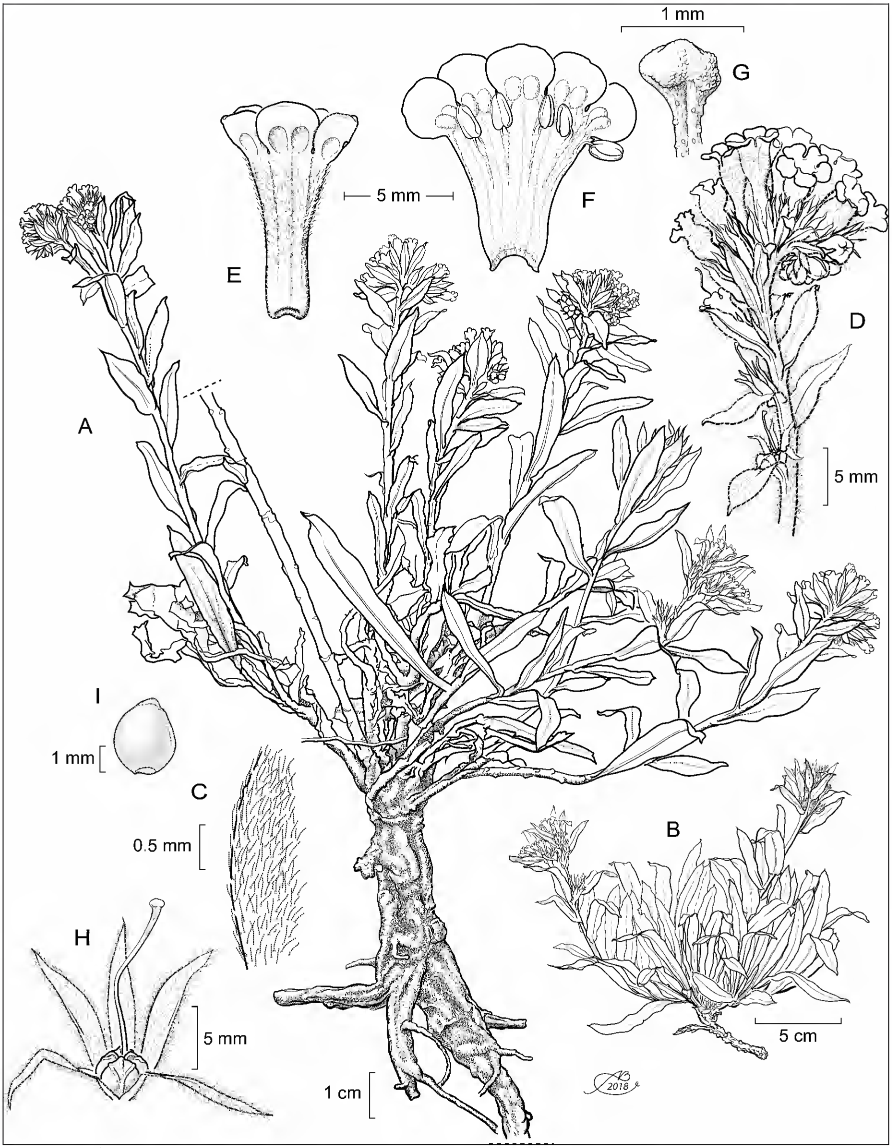

Figura 2. *Lithospermum ireneae*. A. Aspecto general de una planta madura. B. Vista de una planta joven con las hojas inferiores (pseudobasales). C. Detalle de la superficie estrigosa del haz de la hoja. D. Acercamiento de la inflorescencia. E. Vista exterior de la corola. F. Disposición de los estambres y apéndices fauciales en un corte longitudinal de la corola. G. Vista lateral del estigma. H. Vista lateral de la inserción del estilo. I. Vista lateral de la clusa. Ilustrado por Alfonso Barbosa.

estrigosos; corola hipocraterimorfa, amarilla, de 8 a 11 mm de largo, vilosa a vilósula por fuera, aunque con la base glabra, internamente glabra, apéndices fauciales glandulosos, de 1 mm de diámetro, anillo basal de 6 a 7 pliegues, lóbulos suborbiculares, externamente vilósulos en la parte media, internamente glabros, de 2 a 3 mm de largo, de 2 a 3 mm de ancho, llegando a ser reflejos, tubo de 6 a 8 mm de largo, constreñido en la garganta; estambres inclusos, ubicados 6 a 7 mm arriba de la base del tubo de la corola, filamentos de menos de 1 mm de largo, con glándulas en las venas que llegan a los filamentos, anteras elipsoides, de 1 a 2 mm de largo, dorsifijas; estilo incluso, filiforme, de 5 a 7 mm de largo, estigma geminado, de menos de 0.5 mm de diámetro; fruto de 3 o 4 clusas, de 2 a 3 mm de largo, 1.5 a 2 mm de grueso, blancas, lisas, brillantes, con una quilla dorsal, base circular, ginobase plana.

Especie estrechamente relacionada con *L. distichum* Ortega, de la que difiere por la presencia de hojas sésiles con las bases abrazadoras, el haz estrigoso, las ramas floríferas en ternas y las flores amarillas, otras diferencias se aprecian en el Cuadro 2. También difieren en el hábitat en que crecen, *L. distichum* lo hace en bosques de pino y de encino, en laderas de cerro, terrenos planos y en pastizales secundarios; también es común en caminos y cultivos abandonados, en donde se comporta como ruderal y arvense, en altitudes entre 900 y 3300 m; en tanto que la nueva especie se desarrolla en altitudes mayores a 3200 m, en bosques de oyamel y de *Pinus hartwegii.* con pastos amacollados.

Distribución y hábitat. *Lithospermum ireneae* es una especie endémica de la zona de clima templado de la parte NNE de Michoacán, donde sólo se ha colectado cerca de la cima del cerro San Andrés, en los municipios de Hidalgo y Zinapécuaro, Michoacán, en la provincia fisiográfica del Eje Neovolcánico Mexicano. El tipo de vegetación en donde crece corresponde al bosque de *Abies religiosa* y *Pinus hartwegii*, con pastizal amacollado, que se desarrolla sobre laderas de rocas volcánicas, con suelos poco profundos y pedregosos y en clima templados subhúmedo; en altitudes entre 3200 y 3450 m s.n.m.

Fenología. De acuerdo con el material revisado, florece y fructifica en los meses de julio a septiembre.

Material adicional revisado. MÉXICO. Michoacán. Mpio. Hidalgo: cima del cerro San Andrés, alrededor de las antenas, bosque de *Pinus hartwegii* con pastizal amacollado, alt. 3440 m, 12 jun 2011, *Aguilar y Zamudio 335* (IEB). Mpio. Zinapécuaro: puerto San Andrés, bosque de *Pinus hartwegii,* con pastizal amacollado, alt. 3000 m, 8 jul 1987, *Díaz-Barriga 3920* (IEB); parte alta del cerro San Andrés, bosque de *Pinus hartwegii,* con pastizal amacollado, alt. 3400 m, 29 ago 1987, *Zamudio 5566* (IEB, MEXU).

Estado de conservación. Planta escasa, únicamente conocida de la parte alta del cerro de San Andrés, en los municipios de Hidalgo y Zinapécuaro, estado de Michoacán, por lo que se considera que se puede incluir en la categoría “En Peligro”, con fundamento en el criterio B, subcriterio 1a y el criterio D (EN, B1a + D) de la propuesta de la IUCN (2012).

Etimología. El epíteto está dedicado a la Bióloga Irene García González, Jefa del Departamento de Botánica de la Dirección General de Geografía y Medio Ambiente del INEGI, por su contribución, silenciosa pero incansable, al conocimiento de la flora de nuestro país.

Caracteres		***Lithospermum ireneae***	***Lithospermum distichum***
Lámina foliar			
	Forma/ largo del peciolo	Lanceoladas, sésiles	Elípticas a lanceoladas u ovadas, peciolos de 1 a 3 mm
	Base	Decurrente a ligeramente abrazadora	Redondeada a trunca
Inflorescencia	Tipo	Cimas terminales, con 2 a 3 ramas	Cimas terminales o axilares, con 3 a 7 ramas
	Largo	4 a 8 cm	hasta 16.5 cm
	Flores/inflorescencia	10 a 14	12 a 22
Cáliz	Segmentos	Linear-lanceolados	Lanceolados a oblongo-lanceolados
Corola	Color/largo	Amarilla, de 8 a 11 mm	Blanca con el centro amarillo, de 4 a 7 mm
	Largo del tubo	6 a 8 mm	3 a 5 mm
Estambres	Ubicación	7 mm arriba de la base del tubo de la corola	3 mm arriba de la base del tubo de la corola
Estilo	Longitud	5 a 7 mm	3 a 5 mm
Clusa	Color	Blancas	Blancas a café claro

Cuadro 2. Características diferenciales entre *Lithospermum ireneae y L. distichum.*

AGRADECIMIENTOS

Los autores agradecen a Jerzy Rzedowski por la elaboración de las diagnosis latinas, a Gabriela Aguilar, Benito Servín, Hugo Von Thaden y Juan José Von Thaden su ayuda en las colectas de campo, a Alfonso Barbosa y Manuel Ramírez por las excelentes ilustraciones.

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Phytoneuron 2018-57: 1–4. Published 13 August 2018. ISSN 2153 733X

ADDITIONS TO THE VASCULAR FLORA OF CADDO PARISH, LOUISIANA

M.H. MacRoberts and B.R. MacRoberts
Herbarium (LSUS), Museum of Life Sciences
Louisiana State University in Shreveport
Shreveport, Louisiana 71115
mmacrobe@lsus.edu

M. Jerome Lewis
Assistant Director, Red River Watershed Management Institute
Louisiana State University in Shreveport
Shreveport, Louisiana 71115
jerome.lewis@lsus.edu

ABSTRACT

The vascular flora of Caddo Parish, Louisiana, is updated. Field research has yielded three new species in the area: *Scutellaria racemosa*, *Nama jamaicense*, and *Bacopa monnieri.*

Since the publication of our "An updated, annotated vascular flora of Caddo Parish, Louisiana, with notes on regional phytogeography and ecology" (MacRoberts & MacRoberts 2006) and several updates recording new species to the parish (MacRoberts & MacRoberts 2017, and references), we have continued to locate interesting additions. The Caddo Parish vascular plant list now stands at 1446 species, of which about 17% are non-native.

LAMIACEAE

Scutellaria racemosa Pers. *MacRoberts & MacRoberts 8993,* 8997 (LSUS, LSU).

Scattered in shallow stream bed in Betty Virginia Park, Shreveport, Louisiana, in association with *Acmella oppositifolia*, *Amphicarpaea bracteata*, *Diodia virginiana*, *Justicia ovata* var. *lanceolata*, *Toxicodendron radicans*, *Triadica sebiferum*, and *Trifolium repens*. *Scutellaria racemosa* is apparently a recent introduction to the southeastern USA from South America (Godfrey & Wooten 1981). The species was first found in the park in June 2017 and was still present in May 2018. The area is frequently mowed, but the small intermittent stream in which the *Scutellaria* occurs is not as severely mowed as the remainder of the park, possibly accounting for the survival of the species at this location.

HYDROPHYLLACEAE (Namaceae)

Nama jamaicense L. *Lewis 303* (LSUS); *MacRoberts & MacRoberts 8996* (CONN, LSU).

About a hundred individual plants of this species have been found growing on rain drip areas near buildings along shaded sidewalks of Louisiana State University in Shreveport (LSUS) campus (Figures 1, 2, and 3). This population apparently is about 200 miles (370 km) from its closest Texas and south Louisiana locations (Turner et al. 2003; Kartesz 2014). The plants occur in frequently mowed and "weed eaten" areas; nonetheless the species has managed to survive apparently largely because of its low, sprawling habit. It was first found 3 March 2018 and has continued to flower into the summer. Associated species include *Bowlesia incana*, *Lamium amplexicaule*, *Modiola caroliniana*, *Oxalis corniculata*, *Sherardia arvensis*, *Taraxacum officinale*, and *Trifolium repens.*

Because very little has been written about this species habitat preference ["hammocks and waste places" (Rickett 1967, p. 418); "sandy or silty ground, road-sides, or disturbed places" (Diggs et al. 1999, p. 740); "disturbed sites" (Wunderlin 1998, p. 515); "ruderal" (Clewell, 1985, p.377); "moist places under shrubs and elsewhere" (Correll & Johnston 1970, p. 1278); "common on various soils in prairies, openings, fields and waste places" (Jones 1977, p. 159); "shady areas with moist soils" (Eason 2018, p. 138); "flower beds, sidewalk margins … usually there is a little bit of exposed dirt and at least partial shade" (Guy Nesom, pers. comm.); "mesic riparian zones, streambanks, creekbeds, canyons, slopes, ridges, and banks, ruderal habitats like old pastures, dirt parking lots, and roadside ditches; 10-700m" on "sandy clay loam or limestone soils" (Taylor, in prep.)], and because *Nama jamaicense* appears to be thriving so far outside its normal range, we examined its habitat at LSUS more carefully. Prior to the founding of the university in 1968 the site was a cotton field on the Red River flood plain (MacRoberts & MacRoberts 2005; Eli Henry, pers. comm.; Edwards et al. 1980). The Red River alluvial soil area within the LSUS campus boundary was modified during construction in 1967 and is now classified as an "Urbanland-Moreland clay complex" with a 0-1% slope (USDA, NRCS, Web Soil Survey). Since *Nama jamaicense* at LSUS is growing in a single specific locality (exposed, highly disturbed, rain drip, mainly shade, near buildings), we collected three soil samples next to three plant populations and three soil samples in fields on campus away from buildings and away from the plant sites. Soil sample results from the School of Plant, Environmental & Soil Sciences, Soil Testing Plant Analysis Laboratory in Baton Rouge, showed that the soils containing the plants had higher calcium levels (3500-3900 ppm vs. 850-2600 ppm) and pH values (7.8-8.1 vs. 5.9-7.6) than the control areas. This is possibly due to the association of concrete corrosion with wetter soils associated with rain drip areas combined with poor soil runoff characteristics. Otherwise, P, K, Mg, Na, S, Cu, and Zn were about the same.

Figure 1. *Nama jamaicense* habitat.

Figure 2. *Nama jamaicense* flower.

Figure 3. *Nama jamaicense* in drip zone near building.

SCROPHULARIACEAE

Bacopa monnieri (L.) Pennell *MacRoberts & MacRoberts* 8992 (LSUS, LSU).

This species was common in the wet edge of a man-made shallow, frequently mowed ephemeral pond near a shopping mall, one km north of LSUS. Associated species include *Centaurium muhlenbergii*, *Fuirena simplex*, *Phyla nodiflora*, *Rhynchospora corniculata*, and *Typha domingensis*. Although common along the Gulf Coast, it appears to be rare in Arkansas, Oklahoma, north Texas, and northwest Louisiana (Kartesz 2014).

ACKNOWLEDGEMENTS

Guy Nesom confirmed our initial identification of *Nama jamaicense*. Sarah Taylor also confirmed our identification and provided us with a pre-publication copy of her *Nama* contribution to FNANM. Eli Henry described for us the Red River floodplain prior to the construction of LSUS. Michael Lindsey (USDA-NRCS) and J. Cheston Stevens (LSU Ag. Center, Alexandra, Louisiana) helped explain soil characteristics.

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TAXONOMIC REVIEW OF *CHLORACANTHA* (ASTERACEAE, ASTEREAE)

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109
guynesom@sbcglobal.net

ABSTRACT

The four entities that comprise the North American genus *Chloracantha* are morphologically discrete, with little or no intergradation. Var. *spinosissima* (Baja California Sur) and var. *strictospinosa* (Central America, southern Mexico) do not overlap in distribution with other entities. Var. *spinosa* and var. *jaliscensis* are largely allopatric but they are sympatric along the Pacific slope in Chihuahua, Sonora, and Sinaloa. Each of the four is recognized here at specific rank: *Chloracantha spinosa* (Benth.) Nesom, **Chloracantha spinosissima** (Brandeg.) Nesom, **comb. et stat. nov.**, **Chloracantha ortegae** (Blake) Nesom, **comb. nov.** (= var. *jaliscensis*), and **Chloracantha australis** Nesom, **nom. et stat. nov.** (= var. *strictospinosa*).

The genus *Chloracantha* has been considered to comprise a single species with four varieties. (Nesom et al. 1991; Sundberg 1991; Nesom & Robinson 2007). The typical variety occurs from the south-central and southwestern USA through the northern two-thirds of Mexico; var. *spinosissima* and var. *jaliscensis* are endemic to western Mexico; var. *strictospinosa* is abundant from Central America (Panama to Guatemala) into southernmost Mexico. Sundberg (1991) provided a treatment of infraspecific taxonomy and discussions of typification.

The genus is recognized by its shrubby habit and green, usually leafless stems bearing scattered, small, white-rayed heads. All plants except those of var. *jaliscensis* usually produce spines (branch homologues, technically thorns). Although *Chloracantha spinosa* (all variants) produces no terminal resting buds and its permanently green stems without periderm are herbaceous in aspect, it behaves like a shrub in its perennial stems (alive for up to about four growing seasons) with a quickly developed vascular cambium and its production of axillary buds with bud scales (Nesom et al. 1991). The leaves are usually shed by flowering, except in var. *jaliscensis*. The plants occur in a variety of habitats, though most commonly near water and mostly at low elevations but at some sites up to nearly 2000 meters. Molecular studies indicate that *Chloracantha*, the monotypic genus *Batopilasia* of southern Chihuahua, and *Boltonia* of the eastern USA are closely related (Brouillet et al. 2009).

Perhaps because of the highly distinctive appearance of plants of the *Chloracantha* complex across its geographic distribution, most authors have chosen to recognize a single species with formal variants at varietal rank (Brandgee 1917; McVaugh 1972, 1984; Sundberg 1991), but none has provided an explicit rationale for choice of rank. In his treatment of Mesoamerican Astereae, Pruski (2018) regarded putative differences in thorniness, phyllary morphology, and pappus length as of no taxonomic significance and recognized only a single species, *C. spinosa*, with no infraspecific taxa.

In the review here, the existence of four entities is confirmed –– each is morphologically discrete and intergrades little or none with the others. Morphological differences are consistent in vegetative, involucral, and fruit characters. Var. *spinosissima* and var. *strictospinosa* do not overlap in geography with other entities; var. *spinosa* and var. *jaliscensis* are largely allopatric but sympatric along the Pacific slope in Chihuahua, Sonora, and Sinaloa. Each of the four taxa has a discrete geographical range, non-intergrading with the others, and each is recognized here at specific rank.

CHLORACANTHA Nesom, Suh, Morgan, Sundberg, & Simpson, Phytologia 70: 378. 1991. **TYPE**: *Chloracantha spinosa* (Benth.) Nesom

Aster sp. group Spinosi Alexander in Small, Man. S.E. Fl., 1365, in clave. 1933. *Aster* sect. *Spinosi* (Alexander) A.G. Jones, Brittonia 32: 233. 1980. *Erigeron* sect. *Spinosi* (Alexander) Nesom & Sundberg, Phytologia 67: 85. 1989. **TYPE**: *Aster spinosus* Benth.

Perennial subshrubs, spreading by rhizomes, glabrous or glabrate. **Stems** strictly erect, 0.5–1.5(–2.5) m tall, lateral branches sharply ascending, the latter sometimes modified as thorns, axillary buds with scales, thorns commonly adnate to stems 0.5–2 mm. **Leaves** all cauline, alternate, 1-nerved, mostly 1–4 cm long, oblanceolate, entire or very rarely with 1–2 pairs of small teeth, early deciduous (except in *C. ortegae*), glabrous except the margins sometimes sparsely ciliate and the upper surface sometimes with scattered minute hairs. **Heads** produced singly in loose, corymboid panicles; buds erect; involucres broadly turbinate to hemispheric; phyllaries strongly graduated in (3–)4–5 series, the inner 4–7.5 mm long, each with (1–)3(–5), parallel, orange-resinous veins, oblong-elliptic to lanceolate, apices usually rounded but sometimes lanceolate, the margins (including the apex) hyaline. **Ray florets** 10–33 in a single series, pistillate, fertile, the corollas 4–8(–11) mm long, the ligules (0.5–)1–2 mm wide, white, sometimes bluish-tinged, coiling at maturity. **Disc florets** bisexual, fertile, the corollas yellow with orange-resinous veins, becoming purplish at maturity. **Achenes** glabrous, slightly compressed, 1.5–4 mm long, with 5(–6) nerves; pappus of 30–60 barbellate bristles in ca. 2 series, 2.5–6.5 mm long, usually with a few with much shorter outer setae. **Base chromosome number** x=9.

Key to species

1. Leaves often persisting, at least proximally, until flowering; stems usually without spines (spines 5-15 mm long if present, straight to recurved); phyllaries broadly oblong-elliptic to lanceolate-elliptic, apex of midportion rounded .... **Chloracantha ortegae**

1. Leaves deciduous by flowering; stems sparsely spiny on proximal portions or densely spiny over all; phyllaries mostly lanceolate, apex of midportion acute.

  2. Stems densely spiny, spines (6–)20–70 mm long; pappus bristles 3–4 mm long .... **Chloracantha australis**

  2. Stems densely or sparsely spiny, spines 3–20(–30) mm long or 20–70 mm long; pappus bristles 4.5–6.5 mm long.

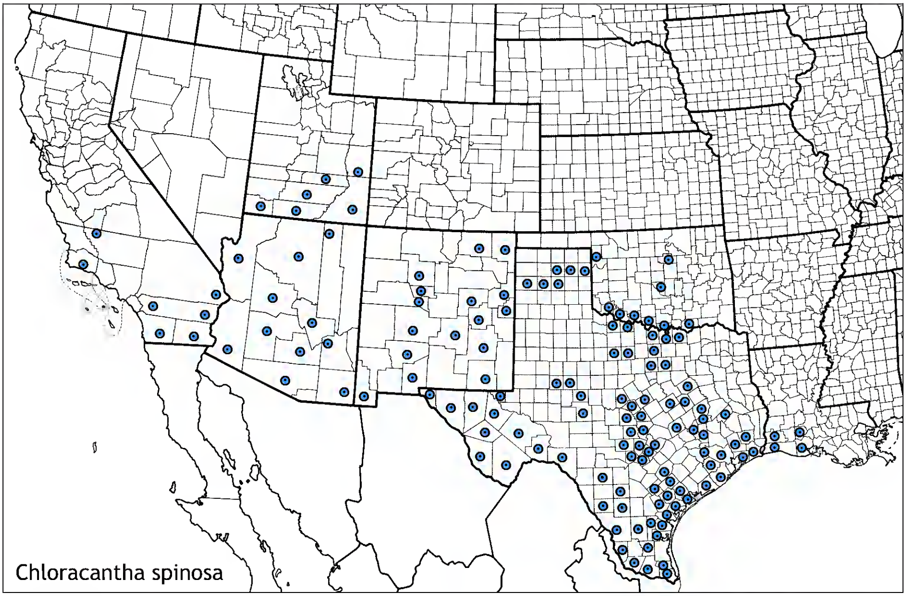
    3. Stems sparsely to densely spiny proximally or sometimes without spines, distal branches spineless; spines 3–20(–30) mm long, straight to slightly recurved, spreading; involucres 4–5.5(–6) mm high; achenes 1.5–2.3 mm long .... **Chloracantha spinosa**

    3. Stems consistently densely spiny proximally and distally; spines 20–70 mm long, straight, ascending; involucres (5–)6.5–7.5 mm high; achenes 2.8–3.5 mm long **Chloracantha spinosissima**

1. **CHLORACANTHA SPINOSA** (Benth.) Nesom, Phytologia 70: 378. 1991. *Aster spinosus* Benth., Pl. Hartweg., 20. 1839. *Leucosyris spinosa* (Benth.) Greene, Pittonia 3: 244. 1897. **TYPE**: **MEXICO**. **Aguascalientes**. 1839, *K.T. Hartweg 148* (holotype: K image!; isotypes: BM, CGE, E image!, GH image!, LD image!).

USA (south-central and southwest), Mexico (broadly distributed; (Maps 1, 2). Along streams and ditches, lake shores, low areas in pastures and prairies, seepage, sometimes saline areas, 20–1250 (–1500) m; flowering mostly Sep–Feb, all year with moisture. Chromosome number $2n$=18.

As noted by Sundberg (1991), "collections from cultivated areas in the Valley of Oaxaca may be introductions from farther north": Valley of Oaxaca, fields along Route 190, ca. 10 mi NW of Oaxaca, locally abundant roadside weeds, 27 Jul 1960, King 3518 (TEX); ca. 6 mi N of city of Oaxaca on Rte 190, beside road in grassy field with occasional *Acacia* and other thorn scrub, 1700 m, 19 Jan 1990, *Soule 2182* (TEX).

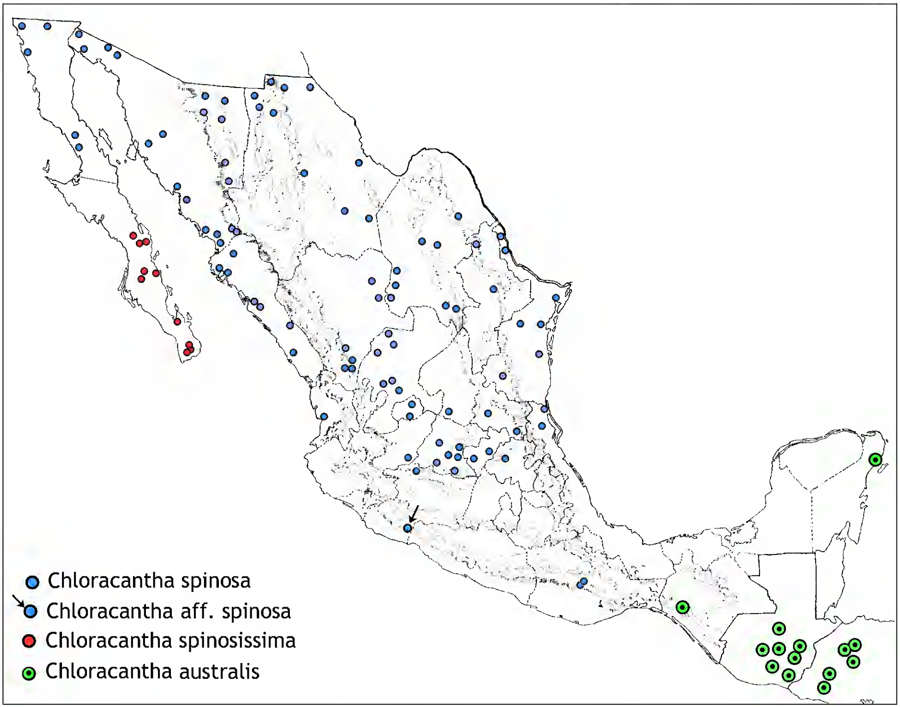


Map 1. Distribution of *Chloracantha spinosa* in the USA.

"Populations from the Imperial Valley and the lower Colorado River of southern California and Arizona are unusual in having fleshy stems, larger heads, and short branchlets in the capitulescence. In this area, the plants are often phreatophytic, growing in areas that are frequently flushed by of salt buildup" (Sundberg 1991, p. 386). Sundberg made numerous collections from this area in August 1983 and 1984, mostly from along irrigation ditches –– chromosome counts from three populations were $2n = 18$. The specimens appear to be within the morphological range of typical *Chloracantha spinosa*.

A collection from along the coast near Guaymas, Sonora, was annotated by Sundberg as a typical *Chloracantha spinosa* influenced by genes of var. *spinosissima*: N of Guaymas along coast just S of Catch 22 airfield at Playa de los Algodones, *Maytenus*-dominated shrubland and tidal mudflat area, 5 Jan 1983, *Keil 16615* (TEX). The plants have relatively large heads, with pappus 6 mm long, and short, thick spines, but the phyllaries are mostly oblong-lanceolate, more like those of var. *jaliscensis* than either var. *spinosa* or var. *spinosissima*.

A collection from southern Michoacan was identified by Sundberg (1991) as var. *strictospinosa*: Distr. Huetamo, Tacupa, cliffs over Balsas River, 2 Dec 1934, *Hinton 5610* (MEXU image, Fig. 4, MO; also GH, NY, and US fide Sundberg 1991). As such, however, these plants would be long-disjunct (Map 2) and their morphology is mostly like typical *Chloracantha spinosa*. The plants are densely spiny and the pappus is short as in var. *strictospinosa* but the spines are relatively short and the phyllaries are mostly lanceolate. One of the branches has persistent cauline leaves. They are identified here as *Chloracantha* aff. *spinosa*.



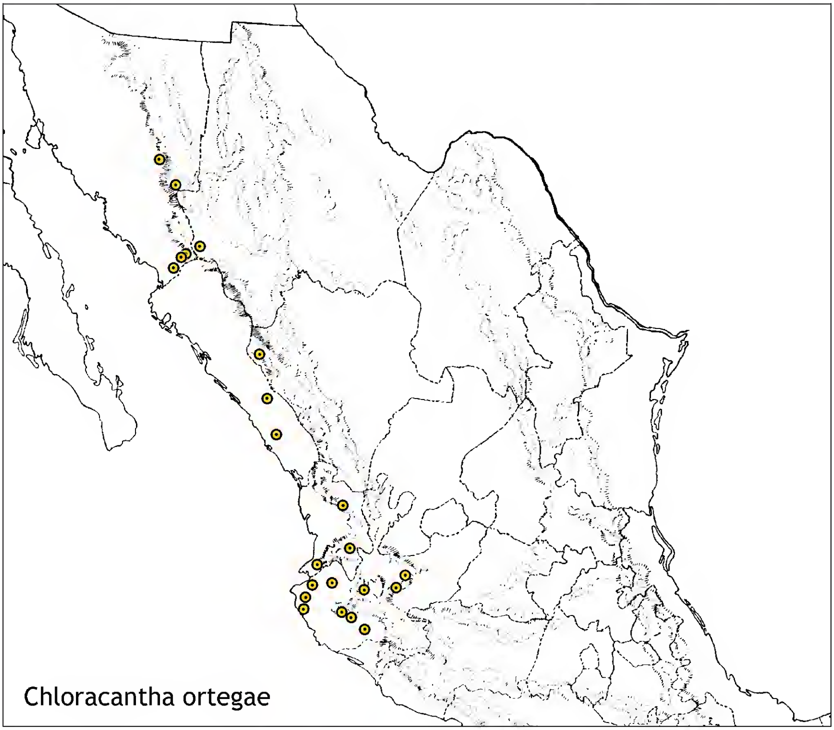
Map 2. Distribution of *Chloracantha spinosa* (Mexican localities), *C. spinosissima* (endemic to Baja California Sur), and *C. australis* (Map 4 for range through Central America). See text for comments on "*Chloracantha* aff. *spinosa*" in Michoacan.

2. **CHLORACANTHA SPINOSISSIMA** (Brandeg.) Nesom, **comb. et stat. nov.** *Aster spinosus* var. *spinosissimus* Brandeg., Univ. Calif. Publ. Bot. 6: 375. 1917. *Chloracantha spinosa* var. *spinosissima* (Brandeg.) Sundberg, Phytologia 70: 386. 1991. **TYPE**: **MEXICO**. **Baja California Sur**. San Gregorio, 1 Feb 1889, *T.S. Brandegee s.n.* (holotype: UC!; isotypes: PH image!, US image!).

Baja California Sur (Map 2). Arroyos and canyons, along rivers and around springs and ponds, fencelines; 10–900 (–1100) m; flowering (Apr–)Jun–Jan.

3. **CHLORACANTHA ORTEGAE** (Blake) Nesom, **comb. nov.** *Erigeron ortegae* Blake, Proc. Biol. Soc. Washington 37: 55. 1924. **TYPE**: **MEXICO**. **Sinaloa**. Mpio. San Ignacio: San Javier, terrenos de Balboa, Jan 1923, *J.G. Ortega 4974* (holotype: US!; isotype: K digital image!).

Aster spinosus var. *jaliscensis* McVaugh, Contr. Univ. Michigan Herb. 9: 363. 1972. *Chloracantha spinosa* var. *jaliscensis* (McVaugh) Sundberg, Phytologia 70: 388. 1991. **TYPE**: **MEXICO**. **Nayarit**. 2 mi NE of Santa María del Oro, steep mountainsides, in the basin of La Laguna, abundant among rocks in streambed, 800 m, oak forest near summits and tropical forest with *Ficus*, *Brosimum* below, 15-16 Sep 1960, *R. McVaugh 19049* (holotype: MICH digital image!; isotypes: DUKE image!, ENCB image!, LL!, NY image!, US image!).



Map 3. Distribution of *Chloracantha ortegae*.

Sonora, Chihuahua, Sinaloa, Nayarit, Jalisco (Map 3). Along rivers, streams, and ditches, arroyos, rocky and gravelly channels, riparian and gallery forests, disturbed oak-pine; 50–1900 m; flowering Sep–Jan. Chromosome number 2*n*=18.

Northern localities. **Chihuahua**. 6 km antes de Batopilas, intersection Arroyo de Santiago con el Rio Batopilas, 600-650 m, 14 Nov 1998, *Lebgue et al. 1726* (NMC). **Durango**. 10 mi N of Tamazula, rocky canyon bottom, climax short tree forest, 1500 ft, 18 Dec 1939, *Gentry 5260* (MEXU-2 sheets images). **Sinaloa**. Mpio. Concordia: La Tuna on Rio Magistral, 3 km by air NNE of Piedras Blancas, 12.5 km by air NE of Concordia, semideciduous forest, 843 ft, 0.3-0.6 m shrub on rocks near water, 5 Dec 2007, *Van Devender et al. 2007-1219* (ARIZ). Mpio. Cosalá: Vado Hondo, ca. 8.2 km W of Cosalá, tropical deciduous forest, 426 m, uncommon subshrub at edge of water, 4 Jan 2006, *Van Devender 2006-28* (USON). **Sonora**. Mpio. Alamos: Arroyo el Cobre, ca. 0.5 km S of Choquincahui, ca. 6.5 mi N of Guirocoba, 530 m, stream bottom in tropical deciduous forest with *Cyperus involucratus*, 16 Mar 1995, *Fishbein 2192* (USON); ca. 8 mi SE of Alamos on road to Guirocoba, lower crossing of Rio Cuchujaqui, edge of stream, 30 Dec 1983, *Van Devender 830153* (TEX); El Guayabo crossing of Río Cuchujaqui, 2.6 km NE of Sabinito Sur, 14 km (by air) ESE of Alamos, tropical deciduous forest on slopes and *Taxodium-Salix* gallery forest along stream, along stream, 350 m, 21 Nov 1993, *Van Devender 93-1221* (ASU); Rio Cuchujaqui at Arroyo El Mentidero, 11.3 km S of Alamos, 240 m, edge of river with *Taxodium*, 28 Oct 1995, *Van Devender 95-1162* (UCR). Mpio. Sahuaripa: 42.9 km (by air) NNW of Sahuaripa, Río Áros, Rancho El Refugio, 488 m, 30 Mar 2011, *Van Devender 2011-42* (USON). Mpio. Yecora: 3.9 km E of Yecora on Mex Hwy 16, Arroyo El Otro Lado, oak woodland, locally common in water at edge of stream, 1560 m, 25 May 1998, Van Devender 98-635 (TEX); Río Yepachic near jct with Arroyo Hondo, ca. 2 km by air W of Chihuahua border, 1380 m, oak woodland with canyon riparian forest with *Acer*, *Alnus*, *Cupressus*, and *Prunus gentryi*, in water, 27 Sep 1998, *Van Devender & Reina G. 98-1780* (NMC).

Chloracantha ortegae and *C. spinosa* are largely allopatric but the range of *C. ortegae* extends northward along the Pacific slope from its concentration in Jalisco and Nayarit to the Yecora area of east-central Sonora. Along this northward, linear extension, it is sympatric with *C. spinosa* (Maps 2, 3) apparently with little or no intergradation. The two entities are compared in the following couplet.

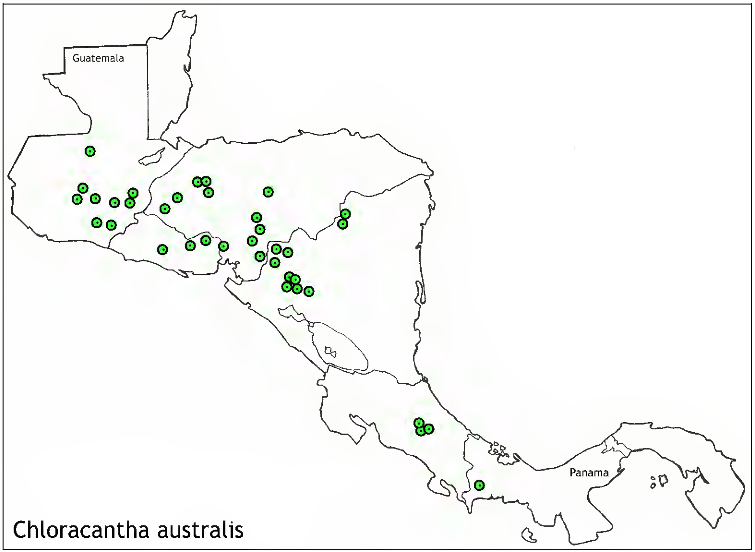
a. Leaves often persisting until flowering; stems usually without spines; phyllaries broadly oblong-elliptic to lanceolate-elliptic, apex rounded; achenes 2–3 mm long, pappus bristles 2.5–3.5 mm long .... **Chloracantha ortegae**

a. Leaves consistently deciduous by flowering; stems usually sparsely spiny proximally, with many spineless branches above; phyllaries mostly lanceolate, apex acute; achenes 1.5–2.3 mm long, pappus bristles 4–6.5 mm long ....**Chloracantha spinosa**

4. **CHLORACANTHA AUSTRALIS** Nesom, **nom. et stat. nov.** *Chloracantha spinosa* var. *strictospinosa* Sundberg, Phytologia 70: 389. 1991. TYPE: **HONDURAS**. **Dept. Morazán**. Rocks in Río Caparosa, near Zamorano, 800 m, 1 Jan 1963, *L.O. Williams 23285* (holotype: LL!; isotypes: ARIZ image!, F image!, GH image!, MEXU image!, MO!, PH image!, US image!). Sundberg cited additional collections at DS, MICH, NY, and UC.

Mexico (Chiapas; the collection from Quintana Roo is out of range and probably adventive), Central America (Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama) (Maps 2, 4). Moist or marginally wet areas, river banks, 800–1200 m; flowering Jul–Jan.

Mexico localities (Map 2). **MEXICO**. **Chiapas**. Rancho La Aurora, *Sanchez 1078* (ENCB, UC). **Quintana Roo**. Playa Paraíso, grounds of Iberostar Paraíso Del Mar resort, along Carretera Chetumal-Cancún, km 309, 12 Dec 2005, *King & Garvey 14164* (ARIZ).



Map 4. Distribution of *Chloracantha australis* (Central American localities).

SPRING BRANCH SCIENCE CENTER HERBARIUM (SBSC)

ASTERACEAE
TEXAS
Trinity County

Chloracantha spinosa (G. Bentham) G. Nesom var. *spinosa*

Trinity National Wildlife Refuge; new tract NE of the intersection of Hwy. 105 and the Trinity River, N of Tanner Bayou and NW of the town of Moss Hill. Occasional shrubs along drawn down margin of Rayburn Lake with *Leptochloa panicoides*, *Ludwigia peploides*, and *Paspalum distichum*

GPS - UTM 15 327528E 3352331N (NAD 83)

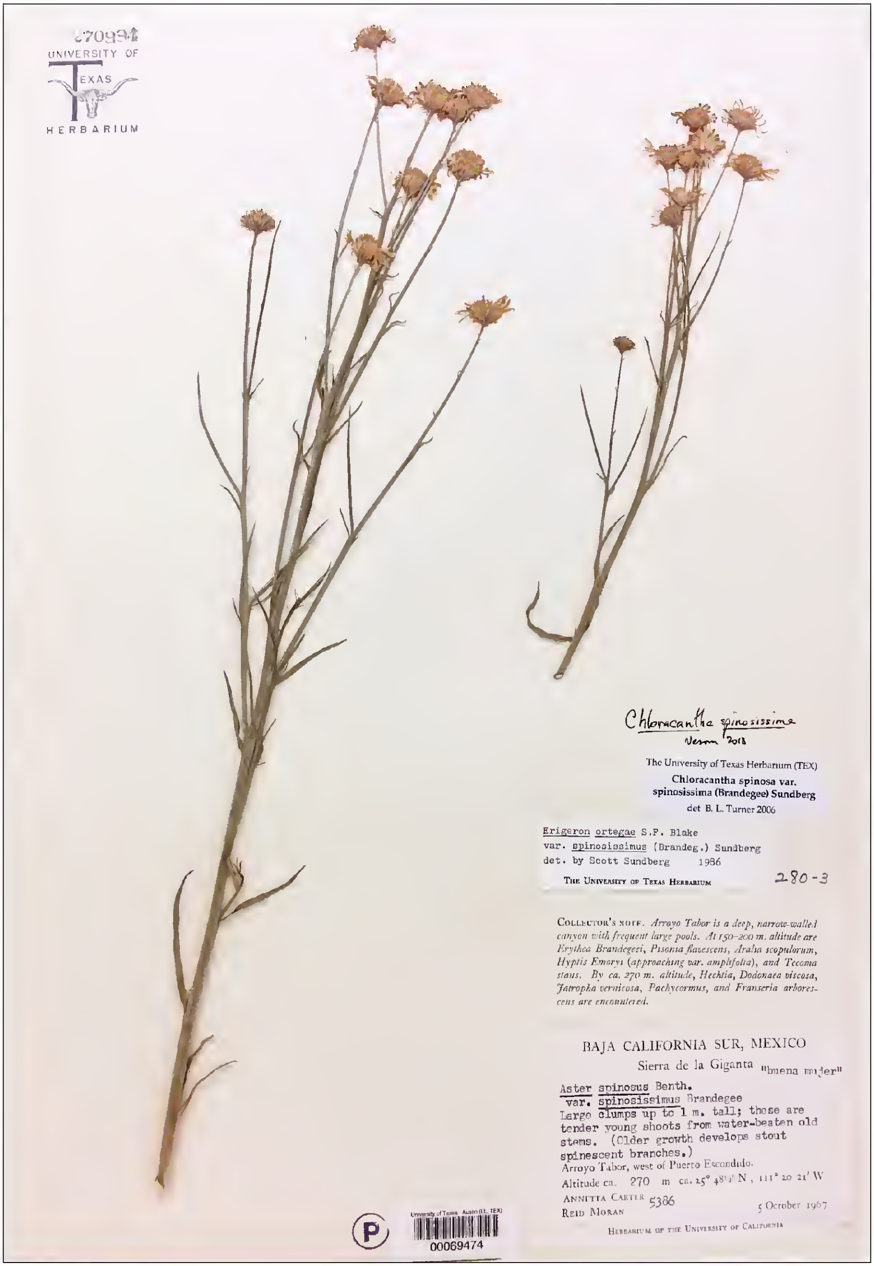
D.J. Rosen 2550
L. Brown, S. Marcus
27 June, 2003

Figure 1. *Chloracantha spinosa*, Texas -- variation in branching and spine production, I.

Figure 2. *Chloracantha spinosa*, Baja California –– variation in branching and spine production, II.

Figure 3. *Chloracantha spinosa*, Coahuila –– variation in branching and spine production, III.

Figure 4. *Chloracantha* aff. *spinosa*, Michoacan -- unusual variant, out of geographical range.



Chloracantha spinosissima
Nesom 2013

The University of Texas Herbarium (TEX)
Chloracantha spinosa var.
spinosissima (Brandegee) Sundberg
det B. L. Turner 2006

Erigeron ortegae S.F. Blake
var. spinosissimus (Brandeg.) Sundberg
det. by Scott Sundberg 1986
THE UNIVERSITY OF TEXAS HERBARIUM

280-3

COLLECTOR'S NOTE. *Arroyo Tabor is a deep, narrow-walled canyon with frequent large pools. At 150–200 m. altitude are Erythea Brandegeei, Pisonia flavescens, Aralia scopulorum, Hyptis Emoryi (approaching var. amplifolia), and Tecoma stans. By ca. 270 m. altitude, Hechtia, Dodonaea viscosa, Jatropha vernicosa, Pachycormus, and Franseria arborescens are encountered.*

BAJA CALIFORNIA SUR, MEXICO
Sierra de la Giganta "buena mujer"

Aster spinosus Benth.
var. spinosissimus Brandegee
Large clumps up to 1 m. tall; these are tender young shoots from water-beaten old stems. (Older growth develops stout spinescent branches.)
Arroyo Tabor, west of Puerto Escondido.
Altitude ca. 270 m ca. 25° 48½' N, 111° 20 21' W
ANNETTA CARTER 5386
REID MORAN 5 October 1967
HERBARIUM OF THE UNIVERSITY OF CALIFORNIA

Figure 5. *Chloracantha spinosissima,* Baja California Sur.

Figure 6. *Chloracantha spinosissima*, Baja California Sur.

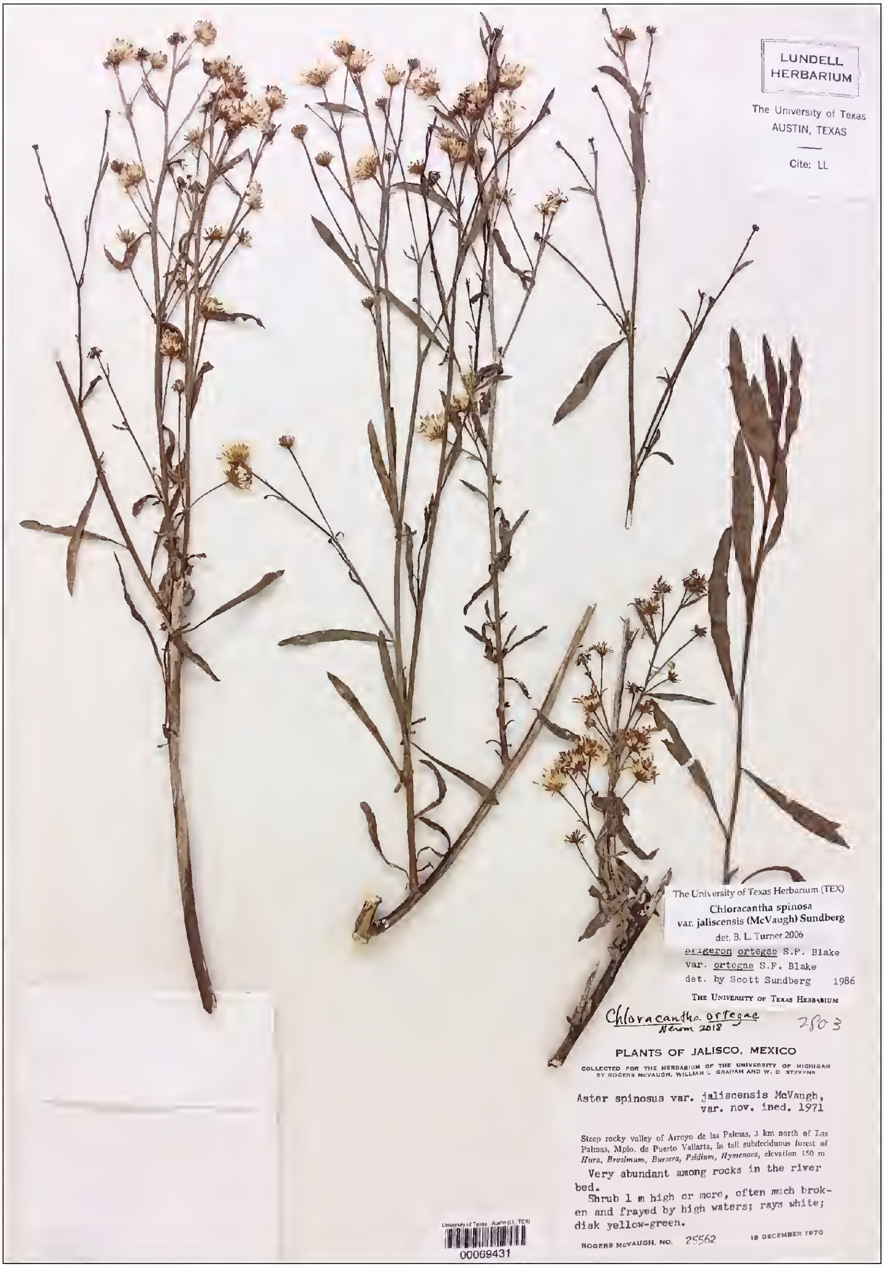


Figure 7. *Chloracantha ortegae*, Jalisco.

Chloracantha ortegae
Nesom 2018

The University of Texas Herbarium (TEX)
Chloracantha spinosa
var. jaliscensis (McVaugh) Sundberg
det. B. L. Turner 2006

FLORA OF SINALOA, MÉXICO

Chloracantha spinosa (Benth.) G.L. Nesom
var. jaliscensis (McVaugh) Sundberg

La Tuna on Río Magistral, 3 km by air north-northeast of Piedras Blancas, 12.5 km (by air) northeast of Concordia; semideciduous forest; Comunidad La Guásima; 23°22'23"N 105°58'59"W, elevation 257 m. Occasional 0.3-0.6 m shrub on rocks near water; flowers white.
T.R. Van Devender 2007-1219, A.L. Reina G., D.R. Hansen, M. Ruiz G., S. Guido, A. van der Heiden, P. Mejía, H. Plascencia
Municipio de Concordia
5 December 2007

Figure 8. *Chloracantha ortegae*, Sinaloa.

Figure 9. *Chloracantha australis*, Nicaragua.

Chloracantha australis
Nesom 2018

The University of Texas Herbarium (TEX)
Chloracantha spinosa
var. strictospinosa Sundberg
det. B. L. Turner 2006

PLANTS OF GUATEMALA
ASTERACEAE

Chloracantha spinosa var. strictospinosa Sundb.

DEPT. JUTIAPA: 9.3 km northeast of city of Jutiapa along CA1 at bridge over river (Puente Moran).

Seasonally dry thorn scrub with Acacia and strangler figs in wet areas.

1050 m; 14 20'N, 89 50'W
Uncommon in full sun on rocky banks near the river. 1.5 m tall, yellow disk flowers, white ray flowers.
30 December 1991
Alan Prather 1021a
with Jacqui Soule

UNIVERSITY OF TEXAS HERBARIUM (LL, TEX)

Figure 10. *Chloracantha australis*, Guatemala.

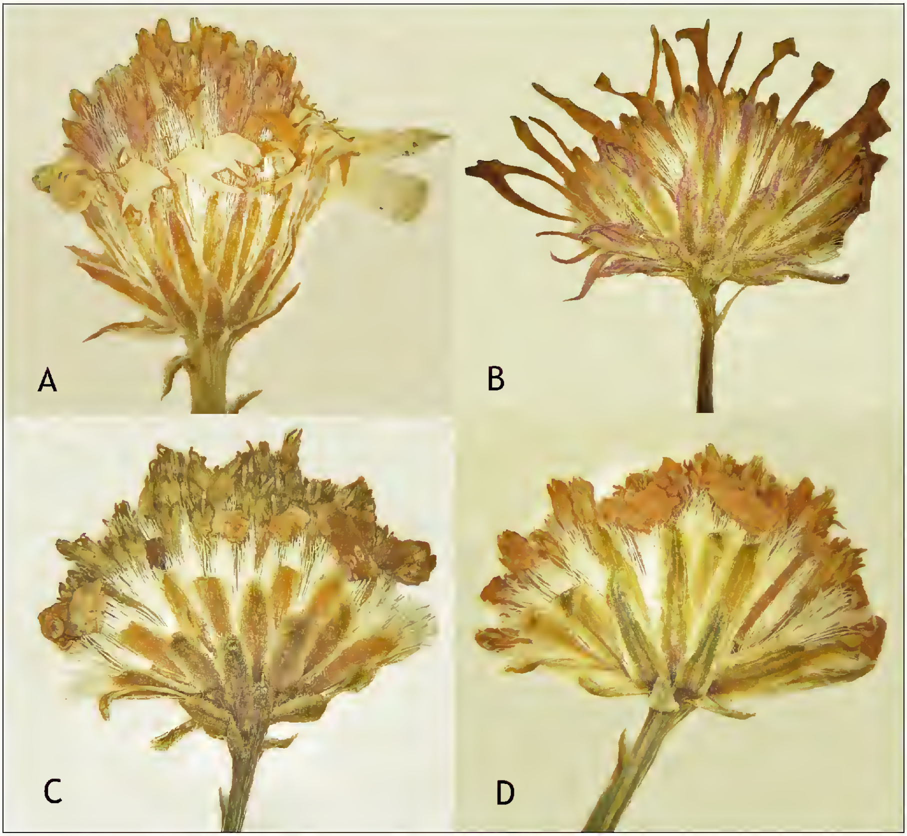


Figure 1. Characteristic involucral morphology of *Chloracantha* species. A. *Chloracantha spinosa*. B. *Chloracantha spinosissima*. C. *Chloracantha ortegae*. D. *Chloracantha australis*.

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GEUM × *CORTLANDICUM* (ROSACEAE), A NEW NATURAL HYBRID PLUS THREE *GEUM URBANUM* HYBRIDS NEW TO THE FLORA OF NEW YORK

MICHAEL HOUGH
State University of New York at Cortland
P.O. Box 2000
Cortland, New York 13045
michael.hough@cortland.edu

ABSTRACT

Geum ×cortlandicum M. Hough, **nothosp. nov.**, a newly discovered natural hybrid of *Geum canadense* and *G. laciniatum* is described from Cortland Co., New York. A photograph of the holotype is provided and differences among the hybrid and the two parents are illustrated. Additionally, *G. ×intermedium* is reported for the first time in North America along with two other *Geum urbanum* hybrids new to New York, *G. ×catlingii* and *G. ×macneillii.* The flowers of all four hybrids and the four species involved are illustrated.

Geum is a cosmopolitan genus of ca 51 species with 20 native to North America if *Waldsteinia* is included (Smedmark 2006; Rohrer 2014). Subg. *Geum* is characterized by the presence of epicalyx bractlets and a hook at the end of the persistent proximal portion of the style (Gajewski 1957). Members of subg. *Geum* have been found to possess a high ability to produce interspecific hybrids experimentally, but most potential hybrids tend to produce mostly sterile achenes and only a few have been identified in nature (Gajewski 1957). Ten species of *Geum* occur naturally in New York, 9 native and 1 introduced, in addition to 6 hybrids (Weldy et al. 2018) when those reported here are included.

The hybrid of *Geum canadense* Jacq. and *G. laciniatum* Murray has been produced experimentally (Raynor 1945; Gajewsky 1957), but this report is the first time it has been documented as occurring in nature. It was first observed by the author in 2018 along the bank of the Tioughnioga River in Homer, New York, while searching through a population of *G. laciniatum* for the hybrid *G. ×macneillii.* Ultimately three plants were found at the site and only one good specimen could be made from the material available. The site at Harford, New York, was found several weeks later and chosen as the type location because more plants were present. Another site was found in Seneca Co., NewYork, with especially robust plants that more closely resemble *G. laciniatum* but still displaying the long hairs on the receptacle and the intermediate number of achenes characteristic of the hybrid. An additional specimen collected by Reznicek et al. in northern Michigan was tentatively determined to be this hybrid in 1991 and, after examination of a photograph of the specimen, is included in the list of vouchers.

The hybrid described here shares many of the characteristics of the artificial hybrids produced by Gajewsky. Most flowers appear to be fertile with normal development of achenes; in his experiments, Gajewsky found the fertility of achenes of the F1 generation to be just over 50%. *Geum ×cortlandicum* is named for Cortland Co., New York, where several *Geum* hybrids recently have been found.

Geum ×cortlandicum M. Hough, **nothosp. nov.** [*G. canadense* × *G. laciniatum*]. **TYPE: USA. New York.** Cortland Co.: Town of Harford, Cortwright Road, James Kennedy State Forest, in ditch next to road, 42.474449°N, 76.171084°W (WGS84), ca 488 m elev, 21 Jul 2018, *M. Hough s.n.* (holotype: CORT 14515, Figure 1; isotype: BH).

Similar to *Geum laciniatum* but the receptacle with 1–2 mm long bristly hairs over the entire surface as in *G. canadense*, disarticulating near the base as in *G. laciniatum*; petals more consistently white relative to *G. laciniatum*; achenes puberulent and sparsely hirsute, sometimes with a few minute stalked glands toward the apex and on the lower portion of the persistent proximal segment of the style as in some forms of *G. canadense*, totaling 92–188 per receptacle (more than is typical for *G. canadense* but fewer than *G. laciniatum*), more easily removed from the receptacle than in *G. laciniatum*, abortive in some flowers; styles more spreading in fruit than in *G. canadense*; pedicels and stems slightly less densely hirsute than *G. laciniatum* but more so than *G. canadense*; the stipules of the lower cauline leaves of similar width as the parents but sometimes more elongate, the larger ones up to 2–3 cm long on robust plants. Figure 2.

Plants herbaceous, perennial. **Stems** 60–105 cm, erect, stout, puberulent and hirsutulous with mostly deflexed hairs. **Leaves**: basal and lower cauline leaves 17–32 cm long, the blade pinnate with 5–7 primary leaflets alternating with 2–6 minor leaflets; middle cauline leaves trifoliate, 10–16 cm wide × 10.5–17 cm long, leaflets cuneate at the base, the terminal one slightly larger than adjacent laterals; upper cauline leaves simple and 3-lobed to unlobed with sharply serrate margins, 1–7.5 cm wide × 2–11 cm long. **Stipules** of lower cauline leaves ± free, 0.6–1 cm wide × 2–3 cm long, ± incised. **Inflorescences** 8–14-flowered; pedicels puberulent and moderately hirsute; flowers erect; epicalyx bractlets 1–2 mm long; hypanthium green; sepals spreading but soon reflexed, 5–6.5 mm long; petals spreading, white, obovate to elliptic, 3–4.9 mm long, shorter than the sepals, obtuse to rounded at the apex. **Fruiting receptacles** 2.5–3.5 mm long, sessile, hirsute, disarticulating near the base. **Achenes** 3–4 mm, puberulent with a few longer hairs and minute stalked glands about the apex. **Fruiting styles** geniculate-jointed, proximal segment persistent, 3.5–5 mm long, hooked at the apex, ± stipitate-glandular in the lower third; distal segment deciduous, ca 1.5 mm long, proximally short hairy.

Additional vouchers. **USA. New York**. Cortland Co.: Town of Homer, ca 100 m S of main parking area, Durkee Park, bank of Tioughnioga River, 42.646610°N, 76.174699°W (WGS84), ca 373 m elev, 8 Jul 2018, *Hough s.n.* (CORT 14449). Seneca Co.: Town of Seneca Falls, Seneca Meadows Wetlands Preserve, ditch next to main loop trail, 42.941167°N, 76.825412°W (WGS84), 10 Jul 2018, *Hough s.n.* (CORT 14518). **Michigan**. Ontonagon Co.: NE 1/4 sect. 34, T48N R40W, ca 1.5 mi S of Ewen along E bank of S branch of the Ontonagon River, 11 Jul 1991, *Reznicek 8835* (MICH 1467106).

Geum urbanum and its hybrids in New York

Geum urbanum L. is native to Eurasia and North Africa. It has been present in North America for at least 100 years (Rohrer 2014) with numerous collections from Cambridge, Massachusetts, dating back as far as 1884 (GH), but there are otherwise few collections in herbaria from elsewhere in the Northeast prior to the 1970's. The oldest non-cultivated specimens located for New York both were collected in 1988, one in Onondaga Co. (NYS) and the other in Cortland Co. (CORT). The following are collections housed at CORT.

Vouchers. USA. New York. Cortland Co.: Town of Cortlandville, Hoxie Gorge Nature Preserve, 17 Jul 1988, *Shinherr 20* (CORT 3790); town of Cortlandville, Lehigh Trail, just E of Gracie Road, 13 Jun 2012, *Hough s.n.* (CORT 14139); town of Homer, ca 100 m N of New York State Route 90, just E of the Cortland-Cayuga county line, 42.643784N°, 76.266503°W (WGS84), ca 404 m elev, 14 Jun 2018, *Hough s.n.* (CORT 14501). Tioga Co.: Town of Richford, Michigan Hill State Forest fishing access road off of State Route 38, 42.395191°N, 76.192781°W (WGS84), 5 Jul 2018, *Hough s.n.* (CORT 14505).

This species is now widely established in disturbed forested areas in central New York and, in addition to the collections cited, has been observed by the author in the counties of Cayuga, Chemung, Delaware, Livingston, Madison, Onondaga, and Tompkins. The widespread range and long flowering period of this species (May-August) create great potential for hybridization with our native species. The following hybrids involving *Geum urbanum* as one of the parents have recently been collected in NY.

Geum* ×*intermedium Ehrh. [*G. rivale* × *G. urbanum*]

Voucher. USA. New York. Cortland Co.: Town of Homer, ca 100 m N of New York State Route 90, just E of the Cortland-Cayuga county line, 42.643784N°, 76.266503°W (WGS84), ca 404 m elev, 14 Jun 2018, *Hough s.n.* (CORT 14496). Figure 3.

Geum* ×*catlingii J.-P. Bernard & R. Gauthier [*G. canadense* × *G. urbanum*]

Vouchers. USA. New York. Cayuga Co.: City of Auburn, Army Corps of Engineers wetland mitigation, NW of County House Road, 42.976962°N, 76.546757°W, 10 Jul 2018, *Hough s.n.* (CORT 14516). Cortland Co.: Town of Cortlandville, Lehigh Trail near Cortland Marl Ponds, 42.571033°N, 76.229950°W (WGS84), ca 360 m elev, 13 Aug 2016, *Hough s.n.* (CORT 14149); town of Homer, ca 100 m S of main parking area, Durkee Park, bank of Tioughnioga River, 42.646610°N, 76.174699°W (WGS84), ca 373 m elev, 2 Jul 2018, *Hough s.n.* (CORT 14510); town of Tully, Heiberg Memorial Forest, 42.756229°N, 76.080531°W, 3 Jul 2018, *Hough s.n.* (CORT 14511). Onondaga Co.: City of Syracuse, Oakwood Cemetery, 43.033783°N, 76.133321°W (WGS84), ca 180 m elev, 1 Aug 2018, *Hough s.n.* (CORT 14554). Tioga Co.: Town of Richford, Michigan Hill State Forest fishing access road off of State Route 38, 42.395191°N, 76.192781°W (WGS84), 5 Jul 2018, *Hough s.n.* (CORT 14509). Figure 4.

Geum* ×*macneillii J.-P. Bernard & R. Gauthier [*G. laciniatum* × *G. urbanum*]

Voucher. USA. New York. Cortland Co.: Town of Homer, ca 100 m S of main parking area, Durkee Park, 42.646610N°, 76.174699°W (WGS84), ca 373 m elev, 14 Jun 2018, *Hough s.n.* (CORT 14494). Figure 5.

Geum ×*intermedium* and *G.* ×*macneillii* thus far have been found only in one location each in the town of Homer, Cortland Co., New York. The most common hybrid *Geum* in New York appears to be *G.* ×*catlingii*, which was first reported by the author in the New York Flora Association Newsletter (Hough 2017) and since has been observed in most places where the two parents occur together. While originally described as highly sterile (Bernard & Gauthier 1986), occasional plants have been found with some normally developed achenes. Flowers of all four hybrids and their parental species are shown in Figure 6.

ACKNOWLEDGEMENTS

I would like to thank Peter Fraissinet, Anna Stalter, and Kevin Nixon of the Bailey Hortorium for their assistance in reviewing *Geum* specimens and access to Raynor's thesis. I am also grateful to Tony Reznicek, Don Leopold, and Linda Curtis for their helpful feedback on the manuscript.

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NEW YORK - CORTLAND COUNTY

Rosaceae

Geum canadense Jacq. × ***G. laciniatum*** Murray

Location: Town of Harford, Cortwright Road, James Kennedy State Forest, 42.474449°N, 76.171084°W

Several plants in ditch next to road, interspersed with parents, petals white.

Michael Hough **21 July 2018**

SUNY Cortland Herbarium (CORT)

Figure 1. *Geum ×cortlandicum.* Holotype, *Hough s.n.* (CORT 14515).

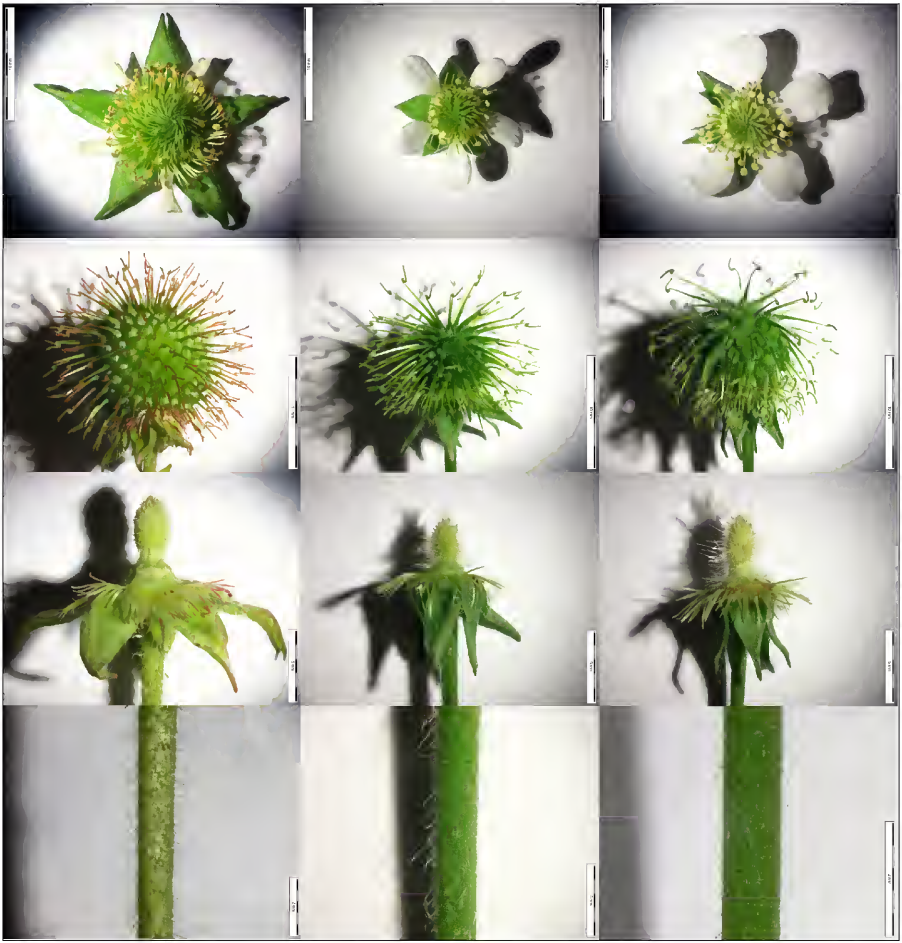
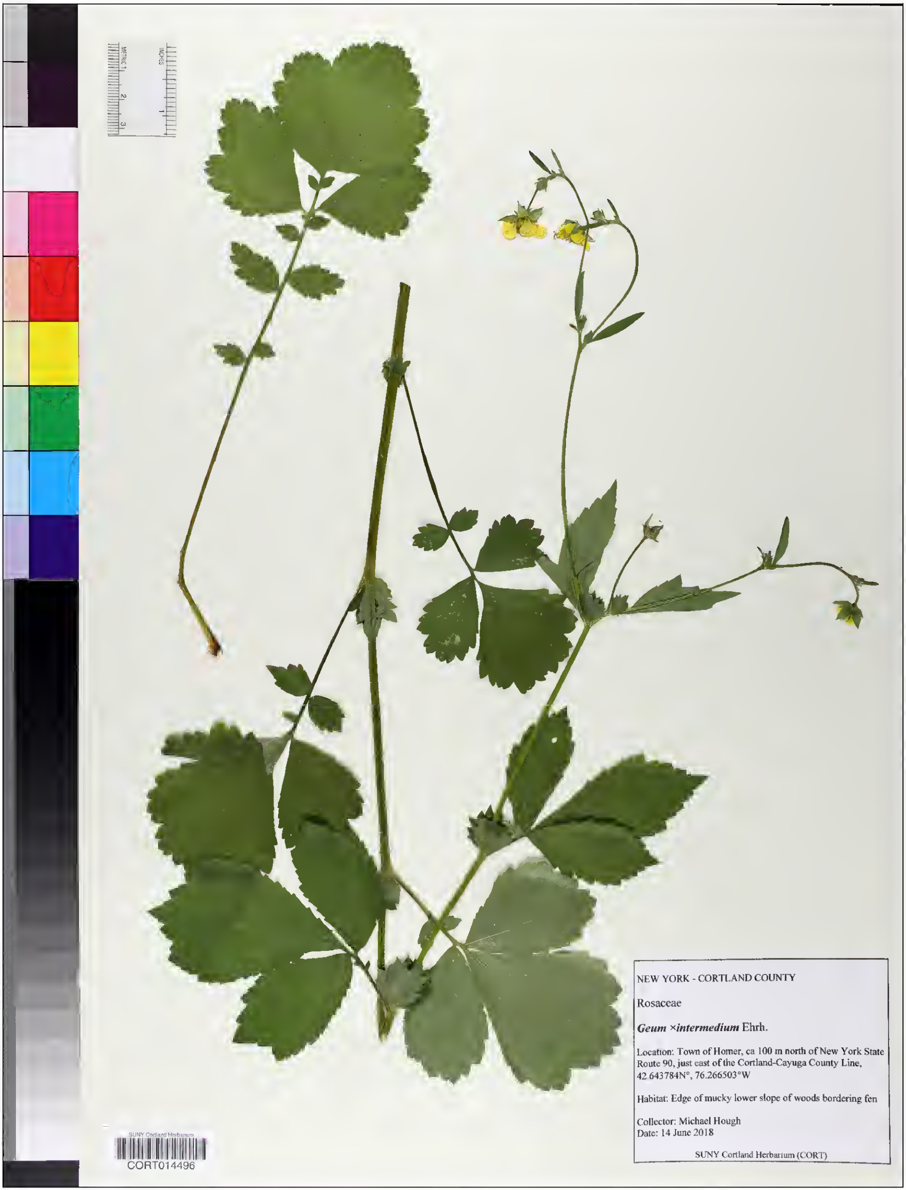


Figure 2. Comparison of floral structures of *G. laciniatum* (left column), *G. ×cortlandicum* (middle column), and *G. canadense* (right column). Top row: flower at anthesis. Second row: head of achenes. Third row: receptacle with achenes removed. Bottom row: pedicel.



NEW YORK - CORTLAND COUNTY

Rosaceae

Geum ×intermedium Ehrh.

Location: Town of Homer, ca 100 m north of New York State Route 90, just east of the Cortland-Cayuga County Line, 42.643784N°, 76.266503°W

Habitat: Edge of mucky lower slope of woods bordering fen

Collector: Michael Hough
Date: 14 June 2018

SUNY Cortland Herbarium (CORT)

Figure 3. *Geum ×intermedium*. *Hough s.n.* (CORT 014496).

NEW YORK - TIOGA COUNTY

Rosaceae

Geum ×catlingii J.-P. Bernard & R. Gauthier

Location: Town of Richford, Michigan Hill State Forest fishing access road off of State Route 38, 42.395191° N, 76.192781°W

Habitat: Edge of dirt road

Collector: Michael Hough
Date: 5 July 2018

SUNY Cortland Herbarium (CORT)

Figure 4. *Geum ×catlingii. Hough s.n.* (CORT 014509).


NEW YORK - CORTLAND COUNTY

Rosaceae

Geum ×macneillii J.-P. Bernard & R. Gauthier

Location: Town of Homer, ca 100 m south of main parking area, Durkee Park, 42.646610N°, 76.174699°W

Habitat: Bank of Tioughnioga River

Collector: Michael Hough
Date: 2 July 2018

SUNY Cortland Herbarium (CORT)

Figure 5. *Geum ×macneillii. Hough s.n.* (CORT 014494).

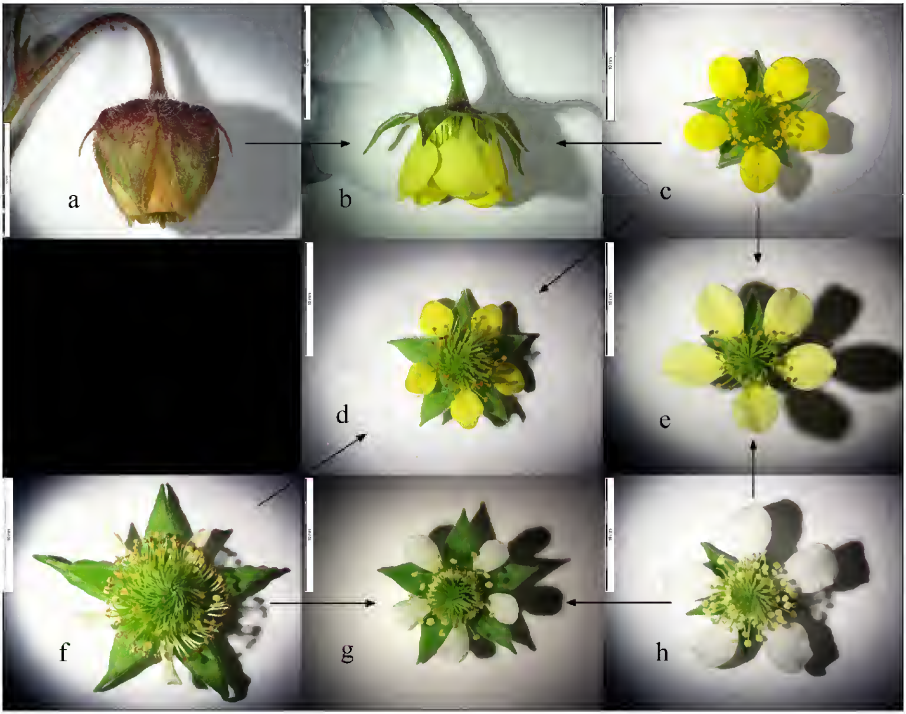


Figure 6. Comparison of flowers of four *Geum* species and their hybrids. Arrows indicate direction of gene flow: a) *Geum rivale*; b) *G.* ×*intermedium*; c) *G. urbanum*; d) *G.* ×*macneillii*; e) *G.* ×*catlingii*; f) *G. laciniatum*; g) *G.* ×*cortlandicum*; h) *G. canadense*.

Embrey, T. 2018. *Buddleja alternifolia* (Scrophulariaceae) naturalized in New Mexico. Phytoneuron 2018-60: 1–3. Published 11 September 2018. ISSN 2153 733X

BUDDLEJA ALTERNIFOLIA (SCROPHULARIACEAE) NATURALIZED IN NEW MEXICO

TEAGUE EMBREY
Tucson, Arizona 85701
teague84@hotmail.com

ABSTRACT

Buddleja alternifolia Maxim. is reported here as new to the flora of New Mexico. A large stand of naturalized plants was discovered adjacent to a dirt road in San Miguel County, near the foundations of an old mill known as El Molino. Photographs of the naturalized plants are provided.

In 2014, a naturalized population of roughly 50 plants of *Buddleja alternifolia* Maxim. (fountain butterfly-bush) was documented in San Miguel Co., New Mexico (Figs. 1 and 2). Shrubs of the species occurred along both shoulders of County Road B-52, within Alamitos Canyon. The largest plants occurred along and adjacent to the road shoulder, while smaller plants extended onto a terrace near a dry wash and up the hillside into pinyon-juniper woodland. The population is near the foundations of an old mill known as El Molino, and in general the area bears signs of past disturbance.

Voucher specimen. **New Mexico**. San Miguel Co.: County Road B-52, ca. 1.8 mi N of Highway 50, ca. 2.4 mi WNW of Pecos, roughly 50 plants of all demographics on road shoulder and extending into the pinyon-juniper woodland about 30 meters, 9 Sep 2014, *Embrey 178* (ARIZ).

Figure 1. Naturalized *Buddleja alternifolia* in San Miguel Co., New Mexico. At the time of the photos were taken (2014), plants occurred on both sides of the road, and extended in all directions.

Figure 2. Flowering branch of *Buddleja alternifolia,* San Miguel Co., New Mexico.

Photographic evidence suggests that a few *Buddleja alternifolia* shrubs were present on the road shoulder in the early 1990's and have since expanded outwards (unpublished photographs).

Buddleja alternifolia is native and endemic to China, where it grows in thickets along river banks and dry river beds (Li & Leeuwenberg 1996). The provisional publication of the genus treatment for *Buddleja* in the Flora of North America North of Mexico does not include *B. alternifolia* (Norman 2012), but in the USA it previously has been reported as naturalized in North Carolina and Pennsylvania (Kartesz 2015). This is the first report of this species in New Mexico (SEINet 2018; Allred & Ivey 2012).

Although *Buddleja alternifolia* is available commercially, how it arrived at the current location is a mystery. The New Mexico location is at the lower end (6a) of the USDA hardiness zones recommended for this plant, reported as zones 5-9 (Missouri Botanical Garden 2018; USDA 2018).

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Keil, D.J. 2018. New combinations and nomenclatural notes in the *Solanum umbelliferum* complex (Solanaceae). Phytoneuron 2018-61: 1–4. Published 11 September 2018. ISSN 2153 733X

NEW COMBINATIONS AND NOMENCLATURAL NOTES IN THE *SOLANUM UMBELLIFERUM* COMPLEX (SOLANACEAE)

DAVID J. KEIL
Professor Emeritus
Biological Sciences Department
California Polytechnic State University
San Luis Obispo, California 93407
dkeil@calpoly.edu

ABSTRACT

New combinations are made at the varietal level within *Solanum umbelliferum* Eschsch. for *S. xanti* A. Gray, four taxa previously treated as varieties of *S. xanti,* and *S. wallacei* (A. Gray) Parish and its var. *clokeyi* (Munz) McMinn: **Solanum umbelliferum** var. **clokeyi** (Munz) D.J. Keil, **comb. nov.**, **Solanum umbelliferum** var. **hoffmannii** (Munz) D.J. Keil, **comb. nov.**, **Solanum umbelliferum** var. **intermedium** (Parish) D.J. Keil, **comb. nov.**, **Solanum umbelliferum** var. **montanum** (Munz) D.J. Keil, **comb. nov.**, **Solanum umbelliferum** var. **obispoense** (Eastw.) D.J. Keil, **comb. nov.**, **Solanum umbelliferum** var. **wallacei** (A. Gray) D.J. Keil, **comb. nov.**, and **Solanum umbelliferum** var. **xanti** (A. Gray) D.J. Keil, **comb. & stat. nov.** If distinct from *S. umbelliferum* var. *glabrescens* Torr., the plants of northern California to which the name *S. parishii* A. Heller or its homotypic synonym *S. xanti* var. *glabrescens* Parish have been applied apparently lack a validly published name at varietal rank.

Treatments of *Solanum* L. (Solanaceae) in western North American floras (e.g., Jepson 1925; Wiggins 1951, 1980; McMinn 1939; Munz 1959, 1974; Hoover 1970; Nee 1993, 2012) have consistently recognized *S. umbelliferum* Eschsch. and *S. xanti* A. Gray as a pair of closely related species, very similar in floral form and differing in vegetative features, and some (Wiggins 1951; Munz 1959; Nee 1993, 2012) have recognized in addition a third species, *S. parishii* A. Heller. Additionally, floras have included the island endemic *S. wallacei* (A. Gray) Parish, a taxon originally named as a variety of *S. xanti.* Infraspecific variants have been named in *S. umbelliferum*, *S. xanti*, and *S. wallacei.* Variable features within the complex include leaf size, shape, base, and margin, growth habit strictly herbaceous to suffrutescent, and leaf and stem surfaces that vary from glabrous or subglabrous to a dense indumentum of dendritic trichomes and/or various types of simple glandless or gland-tipped trichomes. *Solanum umbelliferum* has been characterized primarily by a more or less dense indumentum of dendritic trichomes that give the herbage a gray-green cast whereas *S. xanti* ranges from glabrous to densely pubescent with glandular and/or gland-tipped trichomes and few, if any, dendritic trichomes and a generally dark green cast to the herbage. *Solanum wallacei* has been distinguished by its large leaves, flowers, and fruits. *Solanum parishii* has been characterized by its glabrous or subglabrous herbage and sessile or proximally tapered leaf blades. Variation patterns within these species are complex, and recognized infraspecific taxa intergrade.

Floras that deal with the whole of California have differed in the number of taxonomically recognized variants within this complex. Wiggins (1951) recognized *Solanum umbelliferum* as comprising two varieties: var. *incanum* Torr. and var. *umbelliferum*; *S. xanti* with six varieties: var. *glabrescens* Parish, var. *hoffmannii* Munz, var. *intermedium* Parish, var. *montanum* Munz, var. *obispoense* (Eastw.) Wiggins, and var. *xanti*; *S. wallacei* with two varieties: var. *clokeyi* (Munz) McMinn and var. *wallacei*; and *S. parishii* without varieties. Munz (1959) recognized *S. umbelliferum* with three varieties: var. *glabrescens* Torr., var. *incanum*, and var. *umbelliferum*; *S. xanti* with four: var. *hoffmannii*, var. *intermedium* (including var. *obispoense* as a synonym), var. *montanum*, and var. *xanti*; *S. wallacei* with two varieties; plus *S. parishii.* Nee (1993, 2012) treated *S. umbelliferum*, *S. xanti*, *S. wallacei*, and *S. parishii* conservatively, placing the formerly recognized varieties into synonymy while noting the complex patterns of variation and the need for additional study.

In a revision of the "Dulcameroid Clade" of *Solanum*, Knapp (2013) merged *S. umbelliferum*, *S. parishii*, and *S. xanti* as a single species and chose to not recognize any infraspecific variants. She maintained *S. wallacei* as a separate species. Elsewhere in her paper Knapp described her species concept:

> My decisions relied on clear morphological discontinuities to define the easily distinguished species. Specific characters used for recognition are detailed with each species description and in the keys. Potential reasons for variability and intergradation are recent divergence and hybridization. In this revision I have tried to emphasise similarities between populations instead of differences, which so often reflect incomplete collecting or local variation. I have not recognised subspecies or varieties, as I do not feel these are useful categories, either in a taxonomic or evolutionary sense. The variation is better described and documented, rather than formalised with a name which then encumbers the literature. I have been conservative in my approach, recognising as distinct entities those population systems (sets of specimens) that differ in several morphological characteristics. Minor differences in morphology, distribution, habitat, and ecology are important in some groups, where the common ground plan for the species is very similar.

Editors of the Jepson Manual (Baldwin et al 2012) subscribed to a different philosophy in dealing with infraspecific variation. This was summarized in the contributors guide to the Jepson Manual (Baldwin et al. 2004):

> Taxonomic concepts of equal scientific validity may differ with respect to rank (e.g., whether to recognize a particular group as a species, subspecies, or variety) or circumscription (e.g., whether to recognize one widely delimited species or to treat the same set of plants within multiple, more narrowly delimited species). Taxonomic concepts of equal validity may even differ regarding the position of a plant group (e.g., which genus a particular species belongs in), insofar as circumscriptions of higher-level taxa may differ. Such legitimate differences in taxonomic practice should not be misconstrued as a lack of rigor in systematics and do not take away from the fundamental reality of plant groups as evolutionary entities. A common feature of all taxonomic concepts recognized by The Jepson Flora Project and the modern systematic community in general is that the taxa being recognized should represent natural, evolutionary lineages. Also, because TJM2 will be used (like TJM) as a definitive resource for assessing plant diversity in California (e.g., for conservation planning by state and federal agencies), we seek to capture within it all biologically meaningful, minimal-rank taxa (e.g., species, subspecies, and varieties) recognized to occur in the California flora.

Differences between Knapp's taxonomic philosophy and the Jepson Manual approach hinge on whether patterns of infraspecific variation are evolutionarily or biologically meaningful. Knapp: "I do not feel these are useful categories, either in a taxonomic or evolutionary sense." Baldwin et al.: "we seek to capture within it all biologically meaningful, minimal-rank taxa (e.g., species, subspecies, and varieties) recognized to occur in the California flora."

In preparation of the second edition of the Vascular Plants of San Luis Obispo County, California (Keil & Hoover in prep.), I am faced with how to deal with the variation in this group of nightshades. I agree with Dr. Knapp that they are best treated as a single variable species. However, members of this complex with differing morphologies occupy different habitats within the San Luis Obispo County and California as a whole. Plants with the traditional concept of *Solanum umbelliferum* (sensu stricto) are largely allopatric from those with *S. xanti* form. Both show considerable variation. In his San Luis Obispo County flora Hoover (1970) recognized two varieties of *S. umbelliferum* and three of *S. xanti* while recognizing that "the [latter] species is highly variable, and varieties can be distinguished only rather arbitrarily." However, he noted that "in view of the apparent close relationship between *S. umbelliferum* var. *incanum* and *S. xanti* var. *obispoense*, the absence of hybrids is notable." In my opinion merging all the variants under a single species name without recognition of infraspecific variants masks important patterns of ecogeographical variation, at least some of which may be evolutionarily important. Focused research that is far beyond the scope of my floristic studies is needed to shed light on these patterns. The *S. umbelliferum* complex is much in need of a detailed investigation using modern tools. In the meantime, California taxonomists need the nomenclatural flexibility to deal with the range of variation among these plants.

Names already exist at the varietal level for variants recognized in the past in *Solanum umbelliferum* (sensu stricto). However, *S. xanti* and most of the variants that were taxonomically recognized by Abrams (1951) and Munz (1959) in *S. xanti* have no names at the varietal level within *S. umbelliferum* (sensu lato). I am here making the new combinations needed to treat five of these taxa as varieties of *S. umbelliferum*, thereby making these combinations available to taxonomists who wish to recognize infraspecific taxa in the *S. umbelliferum* complex. Following discussions with Dr. Knapp I am also treating *S. wallacei* and *S. wallacei* var. *clokeyi* as varieties of *S. umbelliferum*.

SOLANUM UMBELLIFERUM Eschsch. var. **CLOKEYI** (Munz) D.J. Keil, **comb. nov.** *Solanum arborescens* Clokey, Bull. S. Calif. Acad. Sci. 30: 60. 1931, non Moench, 1794. *Solanum clokeyi* Munz Bull. S. Calif. Acad. Sci. 31: 69. 1932. *Solanum wallacei* (A. Gray) Parish var. *clokeyi* (Munz) McMinn, Man. Calif. Shrubs 491. 1939. **LECTOTYPE** (Knapp 2013): **USA.** Santa Barbara Co.: Santa Cruz Island, Pelican Bay, 23 May 1930, *I.W. Clokey 5047* (UC, image!).

SOLANUM UMBELLIFERUM Eschsch. var. **HOFFMANNII** (Munz) D.J. Keil, **comb. nov.** *Solanum xanti* A. Gray var. *hoffmannii* Munz, Bull. S. Calif. Acad. Sci. 31: 70. 1932. **TYPE**: **USA. California.** Santa Barbara Co.: Gaviota Pass, 26 Mar 1925, *P. Munz 9315* (holotype: POM-98450 [image requested]).

SOLANUM UMBELLIFERUM Eschsch. var. **INTERMEDIUM** (Parish) D.J. Keil, **comb. nov.** *Solanum xanti* A. Gray var. *intermedium* Parish, Proc. Calif. Acad. Sci. ser. 3, Bot. 2: 168. 1901. **LECTOTYPE** (Knapp 2013): **USA. California.** San Bernardino Co.: Vicinity of San Bernardino, 12 May 1897, *S.B. Parish 4388* (JEPS-12142 [image requested]).

SOLANUM UMBELLIFERUM Eschsch. var. **MONTANUM** (Munz) D.J. Keil, **comb. nov.** *Solanum xanti* A. Gray var. *montanum* Munz, Bull. S. Calif. Acad. Sci. 31: 70. 1932. **TYPE**: **USA. California.** San Bernardino Co.: North end of Bear Valley, San Bernardino Mountains, 6000–8500 ft., 26 Mar 1925, *P. Munz 5718* (holotype: POM-13481 [image requested]).

SOLANUM UMBELLIFERUM Eschsch. var. **OBISPOENSE** (Eastw.) D.J. Keil, **comb. nov.** *Solanum obispoense* Eastw., Leafl. West. Bot. 1: 104. 1934. *Solanum xanti* A. Gray var. *obispoense* (Eastw.) Wiggins in L. Abrams, Illustr. Fl. Pacific States 3: 680. 1951. **LECTOTYPE** (Knapp 2013): **USA. California.** San Luis Obispo Co.: Santa Margarita, El Dorado School, 20 Apr 1933, *M.E. Wall s.n.* (CAS-204657, image!).

SOLANUM UMBELLIFERUM Eschsch. var. **WALLACEI** (A. Gray) D.J. Keil, **comb. & stat. nov.** *Solanum xanti* A. Gray var. *wallacei* A. Gray, Proc. Amer. Acad. Arts 11: 91. 1876. *Solanum wallacei* (A. Gray) Parish, Proc. Calif. Acad. Sci. ser. 3, Bot. 2: 166. 1901. **TYPE**: **USA. California.** Los Angeles Co.: Santa Catalina Island, undated, *W.A. Wallace s.n.* (holotype: GH [GH00077433, image!]).

SOLANUM UMBELLIFERUM Eschsch. var. **XANTI** (A. Gray) D.J. Keil, comb. & stat. nov. *Solanum xanti* A. Gray, Proc. Amer. Acad. Arts 11: 90. 1876. **LECTOTYPE** (Parish 1901): **USA. California.** Kern Co.: Fort Tejon and vicinity, near lat. 35°and long. 119°, 1857–1858, *L.J. Xantus de Vesey 73* (GH-00077430 [image requested]).

The sixth variety of *Solanum xanti* recognized by Wiggins, *S. xanti* var. *glabrescens* Parish, cannot be directly transferred to *S. umbelliferum* because the combination *S. umbelliferum* var. *glabrescens* Torr. already exists. Heller (1906) raised *S. xanti* var. *glabrescens* Parish to the species rank as *S. parishii* A. Heller. However, it is doubtful that the types of the two glabrescent varieties actually represent different entities; they strongly resemble each other and both were collected from the San Bernardino area in San Bernardino County, California. Heller (1906) considered it likely that the plants to which he applied the name *S. parishii* were the same as *S. umbelliferum* var. *glabrescens* Torr. If this is so, the heterotypic combination *S. umbelliferum* var. *glabrescens* Torr. is already available for use for the plants treated as *S. xanti* var. *glabrescens* Parish. Nee (1993, 2012) recognized *S. parishii* as a widely distributed species ranging from southern Oregon to northern Baja California. However, Wiggins (1951) and Munz (1959) considered the northern California plants to which they applied the name *S. parishii* to be a species separate from *S. umbelliferum* and *S. xanti.* I agree with Knapp (2013) that Heller (1906) proposed *S. parishii* as a replacement name for Parish's *S. xanti* var. *glabrescens*, and did not describe it as a new taxon. It is quite possible that the northern California plants do represent a separately derived lineage of glabrescent plants that might warrant taxonomic recognition at the varietal level, but this lineage, *S. parishii* (sensu Wiggins and Munz), lacks a validly published varietal epithet. However, I am not proposing a varietal name within *S. umbelliferum* for these plants.

ACKNOWLEDGEMENTS

I thank Bruce Baldwin for reviewing the manuscript and Sandra Knapp for discussions of the taxonomy of the *Solanum umbelliferum* complex.

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ENTEROPOGONOPSIS (POACEAE: CYNODONTEAE), A NEW GENUS FOR *TETRAPOGON CHLORIDEUS* AND *T. BRANDEGEEI*

JOSEPH K. WIPFF
3512 25th Court SE
Albany, Oregon 97322
jkwipff@gmail.com

ROBERT B. SHAW
Department of Ecosystem Science and Management
Texas A&M University
College Station, Texas 77842
rbshaw10@gmail.com

ABSTRACT

Enteropogonopsis Wipff & Shaw, **gen. nov.**, is established to comprise two species: **Enteropogonopsis chloridea** (J. Presl) Wipff & Shaw, **comb. nov.**, and **Enteropogonopsis brandegeei** (Vasey) Wipff & Shaw, **comb. nov.** The new genus is segregated from the Eastern Hemisphere species of *Enteropogon* based primarily on molecular evidence and forms a clade adjacent to *Tetrapogon.* It is separated from *Tetrapogon* based on molecular and morphological evidence.

As part of ongoing work on the *Guide to Texas Grasses* (Shaw & Wipff, in prep.) and on the grasses of Texas in general, it is necessary to discuss aspects of the taxonomy that we are adopting –– changes in rank, generic transfers to allow for the use of generic concepts, new or old, reinstatement of genera and species previously lost to synonymy, and clarification of characters used to delineate difficult genera or species complexes.

Peterson & al. (2015), studying the molecular phylogeny and classification of the Eleusininae, reported strong support for a monophyletic *Enteropogon* in a circumscription which included eight species from the Eastern Hemisphere (Africa, Australia, South Pacific, Japan, and South Asia). However, the two Western Hemisphere taxa of *Enteropogon* (*E. chlorideus* and *E. brandegeei*) were found to be sister to *Tetrapogon* as a moderately supported clade. These two species together have at one time been placed in seven other genera (*Chloris*, *Dinebra*, *Diplachne*, *Eutriana*, *Gouinia*, *Gymnopogon*, *Leptochloa*). Peterson & al. (2015) chose to treat these two species in *Tetrapogon* but also proposed an alternative taxonomy, supported by their data, that these two taxa, *E. brandegeei* and *E. chlorideus*, could also be placed into a new genus. We prefer their alternative classification proposal of placing two taxa into a new genus, which then brings the molecular and morphological data into congruence. Though molecular data align the taxa in a clade sister to *Tetrapogon,* the morphological data do not support their placement in *Tetrapogon.* See Table 1.

Fertile floret compression in an important character in separating genera in the Cynodonteae subtribe Eleusininae (Lazarides 1972; Anderson 1974; Clayton 1982; Simon 1984; Clayton & Renvoize 1986; Jacobs & Highet 1988). The compression of the fertile lemma separates the *Tetrapogon* (laterally compressed) clade from the adjacent *Enteropogon chlorideus* and *E. brandegeei* clade (dorsally compressed). The inflorescence type, lower lemma margins, and basal sheaths can be used to separate *E. chlorideus* and *E. brandegeei,* from the Eastern Hemisphere *Enteropogon,* thus reconciling the molecular results of Peterson & al. (2015).

Table 1. Comparison of the characters used to separate the genera *Enteropogon, Tetrapogon,* and *Enteropogonopsis.*

TAXON	Fertile Floret Compres-sion	No. Fertile Florets	No. Sterile florets, apices, awns	Glumes	Inflorescence branches - arrangement	Lower lemma margin	Basal Sheaths	Source
Tetrapogon	Lateral	2–5	(1–)2–4 (–6) Clavate, awned or awnless	Large, broad Equal or Subequal	Single to multiple branches; digitate	Glabrous, Sparsely ciliate, Densely pubescent	Usually overlapping	1, 3, 4, 5
Enteropogon	Dorsal	1	1(–2) Acute, Awned (Awnless)	Subulate to Lanceolate Markedly unequal	Single to multiple branches; digitate, subdigitate	Scabrous	Usually not markedly overlapping	1, 2, 3, 4, 5
Enteropogonopsis *E. chlorideus* *E. brandegeei*	Dorsal	1	1 Acute, Awned	Narrowly lanceolate Markedly unequal	Branches arranged in a series of distant verticils or sub-verticils along a long panicle axis	Ciliate	Overlapping	1

1 Anderson (1974)
2 Jacobs and Highet (1988)
3 Clayton and Renvoize (1986)
4 Clayton & al. (1974)
5 Clayton (1982)

ENTEROPOGONOPSIS Wipff & Shaw, **gen. nov.**

Type species, *Enteropogonopsis chloridea* (J. Presl) Wipff & Shaw

Differing from *Tetrapogon* in its dorsally compressed spikelets, with a single fertile and sterile floret per spikelet. Differing from *Enteropogon* in its panicles of 3–20 racemose branches arranged in a series of distant, well separated, verticils or subverticils, with most nodes having multiple branches, or occasionally with a single branch per node, in its panicle axis of 6-11 cm, in its lower lemmas with ciliate margins, and in its lower overlapping sheaths that are usually keeled.

Plants perennial, cespitose; with or without long, branched scaly rhizomes terminating in a cleistogamous spikelet. Sheaths overlapping at the base, keeled, glabrous or pubescent; ligules variable, a ciliate membrane to a prominent tuft of hairs; blades flat or folded, glabrous, scabrous or pilose. Panicles with (3–)5–20 racemose branches, branches arranged in a series of distant, well separated, verticils or sub-verticils, with most nodes having multiple branches, or occasionally with a single branch per node; panicle axis 6–11 cm long; branches (5–)6–18 cm long, ascending, spreading, reflexed; naked below, with 3–4 spikelets per cm, spikelets appressed. Spikelets dorsally compressed, with 1 bisexual and 1 sterile floret. Glumes markedly unequal. Lower lemmas dorsally compressed, glabrous, scabrous, or hirsute; margins hirsute to sparsely strigose above, apices acute to acuminate, often bidentate, awned; callus bearded. Sterile florets variable, narrowly cylindrical to ellipsoid or flattened, awned. Caryopses flattened, dorsally compressed. $2n = 40, 80$.

Distribution and habitat. The two species are distributed in the southwestern USA through Mexico to Honduras. *Enteropogonopsis chloridea* is found in grasslands, brushy areas, and old fields. *Enteropogonopsis brandegeei* in endemic to Baja California, where it grows on rocky slopes and in arroyos.

Enteropogonopsis chloridea (J. Presl) Wipff & Shaw, **comb. nov.** *Dinebra chloridea* J. Presl in C. Presl, Reliq. Haenk. 1(4–5): 291. 1830. *Eutriana chloridea* (J. Presl) Kunth, Enum. Pl. 1: 280. 1833. *Chloris chloridea* (J. Presl) Hitchc., Proc. Biol. Soc. Wash. 41: 162. 1928. *Enteropogon chlorideus* (J. Presl) Clayton, Kew Bull. 37: 419. 1982. *Tetrapogon chlorideus* (J. Presl) P.M. Peterson, Taxon 64: 460. 2015. **TYPE**: **MEXICO**. *T. Haenke s.n.* (holotype: PR; isotypes: MO, US-image!).

Enteropogonopsis brandegeei (Vasey) Wipff & Shaw, **comb. nov.** *Diplachne brandegeei* [as "brandegei"] Vasey, Proc. Calif. Acad. Sci., ser. 2: 213. 1889. *Gouinia brandegeei* (Vasey) Hitchc., Bull. Bur. Pl. Industr. U.S.D.A. 33: 21. 1903. *Leptochloa brandegeei* (Vasey) Hitchc., Bull. Bur. Pl. Industr. U.S.D.A. 33: 21. 1903. *Chloris brandegeei* (Vasey) Swallen, Amer. J. Bot. 22: 41. 1935. *Enteropogon brandegeei* (Vasey) Clayton, Kew Bull. 37: 419. 1982. *Tetrapogon brandegeei* (Vasey) P.M. Peterson, Taxon 64: 460. 2015. LECTOTYPE (Hitchcock, Contr. U.S. Natl. Herb. 17: 352. 1913): **MEXICO**. **Baja California Sur**. Magdalena Island, 18 Jan 1889, *T.S. Brandegee 11* (US-image!).

"Originally named by Vasey to honor Townshend Stith Brandegee (1843–1925) and ... therefore to be spelled "brandegeei" as per Art. 60.12 and Rec. 60C.1(a)" (Peterson & al. 2015).

ACKNOWLEDGEMENTS

We are grateful for the reviews of the manuscript by Kanchi Gandhi (nomenclature), Guy Nesom, and David Rosen, which significantly improved it.

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CIRSIUM WRIGHTII (ASTERACEAE) IN THE TEXAS FLORA

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, Texas 76109
guynesom@sbcglobal.net

ABSTRACT

Cirsium wrightii A. Gray has not been included in previous accounts of the Texas flora. Its rare occurrence in the state is documented here by a collection from Pecos County in 1849 and from Presidio County in 2003. The range of the species is primarily in New Mexico, where it also is considered rare. A two-step lectotypification of *C. wrightii* is completed here.

Charles Wright encountered *Cirsium wrightii* in Reeves County, Texas, in 1849 on a trip from the town of Pecos toward the Davis Mountains. More than 150 years later (in 2003), Jackie Poole and colleagues from the Texas Parks & Wildlife Department found it in Presidio County. These are the only known collections from Texas.

Vouchers. Presidio Co.: Chinati Mountains, Arroyo Chupadero, 30.09784° N, 104.6384° W, sandy soils over seeping sandstone, with *Cleome multicaulis*, *Anemopsis californica*, *Sorghastrum nutans*, and *Fimbristylis*, rare perennial to 2 meters, florets white, 23 Sep 2003, *Poole 4861* et al. (TEX + 2 dups). Reeves Co.: About 30 miles beyond Pecos [toward the southwest], 18 Aug 1849, *Wright* 406 [field #852] (GH-2 sheets digital images, US-2 sheets digital images!).

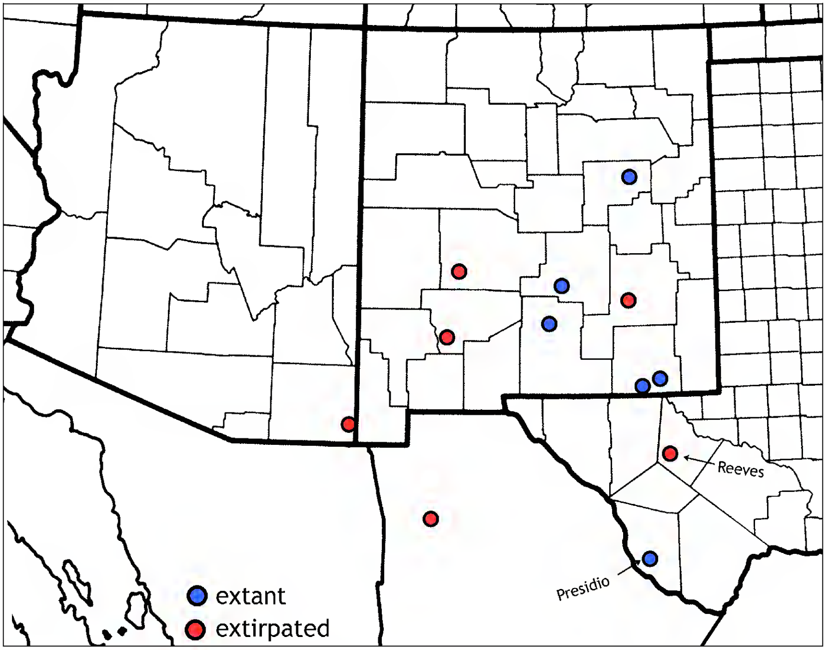

Figure 1. Distribution of *Cirsium wrightii.* No collection has been made from Reeves County since Wright's in 1849; information on the other extirpations from NMRPTC (2011).

Cirsium wrightii as a species has not been included in accounts of the Texas flora (e.g., Hatch et al. 1990; Johnston 1990; Jones et al. 1997; Turner et al. 2003). Correll and Johnston (1970) noted that the type collection of *C. wrightii* perhaps represented a hybrid between *C. texanum* and *C. undulatum*. The species surely would have been included in the account of rare Texas species (Poole et al. 2007) had the present author been more conscientious with specimens given to him at TEX for identification (including *Poole 4861*). Wooton and Standley (1915), Petrak (1917), Blake (1951), and Keil (2006) noted that the range of *C. wrightii* includes Texas.

Most of the occurrences of *Cirsium wrightii* are in New Mexico and the species has long been considered a member of that state's flora (Wooton & Standley 1915; Martin & Hutchins 1980; Allred & Ivey 2012). The characteristic habitat of desert springs and seeps and marshy edges of streams and ponds is uncommon and vulnerable to disruption, thus the species is widely scattered, rare, and extirpated in many of the known localities (NMRPTC 2011; summarized in Fig. 1). As noted by Sivinski (2016), "Ciénega wetlands are among the most endangered habitats in NM. All Wright's marsh thistle habitats are threatened by aquifer depletion, but some are also threatened with urbanization, agriculture and livestock grazing."

Cirsium wrightii lectotypified

In the protologue, Gray cited two collections. The first is an 1849 collection from Texas that he had earlier identified (Gray 1852) as *C. altissimum* "var. lanugine deciduo" -- *Wright 406* (# 852 in Wright's field notes). The second is a collection by Wright from southeastern Arizona made in 1851 -- *Wright 1290*. Gerald Ownbey in 1961 annotated *Wright 406* (GH 6004, Fig. 2) as the holotype, but later annotations as a syntype (see Fig. 2) by Walter Kittredge reflect the ambiguity in the protologue (Gray 1853). Gray (1874) also later alluded to the two collections by Wright.

In 1951, however, Blake cited documentation for *Cirsium wrightii* in Arizona as "*Wright 1290*, the type collection," effectively, though inadvertently, establishing it as the lectotype. The second step in completing the lectotypification (Turland et al. 2018, Art. 9.17) follows here.

CIRSIUM WRIGHTII A. Gray, Smithsonian Contr. Knowl. 5(6) [Pl. Wright., Part 2]: 101. 1853. *Cnicus wrightii* (A. Gray) A. Gray, Proc. Amer. Acad. Arts 10: 41. 1874. *Carduus wrightii* (A. Gray) Heller, Cat. N. Amer. Pl., 8. 1898. **LECTOTYPE** (process completed here, following Blake 1951): **USA**. **Arizona**. [Cochise Co., see Wooton 1906]: Near San Bernardino, on the borders of New Mexico and Sonora, around springs, [3 Oct 1851], *C. Wright 1290* (GH 00006001 digital image!; isolectotypes: GH 00006001 digital image, K 000778258 and 000778259 digital images!, NY 00167537 digital image!).

On the sheet selected here (GH 6001), the heads are badly insect-damaged but the diagnostic involucral morphology is clear enough and the whole distribution (5 duplicates) provides complete and ample material. GH 6001 also is the only one of the duplicates with Gray's annotation as "n. sp."

Figure 2. *Cirsium wrightii* ––*Charles Wright 406* (GH 6004) from Reeves Co., Texas.

Figure 3. *Cirsium wrightii* involucral morphology. Top: from *Wright 406*, GH 6004. Bottom: from K 000778258.

Figure 4. *Cirsium wrightii* involucral morphology, *Poole 4861* from Presidio Co., Texas.

ACKNOWLEDGEMENTS

Many thanks to the staff at TEX-LL for their help, to Jackie Poole and Anna Strong (TPWD) for patiently urging me to get this done, and to Dave Keil for advice regarding the choice of lectotype.

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Phytoneuron 2018-64: 1–8. Published 11 September 2018. ISSN 2153 733X

FIRST REPORT OF *STELLARIA PALLIDA* (CARYOPHYLLACEAE) FOR NEW YORK STATE

DANIEL ATHA
Center for Conservation Strategy
New York Botanical Garden
Bronx, New York 10458
datha@nybg.org

D. P. WIJESINGHE
Department of Natural Sciences
LaGuardia Community College
31-10 Thomson Avenue
Long Island City, New York 11101
pwijesinghe@lagcc.cuny.edu

VALERIO LAZZERI
Museo di Storia Naturale del Mediterraneo
Via Roma 234, 57127 Livorno, Italy
valerio.lazzeri@gmail.com

ABSTRACT

Stellaria pallida is reported for New York State for the first time and is documented with herbarium specimens, DNA samples, and photographs. The species was first identified in 2017 in a photograph taken in Kings County (Brooklyn) in 2007 and uploaded to the citizen science website iNaturalist. *Stellaria pallida* may be confused with *S. media* -- differences between the two species are discussed.

Stellaria pallida (Dumort.) Crépin is a European species which has spread as a weed to the Americas, Asia and Australia (Miller and West 2012). It is reported for North America only sporadically across the continent (USDA, NRCS 2018). It is not reported for New York State in the USDA PLANTS database (USDA, NCRS 2018) nor by Mitchell (1993) in the Caryophyllaceae of New York State or Morton (2005) in the Flora of North America. The species is not included in the recent checklist of New York State plants by David Werier (2017) and was not reported for the Flora of the New York Botanical Garden (Atha et al. 2016). It is not reported for the New England states (Haines et al. 2011). The species is reported for the flora of Pennsylvania (Rhoads & Block 2007) and as a watch species for the flora of Tennessee (Chester et al. 2015).

The validity of *Stellaria pallida* as a species distinct from the morphologically similar *S. media* (L.) Vill. is accepted throughout Europe (e.g., Chater & Heywood 1993; Morton 2005; Stace 2010), Australia (Miller & West 2012), and east-central Asia, the center of diversity for the genus (Mahdavi et al. 2012). Based on published descriptions and observations made by the third author on plants in Europe, *S. pallida* is usually distinguished by the smaller sepals, absence of petals, fewer stamens, and smaller, light brown seeds (see key below). In contrast to *S. media*, *S. pallida* is often characterized by a pale yellowish green color and the generally smaller size of its leaves. Rare examples of *S. pallida* with extremely reduced petals has been reported (Morton 2005). The reduction or absence of petals has been reported rarely also in *S. media* (Chater & Heywood 1993). Cleistogamy was considered diagnostic for *S. pallida* by Whitehead and Sinha (1967), but the character has been reported, if rarely, also in *S. media* (Allen 1988). Pedicel length for *S. pallida* is reported to vary from short and congested (Allen 1998) to wide spreading and up to four times the length of the sepals (Romo 1990).

In January 2017 the third author (VL) identified *Stellaria pallida* in a photograph taken by the second author (DPW) in Kings County (Brooklyn), New York, on 21 April 2007 and uploaded to the iNaturalist website (https://www.inaturalist.org) on 31 December 2016. Additional observations by the second author in 2017 and 2018, supported by photographs and descriptions, mainly in Kings County (Brooklyn), indicated that *S. pallida* was very common in urban habitats such as lawns and grassy areas beside streets where *S. media* often occurs. These observations were reported on iNaturalist and, where possible, confirmed or identified as *S. pallida* by the third author.

Based on photographs and descriptions provided by DPW and VL, the first author sought and found a large population of *Stellaria pallida* in the Bronx, New York, from which herbarium specimens and DNA samples were prepared in early May 2018. Subsequently, all 89 specimens filed as *S. media* from New York state at the New York Botanical Garden (NY) and the Brooklyn Botanic Garden herbaria (BKL, currently at NY) were examined. No New York state specimens were found that were previously identified as *S. pallida*. The herbarium search yielded 8 specimens from New York state consistent with the characters described for *S. pallida*. The first New York state specimen was collected in 1990 at West Point Military Reservation, Orange Co., New York. No specimens of *S. neglecta* were found from New York state. The European *S. holostea* L. was collected once in Brooklyn, New York (Kings County) in 1872 (*Merriam s.n.*, BKL). The species is probably a historical waif in New York state.

In New York City, plants of *Stellaria pallida* are prostrate or decumbent annuals (Fig. 1, 2) and usually occur in lawns, roadsides, sidewalk cracks, tree pits, and similar, highly disturbed, eutrophic and sunny sites. It is sometimes found growing with *S. media*.

Voucher specimens. USA. New York. Bronx Co.: New York City, grounds of the New York Botanical Garden, W of the Bronx River and N of Stone Mill road, SW of the Museum/Library building, 40.867072, -73.87977 (WGS84, ±10m), ca 15 m elev., 4 May 2018, *Atha 16000* (MICH, NY); NW corner of Garden, ca 267 m W (by air) of the Bronx River and 113 m S (by air) of Kazimiroff Blvd., on bridge between Twin Lakes, 40.867854, -73.876288 (WGS84, ±5 m), 5 Apr 2009, *Atha 6923* (NY). Kings Co.: East 16th St, N of Ave I to LIRR cut, 30 ft elev., 28 Mar 2011, *Bennett 11006* (BKL); Gateway National Recreation Area, Floyd Bennett Field, near Hanger B, 14 May 1992, *Clemants & Wallick 4588* (BKL). Orange Co.: West Point Military Reservation, cliffs between N. & S. Dock, 24 Apr 1990, *Clemants & Barringer 3358* (BKL). New York Co.: Manhattan, Central Park, the Mount, between 103rd and 104th Streets and between 5th and 6th Avenues, 40.793469, -73.954082 (WGS84, ±25m), ca 24 m elev., 27 Apr 2015, *Atha & Seirup 14999* (NY); Central Park, N perimeter wall, between 109th and 110th Streets and between 7th and 8th Avenues, 40.799838, -73.956650 (WGS84, ±25m), ca 13 m elev, 3 May 2014, *Atha & Alvarez 14365* (NY). Queens Co.: Alley Pond Park, 17 Apr 2008, *Greller 080417-24* (BKL).

Key to *Stellaria* species of New York City

1. Plants annual from slender taproots; leaves ovate or elliptic, at least the lowermost petiolate; hairs on stem internodes usually forming a distinct line; seeds distinctly tuberculate.
  2. Sepals 3–4 mm long; petals usually absent, rarely to 0.5 mm long; stamens 1–3; seeds usually tan, 0.6–0.8 mm diam . ... **Stellaria pallida**
  2. Sepals 4–5 mm long; petals present, usually 2–3 mm long; stamens 3–5; seeds usually brown, 0.8–1.5 mm diam .... **Stellaria media**
1. Plants perennial from rhizomes; leaves linear or lanceolate, all sessile; hairs on stem internodes usually not forming a line; seeds rugose or indistinctly tuberculate.
  3. Flowers in axillary cymes .... **Stellaria alsine**
  3. Flowers in terminal cymes.
    4. Leaves widest below the middle; sepals linear-lanceolate, ≥ 3x as long as wide; petals shorter than the sepals . ... **Stellaria graminea**
    4. Leaves widest above the middle; sepals ovate-lanceolate, ≤ 3x as long as wide; petals about as long as the sepals .... **Stellaria longifolia**

In their study of seed morphology, Mahdavi et al (2012) found that mode for seed size and color were distinct (dark brown and 1.16 × 1.06 mm; brown and 0.81 × 0.73 mm for *Stellaria media* and *Stellaria pallida*, respectively). Although we did not find seed color to be consistent, seed size of New York City plants are consistent with data reported by Mahdavi (Fig. 5). The strongest characters for identification of *S. pallida* are the absent or rudimentary petals and the small seeds. On the basis of sterile characters alone, it is possible that stressed or senescent specimens of *S. media* may be misidentified as *S. pallida* and, conversely, specimens of *S. pallida* growing in ideal conditions with abundant nutrients, sunlight and moisture may appear larger than normal and show a bright green color similar to *S. media.* Based on the observation made in New York City, *S. pallida* tend to occur in brightly lit, drier sites than *S. media.*

Figure 1. *Stellaria pallida* in a lawn, the habitat where it most often occurs in New York City. Note the distinctive yellow-green color (*Atha 1600*, NY).

Figure 2. *Stellaria pallida*, whole plant showing prostrate, mat-forming habit and consistently small leaves (Wijesinghe, iNaturalist observation <https://www.inaturalist.org/observations/11841934>).

Figure 3. *Stellaria pallida*, apical portion of stem (*Atha 16000*, NY). Bar is one centimeter.

Figure 4. *Stellaria pallida*. Open flower showing absence of petals and reduced number of stamens (Wijesinghe, iNaturalist observation <https://www.inaturalist.org/observations/11841934>).

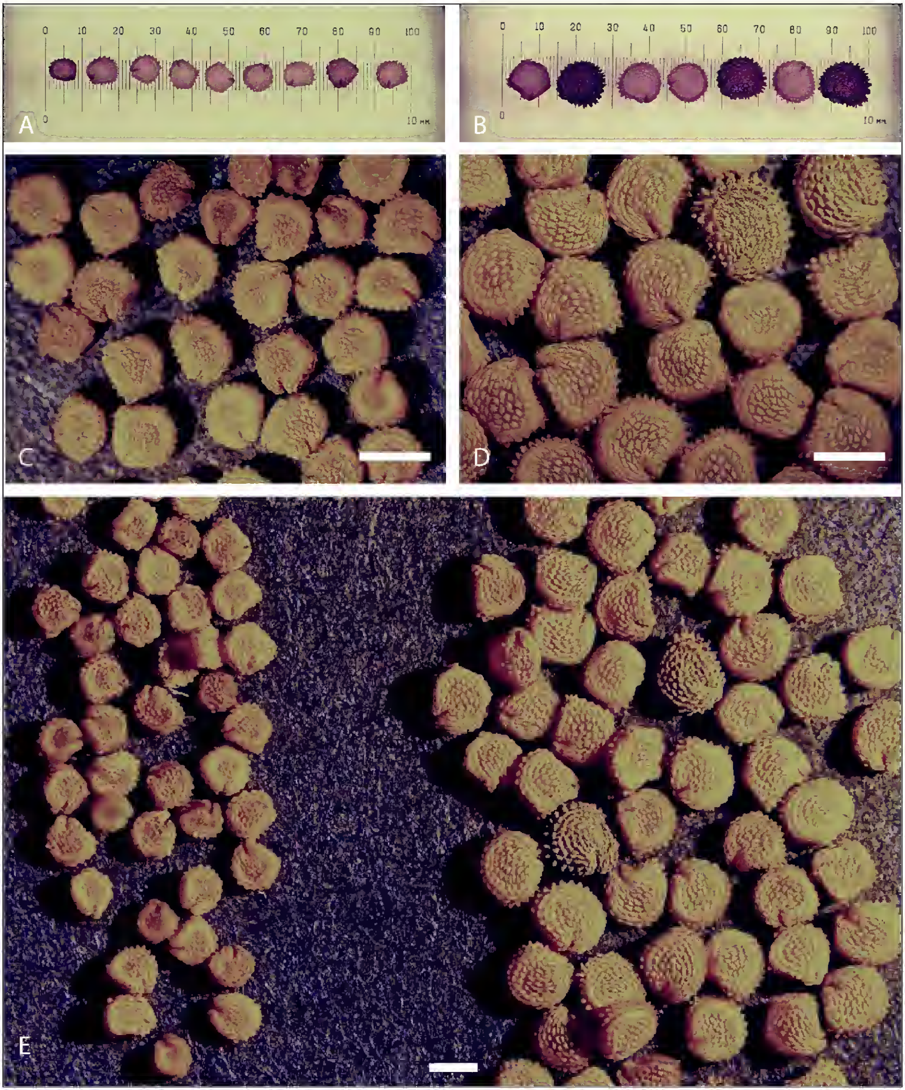

Figure 5. *Stellaria media* and *Stellaria pallida* seeds. *Stellaria pallida* (A, C and E (left)); *Stellaria media* (B, D, E (right)). Scale bar for A and B is 10 mm total, smallest tick marks are 0.1 mm. Scale bar for C,D and E is 1 mm.

This discovery, made on the basis of photographs posted on iNaturalist, demonstrates the importance of web-based citizen science initiatives as places where fruitful collaboration between botanists and others can take place and biological information may be exchanged in an efficient and productive manner.

ACKNOWLEDGEMENTS

We are grateful to Meryl Rubin for processing the herbarium specimens. We thank the Central Park Conservancy for their collaboration on the Central Park Flora Project, the New York City Department of Parks and Recreation for their collaboration and permission to collect specimens of invasive species on city park land, and Guy Nesom for helpful suggestions on the manuscript.

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ATRIPLEX FLAVIDA (CHENOPODIACEAE), A NEW COMBINATION FOR A RECENTLY DESCRIBED ANNUAL SALTBUSH

DAVID J. KEIL
Professor Emeritus
Biological Sciences Department
California Polytechnic State University
San Luis Obispo, California 93407
dkeil@calpoly.edu

DEAN W. TAYLOR
Redwood Drive
Aptos, California 95003
deanmwtaylor@gmail.com

ABSTRACT

Atriplex flavida (S.C. Sand. & G.L. Chu) D.J. Keil & D.W. Taylor, **comb. nov**., is proposed based on *Obione flavida* S.C. Sand. & G.L. Chu (Chenopodiaceae). This species, which is endemic to the Carrizo Plain of eastern San Luis Obispo Co., California, has been misidentified for many years as *Atriplex vallicola* Hoover or its nomenclatural synonym, *A. coronata* S. Wats. var. *vallicola* (Hoover) S.L. Welsh.

Hoover (1938) described an annual saltbush from north of Lost Hills in the San Joaquin Valley of Kern Co., California as *Atriplex vallicola* Hoover. Subsequently Hoover (1970) applied the name *A. vallicola* to an annual saltbush that occurs in the vicinity of Soda Lake on the Carrizo Plain, an arid valley in eastern San Luis Obispo Co., California (average annual rainfall ~160 mm; Intellicast 2018). In the latter publication he noted that the plant from the Carrizo Plain "seems to be essentially like the type of *A. vallicola* . . . although the latter is overmature and therefore difficult to compare." Following the publication of Hoover's flora in 1970, the name *A. vallicola* was in common use for the Carrizo Plain plant (e.g., Skinner 1994). In the 1980s the junior author, with more information about the Lost Hills plants, expressed doubt that the Carrizo Plain plants were the same species. In their Jepson Manual treatment of *Atriplex*, Taylor and Wilken (1993) noted the Carrizo Plain plants to be an undescribed species. In the 1990s the junior author annotated specimens from the Carrizo Plain with the ined. name *Atriplex* 'natrophila.' Welsh (2000) reduced *Atriplex vallicola* to varietal status as *A. coronata* S. Wats. var. *vallicola* (Hoover) S.L. Welsh without directly commenting on the Carrizo Plain plants. In a note under *A. coronata* var. *vallicola* in his treatment of *Atriplex* for the Flora of North America, Welsh (2003) cited the Taylor and Wilken (1993) notation about the Carrizo Plain plants being an undescribed species. Zacharias (2012, 2013) did not mention the Carrizo Plain plants in her treatments of *Atriplex* for the Jepson Manual and Jepson eFlora, and the name *A. coronata* var. *vallicola* is currently in use for these plants (e.g., California Native Plant Society 2018). However, Zacharias (unpubl.) has investigated their relationships (Bruce Baldwin, pers. comm.).

In a recently published conspectus of the Chenopodiaceae, Sanderson and Zhu (2017) recognized *Obione* Gaertn. as a genus distinct from *Atriplex* L. In their treatment *Obione* is differentiated from *Atriplex* by a suite of characters, most notably C_4 photosynthesis and leaves with Kranz venation versus C_3 photosynthesis and leaves with non-Kranz venation. The Sanderson and Zhu study appears to be based largely on morphological evidence, and taxonomic circumscriptions appear not to have been influenced by recent molecular phylogenetic evidence. Kadereit et al. (2010) carried out a molecular phylogenetic survey of the tribe Atripliceae Ulbrich. From the Kadereit et al.

study it is evident that *Atriplex* (sensu stricto) as circumscribed by Sanderson and Zhu is polyphyletic, and the C_4 lineage (*Obione* sensu Sanderson and Zhu) is nested within a more broadly defined and well-supported monophyletic *Atriplex*. Zacharias and Baldwin (2010) provided a strongly supported circumscription of American chenopods in tribe Atripliceae C.A. Mey, consistent with Kadereit et al. (2010) and erected a new genus, *Extriplex* E.H. Zacharias, as one well-supported segregate, with two endemic California species (*E. californica* (Moq.) E.H. Zacharias and *E. joaquiniana* (A. Nels.) E.H. Zacharias). *Atriplex* sensu Kadereit et al. (2010) and Zacharias and Baldwin (2010) is a large genus, distributed widely, with about 300 species (Mabberley 2017).

Zhu and Sanderson (2017) published the name *Obione flavida* S.C. Sand. & G.L. Chu as a new species for the annual saltbush from the Carrizo Plain. We do not agree with the segregation of *Obione* as a genus distinct from *Atriplex,* and therefore we transfer *Obione flavida* to *Atriplex*.

ATRIPLEX FLAVIDA (S.C. Sand. & G.L. Chu) D.J. Keil & D.W. Taylor, **comb. nov.** *Obione flavida* S.C. Sand. & G.L. Chu, Gen. New Evol. System World Chenopod. 339. 2017. **TYPE**: **USA. California.** San Luis Obispo Co.: Carrizo Plain on the N side of Soda Lake [ca. 35.26131°, −119.89006°, 585 m], 20 May 1967, *R.F. Hoover 10584* (holotype: UC1315100!; isotypes: OBI17262!, CAS477088).

Atriplex flavida doubtless resides within *Atriplex* subg. *Obione* (Gaertn.) S.L. Welsh sect. *Obione* subsect. *Pusillae* (Standl.) S.L. Welsh, a group of halophytic herbs nearly endemic to California (Welsh 2000). This subsection comprises 13 taxa treated within 5 species, only one of which, *A. pusilla* (Torr.) S. Wats., ranges outside the state (to central Nevada and southeastern Oregon) (Holmgren & Holmgren 2012). A molecular phylogeny of subsect. *Pusillae* is unavailable; only *A. pusilla* has been included in published DNA-based phylogenies (Zacharias & Baldwin (2010).

Description. Zhu and Sanderson (2017) provided a detailed description of *Obione flavida*, but their publication is likely to be unavailable to many North American botanists. We therefore provide our own description of this species (Figs. 1, 2, 3).

Annual yellowish-green herbs, 1–40 cm tall. **Stems** ascending to erect, branched from the basal nodes with branches simple to much branched, slender, terete, not strongly ribbed or striate, initially furfuraceous throughout but glabrescent except distally. **Leaves** all cauline, plane, with Kranz anatomy; proximal leaves very short-petiolate but most leaves sessile; blades ovate-lanceolate to elliptic or broadly ovate, 3–14 mm long, 2–7 mm wide, strongly furfuraceous on both surfaces, the scurf edges strongly greenish-yellow-margined, base attenuate to rounded, truncate, or subcordate, apex acute to shortly acuminate, margins entire or rarely obscurely toothed at the most proximal nodes. **Inflorescence** of staminate and pistillate flowers in mixed axillary glomerules, these appearing at about the third or fourth node; flowers of both kinds mixed throughout all nodes, each glomerule usually containing 1 or 2 staminate flowers and 2–4 pistillate flowers. **Staminate flowers** sessile; perianth obovoid to subglobose, ca. 1 mm long, generally 3-merous (rarely 4-merous), sepals linear to obovate, usually unequal in size, membranous, slightly fleshy and green dorsally near apex; stamens as many as perianth segments, anthers oblong, ca. 0.5 mm long, filaments united at base. **Pistillate flowers:** bracteole margins united proximal to middle; style very short, stigmas 2, filiform, 1.5–2.5 mm long. **Fruiting bracteoles** sessile, monomorphic, 2.8–3.8 mm long, 2.6–3.6 mm wide, rhombic-obovate to obovate-deltoid, broadly cuneate at base, smooth to more or less prominently tuberculate on both surfaces, this often variable within a glomerule, distal margin irregular denticulate, middle tooth usually largest and longer than lateral teeth, surface densely yellow scurfy. **Utricle** obovate, pericarp membranous. **Seeds** brown, ca. 1 mm wide; radical superior.

Figure 1. *Atriplex flavida*. A. *A. flavida* (yellow-green) with *A. coronata* (gray-green). B. Close-up of foliage and fruiting bracts. Bottom. Habitat on Carrizo Plain north of Soda Lake. Colonies of *A. flavida* in lower left center of photo. Photos by David Keil

Figure. 2. Dried specimen of *Atriplex flavida* (*Taylor 9499*, to be distributed). White balance in image was adjusted to neutrality to show the subtle, characteristic yellow color cast. Photo by Dean W. Taylor.

Comparison with *Atriplex coronata*. *Atriplex flavida* and *A. coronata* (Fig. 1A) are both annuals with small, entire, sessile or proximally short-petioled leaves. Herbage in both is densely scurfy, but the overall color of *A. flavida* is yellow-green whereas that of *A. coronata* is gray-green (Fig. 1A) making it easy to distinguish the species where sympatric (except perhaps for very young plants). Staminate and pistillate flowers in both species are mixed in small axillary glomerules. Staminate flowers of *A. flavida* are 3(4)-merous whereas those of *A. coronata* are (4)5-merous. Fruiting bracteoles of *A. flavida* are 2.8–3.8 mm long, 2.6–3.2 mm wide, obovate to obovate-deltoid in profile, broadly cuneate at base, smooth to more or less prominently tuberculate on both surfaces. The middle tooth of the distal margin generally is more prominent than the other teeth (Fig. 3). Fruiting bracteoles of *A. coronata* vary between varieties but are 2–6 mm long, 3–7 mm wide, broadly cuneate to semicircular in profile, broadly obtuse to truncate at base, with sides smooth or obscurely to prominently tuberculate. The middle tooth of the distal margin generally is not larger than the other teeth. Fruiting bracteoles of var. *coronata*, with which *A. flavida* co-occurs, are semicircular, (2)3–5 mm long, 3–7 mm wide, and broadly cuneate to truncate at base. Var. *vallicola* is characterized by fruiting bracteoles 2–2.5 mm long.

Figure. 3. Detail of *Atriplex flavida* specimen (*Taylor 9499*, to be distributed). White balance in image was adjusted to neutrality to show the subtle, characteristic yellow color cast. Photo by Dean W. Taylor.

Habitat characterization. *Atriplex flavida* occurs in a semi-arid region of sodic, alkaline soils vegetated by annual herbs or scrub (Buck-Diaz & Evans 2011) (Fig. 1C), often dominated by *Atriplex spinifera*, *Suaeda nigra*, and/or *Allenrolfea occidentalis*. Annual associates include *Atriplex coronata*, *Deschampsia danthonioides*, *Hordeum depressum*, *Lasthenia ferrisiae*, *Lepidium dictyotum*, *Lepidium jaredii* var. *jaredii*, and *Spergularia marina*. The regional pattern of vegetation on the Carrizo Plain is strongly controlled by substrate, with many areas on the floor of the valley having barren alkali scalds concentrating sulfates and carbonates (Eghbal et al. 1989). These 'slickspots' are common features on sodic soil landscapes and are often entirely barren of higher plant vegetation. Typically, slickspots are saturated or inundated in an adequate wet season (Reid et al. 1993), and alkali vernal pools are locally present. *Atriplex flavida* often grows around the margins of these pools. Adjoining uplands are vegetated by various native annual herbs and sometimes by non-native annual grasses. Buck-Diaz and Evans (2011) classified an *Atriplex vallicola–Lasthenia ferrisiae–Lepidium jaredii* Herbaceous Association. *Atriplex vallicola* [*A coronata* var. *vallicola*] is absent from the Carrizo Plain, making this an association characterized by *Atriplex flavida.* Typically, *A. flavida* is most abundant on the immediate margins of such slickspots.

Conservation assessment. All 12 previously described taxa of *Atriplex* subsect. *Pusillae* are threatened or endangered to some degree (CNPS 2018), and we indicate here that *A. flavida* qualifies for CRPR List 1B.3, being a narrow endemic known from ca. < 20 occurrences limited to the Carrizo Plain, San Luis Obispo Co., California. When evaluated using IUCN (2000) Red List criteria, *A. flavida* qualifies as Endangered (EN) – High risk of extinction in the wild, based on extent of occurrence estimated to be less than ~100 km². Annotations on individual specimens suggest population sizes in favorable years might approach 10^5 individuals. Approximately half of known specimen locations for *A. flavida* come from locations now within the Carrizo Plain National Monument, created in 2001 and administered by the Bureau of Land Management. The remainder are mostly from privately owned parcels in the failed California Valley subdivisions north of Soda Lake where in recent years a number of lots have been converted to *Cannabis* cultivation. Including *A. flavida*, all taxa within the *Pusillae* are endangered: one species, *A. tularensis* , is presumed extinct (last seen in 1923). In essence, the *Pusillae* comprise a radiation centered in the southerly San Joaquin Valley, a geographic region where very little native habitat remains from conversion to irrigated, intensive agriculture (Preston 2010).

Representative specimens. **USA**. **California**. San Luis Obispo Co.: Carrizo Plain. NE edge of Soda Lake, 2 Jun 1982, *Chamberlain-Bowen 472a* (OBI); E side of Soda Lake, 2 Jun 1982, *Chamberlain-Bowen 482c* (OBI); beside Panorama Rd, 1.3 mi N of Soda Lake Rd., 10 Apr 1995, *Butterworth 39* (OBI); 10 ft E of Panorama Rd., 1.8 mi N of Soda Lake Rd., 20 Jul 1997, *Butterworth 140* (OBI); 1 mi S of Simmler, 2 Jun 1946, *Hoover 6140* (OBI); same location, 16 Jun 1946, *Hoover 6170* (OBI); S end of Soda Lake, 25 May 1952, *Hoover 8238* (OBI); S of Soda Lake, 4 Jun 1967, *Hoover 10616* (OBI); road at S end of Soda Lake, ca. 1/4 mi E of Soda Lake Rd., 24 Apr 1981, *Keil et al. 14470* (OBI); 2.5 mi S of California Valley Fire station along Soda Lake Rd., 24 Apr 1981, *Keil 14492* (OBI); N of Soda Lake, 1.8 mi E of Soda Lake Rd. on Belmont Trail, 22 Mar 1986, *Keil 19072* (OBI); S end of Soda Lake at jct. of Simmler-Soda Lake Rd. with Soda Lake Rd., 22 Mar 1986, *Keil 19091* (OBI); S of Belmont Trail, E of where drainage crosses road between Delray and Cochise roads, 1 Jun 2010, *Keil 30839* (OBI); W of Simmler Rd., 0.5 km NNE of its jct. with Soda Lake Rd., E side of S arm of Soda Lake, 19 May 2011, *Wilken 17950* with Painter (OBI); Calif. Valley, 6 May 1967, *B.W. and T.W. s.n.* (OBI).

ACKNOWLEDGEMENTS

We thank Bruce Baldwin for reviewing this manuscript.

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Published 1 October 2018. ISSN 2153 733X

NOTES ON THE OCCURRENCE OF *ERIGERON SUMATRENSIS* (ASTERACEAE) IN GEORGIA

Guy L. Nesom
2925 Hartwood Drive
Fort Worth, Texas 76109
guynesom@sbcglobal.net

ABSTRACT

A survey for *Erigeron sumatrensis* in central Georgia indicates that it is densely distributed on the the coastal plain there, suggesting that its occurrence may be similar from South Carolina to Louisiana. Vouchers and a distribution map for the Georgia records are provided.

A recent study (Nesom 2018) documented the occurrence of *Erigeron sumatrensis* Retz. across the southeastern USA (Fig. 1). Current herbarium collections suggest that it is common in coastal counties but sporadic in more inland areas. The present report indicates that the species probably is more densely distributed through the coastal plain from South Carolina to Louisiana.

On 9-10 September, 2018, I surveyed a broad loop in central Georgia and added 14 county records to the distribution of *Erigeron sumatrensis*. Figure 2 shows the more geographically saturated distribution the species has attained there.

The tall columnar habit (characteristically 4-6 feet tall) of *Erigeron sumatrensis* makes it conspicuous (Figs. 3-5). In central Georgia I found it along roadsides and fencerows and at edges of cultivated and fallow fields. It is local in occurrence, usually as only 1 or a few plants (but sometimes up to 10-15 in a cluster), often growing with more abundant and continuously distributed *E. canadensis*. *Erigeron sumatrensis* in September is at the end of its growing season and mostly in fruit, while many plants of *E. canadensis* are in full flower.

Vouchers for 2018 collections. **Georgia**. Atkinson Co.: ca. 5 mi NE of Willacoochee on Hwy 135 (5 mi SW of Coffee County line), then 1.5 mi E of Hwy 135 jct on Talmadge-McKinnon Road, ca. 5 plants on roadside beside cotton field, 10 Sep 2018, *Nesom ES8* (GA). Berrien Co.: 1 mi E of Nashville on Hwy 76, at corner of Spells Road turnoff, roadside by mailbox, 1 plant, 10 Sep 2018, *Nesom ES7* (GA). Coffee Co.: along Hwy 135 at jct with Cypress Road, 6 mi SW of jct Hwy 32 in Douglas, 1 mi N of Lanier County line, along fencerow by cotton field, 10 Sep 2018, *Nesom ES 9* (GA). Cook Co.: N of Lenox on Hwy 41, ca. 3 mi S of Tift County line, roadbank alongside peanut field, abundant, mostly senescent, mixed with still-green *Erigeron canadensis*, 9 Sep 2018, *Nesom ES6* (GA). Crisp Co.: between Pitts and Cordele on Hwy 280, 2 mi W of Wilcox County line, roadside by cotton field, very local in occurrence, 10 Sep 2018, *Nesom ES 12* (GA). Dooly Co.: SE of Vienna, Hwy 215 at jct of Pleasant Hill Road, ca. 2.5 mi SE of jct Hwy 257, roadside, abundant at edge of woods, 10 Sep 2018, *Nesom ES13* (GA). Jeff Davis Co.: Hwy 221, 2.5 mi SSW of jct Snipesville Road in Denton, then along Post Road 0.5 mi E of jct Hwy 221, ca. 15 plants on a weedy road bank, 10 Sep 2018, *Nesom ES10* (GA). Lee Co.: Hwy 118, ca. 2 mi SW of jct Hwy 19 on the W side of Smithville, abundant along base of roadbank, S side of road, 9 Sep 2018, *Nesom ES2* (GA). Pulaski Co.: SE of Hawkinsville, Hwy 257, 5 mi SE of jct Hwy 27, beside fallow field, abundant but mixed with more abundant *Erigeron canadensis*, 10 Sep 2018, *Nesom ES 14* (GA). Terrell Co.: Hwy 118 toward Bronwood, 2 mi NE of Dawson town center, roadside by peanut field, N side of road, plants 6 feet tall, 9 Sep 2018, *Nesom ES1* (GA). Tift Co.: N of Chula, 2 mi S of Turner County line on Hwy 41, at jct of Cromer Road, ca. 5 plants in a cluster along roadside, 9 Sep 2018, *Nesom ES5* (GA). Turner Co.: Hwy 32, 4 mi W of jct Hwy 112 on the W side of Ashburn, roadside by woods, 10 plants in a cluster, 9 Sep 2018, *Nesom ES4* (GA). Wilcox Co.: E side of Abbeville along Hwy 280, 0.5 mi E of jct Hwy 129, common on downsloping roadbank on S side of hwy, 10 Sep 2018, *Nesom ES 11* (GA). Worth Co.: Hwy 32, 1 mi W of jct of Hwy 313 at Doles, roadside near edge of woods, 1 plant 5 ft tall, 6 stems from the base, 9 Sep 2018, *Nesom ES3* (GA).

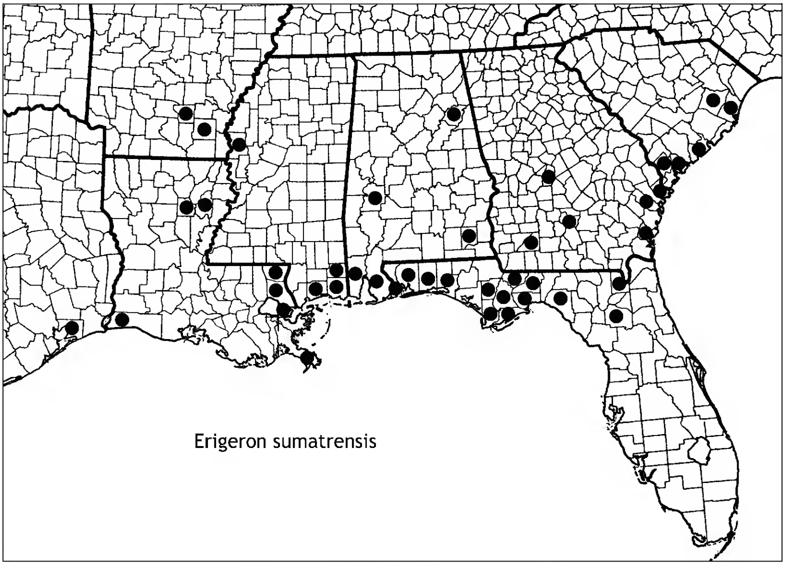

Figure 1. Distribution of *Conyza sumatrensis* in the eastern USA (from Nesom 2018).

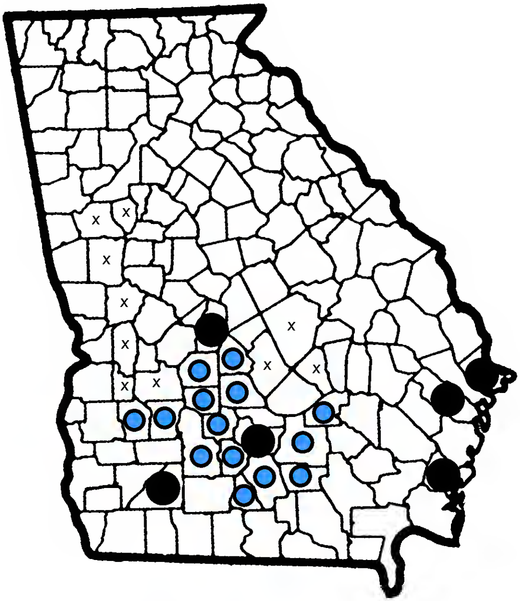

Figure 2. Distribution of *Erigeron sumatrensis* in Georgia. Large black dots show previously reported records (see Fig. 1). Blue circles show records added in the current report from collections in September 2018. Counties searched in 2018 without finding the species are marked with an "x."

Figure 3. *Erigeron sumatrensis*, 3 stems from the base of one plant. Worth Co., Georgia.

Figure 4. *Erigeron sumatrensis*. Worth Co., Georgia.

Figure 5. *Erigeron sumatrensis*. Tift Co., Georgia.

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HOOVERIA, A NEW GENUS LIBERATED FROM *CHLOROGALUM* (AGAVACEAE SUBF. CHLOROGALOIDEAE)

DEAN W. TAYLOR
Redwood Drive
Aptos, California 95003-2517
deanwmtaylor@gmail.com

DAVID J. KEIL
Professor Emeritus
Biological Sciences Department
California Polytechnic State University
San Luis Obispo, California 93407
dkeil@calpoly.edu

ABSTRACT

Molecular phylogenetic analyses have indicated that *Chlorogalum* (sensu lato) (Agavaceae subf. Chlorogaloideae) comprises more than one lineage. A recently published study indicated that *Chlorogalum* is paraphyletic, with two well-supported clades that are successive sister groups to the remainder of the Chlorogaloideae. The first is composed of three vespertine-flowering species (*Chlorogalum* sensu stricto), and the second comprises two diurnally flowering species. Additional morphological and cytological evidence independently support recognition of two lineages. **Hooveria, gen. nov.**, is proposed to accommodate the diurnally flowering species of the second lineage. Three taxa are transferred from *Chlorogalum* to the new genus: **Hooveria parviflora** (S. Wats.) D.W. Taylor & D.J. Keil, **comb. nov.**, **H. purpurea** (Brandeg.) D.W. Taylor & D.J. Keil, **comb. nov.**, and **H. purpurea** var. **reducta** (Hoover) D.W. Taylor & D.J. Keil, **comb. nov.** A neotype is designated for *Chlorogalum parviflorum* S. Wats.

Chlorogalum Kunth (Agavaceae subf. Chlorogaloideae) as treated traditionally is a genus of five species with nine terminal taxa (Jernstedt 2002; Callahan 2015a, b; Table 1). *Chlorogalum* is endemic to the California Floristic Province, extending from its northern limit in southern Coos County, Oregon (Callahan 2015b), southward to extreme northwestern Baja California (Rebman et al. 2016). Four of the nine taxa are considered to be rare and endangered (California Native Plant Society 2018).

Table 1. Taxa of *Chlorogalum* (sensu lato) with their flowering times and chromosome numbers

Taxon	Flowering time	Chromosome number(s)
Chlorogalum angustifolium Kellogg	vespertine	$2n = 34$
Chlorogalum grandiflorum Hoover	vespertine	unknown
Chlorogalum parviflorum S. Wats.	diurnal	$2n = 60$
Chlorogalum purpureum Brandeg.		
var. *purpureum*	diurnal	$2n = 60$
var. *reductum* Hoover	diurnal	unknown
Chlorogalum pomeridianum (DC.) Kunth		
var. *divaricatum* (Lindl.) Hoover	vespertine	$2n = 36$
var. *minus* Hoover	vespertine	$2n = 36$
var. *pomeridianum*	vespertine	$2n = 30, 36$
subsp. *austrooreganum* Callahan	vespertine	unknown

In his monograph of *Chlorogalum*, Hoover (1940) presciently discussed the relationships of the taxa included in the genus:

> It is notable that the species are definitely divided into two groups in regard to flowering, three being vespertine and two diurnal. It is evidently no mere coincidence that the two diurnal species, *C. parviflorum* and *C. purpureum*, are also distinguished by having small flowers with the style longer than the perianth. These differences are so correlated with some difference in general aspect that one is led to suspect that the genus as accepted is composed of two separate lines of descent. At any rate, the two groups of species are so much alike morphologically and so close geographically that their inclusion in a single genus is quite consistent with any generally accepted classification of the Liliaceae.

Subsequent studies have added evidence about the differences between the diurnal and vespertine species. Cave (1970) reported that the vespertine species have chromosome numbers ranging from $2n = 30$ to $2n = 36$ and that the two diurnal species have a chromosome number of $2n = 60$ (Table 1). Although the higher numbers might be interpreted as polyploids based on 15 ($2n = 4x = 60$), Cave pointed out that the karyotypes of the two taxa with $2n = 60$ contain five instead of six pairs of large chromosomes [and 25 instead of 24 pairs of smaller chromosomes]. Consequently the $2n = 60$ chromosome numbers cannot be explained by a simple doubling from a $2n = 30$ base, which is consistent with a complex evolutionary history separating the two groups.

Halpin and Fishbein (2013) examined phylogenetic relationships in the Agavaceae subf. Chlorogaloideae based on four chloroplast DNA regions. Their analyses suggested that *Chlorogalum* is not monophyletic. With moderate support their analysis indicated that while the vespertine species form a well-supported clade, the two diurnal species form a basal grade with *C. parvifolium* and *C. purpureum* as successive sister taxa to a clade comprising the vespertine *Chlorogalum* species, *Hastingsia* S. Wats., and *Camassia* Lindl.

Archibald et al. (2015) also used molecular phylogenetic tools to investigate relationships in Agavaceae subf. Chlorogaloideae, plus other Agavaceae. Using two chloroplast regions, ndhF and trnL–trnF, plus nrDNA ITS for phylogenetic inference, they too concluded that *Chlorogalum* is not monophyletic. With strong support their analyses resolved a clade comprising the vespertine species and a second clade comprising the diurnal taxa. Their *Chlorogalum* 2 clade is sister to the remainder of the Chlorogaloideae, which comprises the Chlorogalum 1 clade plus *Hastingsia* and *Camassia*, each of which is resolved as monophyletic. Jenny Archibald (pers. comm. 2018) indicated to us that the authors of the Archibald et al. (2015) study do not plan to propose taxonomic changes based on their study but have no objections to us doing so. We therefore are proposing a new genus to encompass the taxa comprising their *Chlorogalum* 2 clade.

HOOVERIA D.W. Taylor & D.J. Keil, **gen. nov.** TYPE: *Chlorogalum purpureum* Brandegee, Zoe 4: 159. 1893. [= *Hooveria purpurea* (Brandegee) D.W. Taylor & D.J. Keil]

Herbaceous perennials from tunicate bulbs. Leaves basal, linear, margins undulate. Inflorescence a panicle; bracts linear, subtending inflorescence branches and flowers; pedicels articulated; flowers diurnal, 1–several per node; perianth white, purple, or pinkish; tepals 6, 5–8 mm, distinct, linear to oblong, recurved, with nectaries at base, persisting in fruit and twisting together distal to capsule; stamens 6, inserted on bases of tepals; anthers versatile; style exserted, exceeding perianth lobes, stigmas 3, minute. Fruit a capsule, 3-valved, dehiscence loculicidal. Seeds 2 per locule or 1 by abortion, black.

HOOVERIA PARVIFLORA (S. Wats.) D.W. Taylor & D.J. Keil, **comb. nov.** *Chlorogalum parviflorum* S. Wats., Proc. Amer. Acad. Arts 14: 243. 1879. NEOTYPE (here designated): **USA. California.** San Diego Co.: Cajon Valley, 14 mi. from S. D. [San Diego], May 1878, *D. Cleveland s.n.* (GH 00029896, image!). The original publication cited a collection: "S.

California (Cajon Valley, near San Diego); D. Cleveland, 1877." No specimens of this taxon were found in GH collected by Cleveland in 1877. The label of the 1878 collection bears the notation "*Chlorogalum parviflorum* Watson n. sp." in Watson's handwriting; it is likely that Watson merely cited the wrong date in the original publication, but this cannot be verified. We are therefore designating Cleveland's 1878 collection as neotype for *C. parviflorum*.

HOOVERIA PURPUREA (Brandegee) D.W. Taylor & D.J. Keil, **comb. nov.** *Chlorogalum purpureum* Brandegee, Zoe 4: 159. 1893. **LECTOYPE** (Hoover 1940): **USA. California.** Monterey Co.: near Jolon, 6 Jun 1893, *A. Eastwood s.n.*: (UC 119744, image!; isolectotype, F 0046005F, image!).

HOOVERIA PURPUREA (Brandegee) D. W. Taylor & D.J. Keil var. **PURPUREA**

HOOVERIA PURPUREA (Brandegee) D.W. Taylor & D.J. Keil var. **REDUCTA** (Hoover) D.W. Taylor & D.J. Keil, **comb. nov.** *Chlorogalum purpureum* Brandegee var. *reductum* Hoover, Leafl. W. Bot. 10: 124. 1964. **TYPE**: **USA**. **California**. San Luis Obispo Co.: 18 miles east of Creston on La Panza Road, 3 May 1957, *R.F. Hoover 8384* (holotype: OBI!; isotypes: CAS456960, image!, K 000802709, image!, UC 1296310, image!).

Etymology. *Hooveria* is named in honor of Robert Francis Hoover (1913–1970), one of California's most able field botanists, student of various groups of lilies, author of *The Vascular Plants of San Luis Obispo County, California* (Hoover 1970), and founder of the herbarium at California Polytechnic State University, which is named in his honor. Commemorating Robert Hoover with this new genus is particularly fitting as his ca. 11,000 numbers contributed a substantial record of the California flora prior to rapid post-WWII population growth. He was among the last persons to record several species now presumed extinct, including *Monardella leucocephala* A. Gray (Lamiaceae), *Plagiobothrys glaber* (Gray) I.M. Johnst., and *Cryptantha hooveri* I.M. Johnst. (Boraginaceae). Hoover is commemorated by several taxa, all of which are endangered to some degree and endemic to the California region (California Native Plant Society 2018): *Agrostis hooveri* Swallen (Poaceae) and *Pleuropogon hooverianus* (L. Benson) J.T. Howell (Poaceae); *Arctostaphylos hooveri* P.V. Wells (Ericaceae); *Eryngium aristulatum* Jeps. var. *hooveri* Sheikh and *Lomatium hooveri* (Mathias & Constance) Constance & Ertter (Apiaceae); *Calycadenia hooveri* G.D. Carr (Asteraceae); *Brodiaea elegans* Hoover subsp. *hooveri* T.F. Niehaus (Themidaceae); *Euphorbia hooveri* L.C. Wheeler (Euphorbiaceae); *Eriastrum hooveri* (Jeps.) H. Mason (Polemoniaceae); and *Cryptantha hooveri* I.M. Johnst. (Boraginaceae). Hoover collected type material or the first known specimens for all of these endemics and for various others.

Geographic distribution. The geographic range of *Hooveria* is disjunct. *Hooveria purpurea* occupies sites in Monterey and San Luis Obispo counties in central California. The type variety occurs in foothill woodland areas of southern Monterey and adjacent northern San Luis Obispo counties, where it is wholly or largely restricted to two military bases: Fort Hunter Liggett in southern Monterey County, and Camp Roberts, which straddles the Monterey-San Luis Obispo county line. *Hooveria purpurea* var. *reducta* (Figs. 1, 2) is restricted to a very small area about 40 miles to the southeast on the Red Hill Mesa and nearby sites in south-central San Luis Obispo County, where it grows on highly weathered, rocky, reddish clay soils in an area of open foothill woodland. It occurs in the Los Padres National Forest and nearby areas of privately owned lands. *Hooveria parviflora* ranges from southeastern Los Angeles and adjacent Riverside counties south through Orange and San Diego counties to extreme northwestern Baja California. It occupies sites in coastal scrub, chaparral, grassland, and open woodlands.

Figure 1. *Hooveria purpurea* var. *reducta*. Rosette in rocky red clay soil, Red Hill Mesa in San Luis Obispo County, California. Photo by David Keil.

Figure 2. *Hooveria purpurea* var. *reducta.* Inflorescence branches with diurnal flowers, Red Hill Mesa in San Luis Obispo County, California. Photo by David Keil.

ACKNOWLEDGEMENTS

We thank Jenny Archibald and her coauthors for yielding to us the right to propose a new genus based on their studies. Specimen data were provided by the participants of the Consortium of California Herbaria (ucjeps.berkeley.edu/consortium/) and the JSTOR Global Plants database (https://about.jstor.org/whats-in-jstor/primary-sources/global-plants/). We thank Bruce Baldwin, Judy Jernstedt, and Rob Preston for reviewing this manuscript.

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LECTOTYPIFICATIONS AND NEW RECORDS OF *MIMOSA* (LEGUMINOSAE) FROM MEXICO

ALEJANDRA LÓPEZ-MENDOZA, ROSAURA GRETHER*,
SARA LUCÍA CAMARGO-RICALDE
Departamento de Biología, División CBS
Universidad Autónoma Metropolitana-Iztapalapa
09340, Ciudad de México, México
bioale19@gmail.com, slcr@xanum.uam.mx
*Author for correspondence: rogg@xanum.uam.mx,

ROSA MARÍA FONSECA
Facultad de Ciencias
Universidad Nacional Autónoma de México
04510, Ciudad de México, México
tewamil@hotmail.com

ABSTRACT

As a result of the preparation of a treatment of the genus *Mimosa* (Leguminosae) for the Flora of Guerrero, Mexico, lectotypes for *Mimosa affinis* B.L. Rob., *M. caerulea* Rose, and *M. egregia* Sandwith are designated here, and new records of other eleven taxa of the genus are documented for Guerrero.

RESUMEN

Como un resultado de la preparación de un tratamiento del género *Mimosa* (Leguminosae) para la Flora de Guerrero, México, se designan aquí los lectotipos de *Mimosa affinis* B.L. Rob., *M. caerulea* Rose y *M. egregia* Sandwith y se reportan nuevos registros de otros once taxa del género para el estado de Guerrero, México.

Mimosa L. comprises ca. 540 species worldwide. In Mexico there are 105 species, which constitute ca. 20% of the total, and of these ca. 60% are endemic to the country (Grether & Steinmann 2014), thus Mexico is considered the second center of diversification after Brazil (Grether 1978; Simon et al. 2011). The states with the highest number of *Mimosa* species are Oaxaca with 46 (Grether 2011), Guerrero with 44 (López-Mendoza 2018), Chiapas with 35 (Grether 1997), and Veracruz with 26 (Martínez-Bernal et al. 2008). In Mexico, *Mimosa* is represented by species belonging to 4 of the 5 sections and 37 out of 41 series, according to Barneby's (1991) classification and Grether's (2000) nomenclatural changes.

As a result of the preparation of a treatment of *Mimosa* (Leguminosae) in the state of Guerrero, lectotypes are designated here for three species endemic to Mexico: *Mimosa affinis* B.L. Rob., *Mimosa caerulea* Rose, and *Mimosa egregia* Sandwith. In addition, eleven taxa of *Mimosa* are first recorded for the state.

Mimosa affinis B.L. Rob., Bot. Gaz. (Crawfordsville) 16: 341. 1891. **LECTOTYPE** (designated here): **MEXICO**. **Sinaloa**. Mazatlán and vicinity, Jan 1889, *W.G. Wright 1218* (fl, fr) (GH00065058!; isolectotypes: F0058247F!, MO127533!, MSC0092382!, US00930649!, US00000789!, fragments: NY00002515!). Non *M. affinis* Harms ex Glaz., Bull. Soc. Bot. France 53, Mém. 3b: 185. 1906.

In 1891, B.L. Robinson named and described *Mimosa affinis*, based on the collections of *W.G. Wright 1218* and *1265*. Both specimens are mounted on the same sheet, each with its own bar code, *W.G. Wright 1218*, GH00065058! (fl, fr) and *W.G. Wright 1265*, GH00065059! (fl, fr). The specimen

W.G. Wright 1218 is chosen here as the lectotype, as it shows the important characters of the inflorescence, flower and fruit that fully characterize the species. The isolectotypes F0058247F!, MO127533!, MSC0092382!, and US00000789! correspond to the collection number *W.G. Wright 1218* [additionally labeled: = *1265*], the sheet NY00002515! only includes fragments of *W.G. Wright 1218* ex GH [additionally labeled: = *1265*] and the specimen US00930649! only has the collection number of *W.G. Wright 1218*.

This species is distributed in western, central, southern, and southeastern Mexico and Central America (Guatemala, Belize, and Nicaragua). *Mimosa affinis* grows in diverse vegetation types in foothills and lowlands of the Pacific slope, in elevations of 0–1000 m in western Mexico (McVaugh 1987) and it is found in the Mesoamerican region, in deciduous medium forests, as well as in savannas with *Acoelorrhaphe* and grasses at elevations up to 430 m (Grether 1997, 2001). In Guerrero, this species has been documented at elevations up to 1600 m, growing in oak forests.

Mimosa caerulea Rose, Contr. U.S. Natl. Herb. 5: 141. 1897. **LECTOTYPE** (designated here): **MEXICO**. **Morelos**. [Mpio.] Cuernavaca: on the foothills above Cuernavaca, 18 Nov 1895, *C.G. Pringle 6200* (fr) (US00000809!; isolectotypes: E00383725!, ENCB0003374!, F0058250F!, JE00001084!).

Mimosa caerulea Rose is based on two syntypes: *Pringle 6200* (fr) and *Pringle 6385* (fl), deposited in the U.S. National Herbarium (US). Barneby (1991) recognized *M. caerulea* but did not choose a lectotype. The fruiting specimen *Pringle 6200* is designated here as the lectotype, as it has several important characters such as mature leaves and fruits with stipe 5–7 mm long or sessile, 1–3 cm long, 5–6 mm wide, and short setose margin.

Mimosa caerulea is endemic to Mexico, previously known only from the states of Mexico and Morelos. In Guerrero, this species has been found in tropical deciduous forest and pine-oak forest, in elevations of 1500–2150 m; it is distributed into the Southern Mountain Ridges [floristic province of Serranías Meridionales (Rzedowski 1978)].

Mimosa egregia Sandwith, Bull. Misc. Inform. Kew 1936(1): 7. 1936. **LECTOTYPE** (designated here): **MEXICO**. **Guerrero**. [Mpio. de Coyuca de Catalán] I.R.F. Quirio [Cuirio], Coyuca, Nov 1934, *G.B. Hinton 6907* (fr) (K000082083!; isolectotypes: BM000952352!, GBH006907!, LL00371148!, MO127545!, PH00017688!, RSA0003543!, US00930653!).

Mimosa egregia Sandwith is based on two syntypes: *Hinton 6314* (fl), K000082082!, and *Hinton 6907* (fr), K000082083!. After examination of the syntypes and their duplicates in several herbaria, the fruiting specimen is here selected as the lectotype, because the fruit has several important characters that distinguish *M. egregia* from related species such as *M. guatemalensis* (Hook. & Arn.) Benth., *M. sotoi* R. Grether & V.W. Steinm., and *M. spirocarpa* Rose.

The flowering specimen: *Hinton 6314* (K000082082!) from El Pochote, [Mpio.] Coyuca [de Catalán], Guerrero, was also examined, as well as its duplicates (A00065102!; A00065103!, ENCB0003376!, F0058257F!, K000478116!, MO127546!, NY00002541!; NY00002542!; NY00002543!). It is important to note that the specimen with fruits was collected from the same tree as *Hinton 6296* (fl), as cited in the protologue, and that I.R.F. Quirio [river Cuirio] is a tributary of the Balsas River and not a town, 18° 18' N, 100° 41' W.

Mimosa egregia is endemic to the Balsas Basin and adjacent areas of the Southern Mountain Ridges, in the State of México, Michoacán, and Guerrero, where it occurs in tropical deciduous forest and thorn scrub at elevations of 250–850 m.

New records of *Mimosa* species for Guerrero

1. **Mimosa psilocarpa** B.L. Rob., Proc. Amer. Acad. Arts 35: 325. 1900. TYPE: **MEXICO**. **Oaxaca**. Between San Carlos and San Bartolo Yautepec, 6 Jan 1896, *C. & E. Seler 1727* (holotype: GH00065033! (fragm., US00000901! ex GH); isotype: NY00002599!).

Mimosa psilocarpa had been previously found only in Oaxaca and the Cañón del Sumidero in Chiapas, at elevations of 140–1350 m (Grether 1997). It is recorded here for the first time from Guerrero, where it grows in tropical deciduous forest between 300 and 500 m elevation on the Pacific slope [floristic province of Costa Pacífica (Rzedowski 1978)].

Specimens examined. MEXICO. **Guerrero**. Mpio. Acapulco de Juárez: El Veladero, 26 Jul 2004, *Hernández 407* (FCME); Parque Nacional El Veladero, Colonia de los Burócratas, 3 Mar 1985, *Noriega 472* (FCME).

2. **Mimosa sotoi** R. Grether & V.W. Steinm., Brittonia 67: 5. 2015. DOI 10.1007/s12228-014-9346-0. 2014. TYPE: **MEXICO**. **Michoacán**. Mpio. La Huacana: 1.5 km al oeste-suroeste de Los Ranchos, por la vereda al depósito de agua, 2 Oct 2011, *V.W. Steinmann 7357* (holotype: IEB; isotypes: ARIZ, MEXU, MICH, NY, UAMIZ).

This species was described from Michoacán and this is the first register for Guerrero. *Mimosa sotoi* grows at elevations of 250–350 m, in deciduous tropical forest and riparian tropical forest and it is restricted to the lower Balsas region of southern Michoacán and western Guerrero, into the Balsas Depression province.

Specimens examined. MEXICO. **Guerrero**. Mpio. Zirándaro: El Cacahuananche, 6 km al SO de Zirándaro, camino a Guayameo, 13 Jul 1982, *Martínez* & *Soto 1330* (MEXU).

3. **Mimosa albida** Humb. & Bonpl. ex Willd. var. **pochutlensis** R. Grether, Phytologia 52: 91. 1982. TYPE: **MEXICO**. **Oaxaca**. Distrito de Pochutla: 17 km al O de Pochutla, 18 Dic 1978, *R. Grether & H. Quero 1264* (holotype: MEXU; isotypes: ENCB003373!, UAMIZ0005000!, UAMIZ0005039!, XAL0098964!).

Mimosa albida var. *pochutlensis* is documented for Guerrero for the first time; it is found in tropical subdeciduous forest and secondary vegetation, at elevations of 0–1800 m. This variety is distributed along the Pacific slope. *Mimosa albida* var. *pochutlensis* was only known from Oaxaca, on the Pacific coastal plain, in tropical deciduous and subdeciduous forests; it has also been found in the edges of savannas and oak forests up to 500 m elevation and in cloud forest with coffee plantation at 1200 m. This variety is characterized by leaves with one pair of pinnae, each with two pairs of leaflets up to 11 x 6.5 cm, strigose and puberulent on both surfaces, the margin with short, not appressed irregularly arranged setae, and the fruits hirsute; however, some specimens from Oaxaca and Guerrero have leaflets glabrous on both surfaces and margin with some appressed but irregularly arranged setae; however, they have glabrous flowers and hirsute fruits, with erect setae on valves and margin, which are typical of *M. albida* var. *pochutlensis*.

Specimens examined. MEXICO. **Guerrero**. Mpio. Acapulco de Juárez: 11 km al N de Acapulco, 22 Jan 1982, *Miller et al. 289* (MEXU). Mpio. Coyuca de Benítez: Isla Montosa, 14 Jan 1987, *Andrade 134* (FCME); 2 km al NO de Coyuca de Benítez, 7 Jul 1985, *Grether et al. 1972* (MEXU, UAMIZ). Mpio. San Marcos: 7 km adelante de Huajintepec rumbo a Agua Zarca, 21 Ago 1985, *Fonseca 1242* (FCME).

4. **Mimosa tricephala** Schltdl. & Cham. var. **lignosa** (Micheli) Chehaibar & R. Grether, Novon 10: 31. 2000. *Mimosa lignosa* Micheli, Mém. Soc. Phys. Genève 34(3): 278. 1903. TYPE:

MEXICO. **Michoacán**. Las Higueritas, Jul 1898, *E. Langlassé 232* (holotype: G; isotypes: F, GH01154784!, MEXU 00050990! MEXU00050991!, US).

This variety is recorded in Guerrero for the first time. *Mimosa tricephala* var. *lignosa* was known as endemic to Michoacán; it has been found in Guerrero at elevations of 300–600 m in tropical deciduous forests and gallery forests. It is endemic to the Balsas Basin.

Specimens examined. MEXICO. **Guerrero**. Mpio. Ajuchitlán del Progreso: 1 km al NO de Corral Falso y 21 km al SE de Coyuca de Catalán, carretera Coyuca de Catalán–Ajuchitlán del Progreso, 31 Jul 2011, *Calónico 19206* (MEXU). Mpio. Huitzuco de los Figueroa: 2 km al O de San Francisco Ozomatlán camino a San Miguel Tecuixiapan Amecantla, 2 Jul 1987, *Contreras 2047* (FCME); 1 km al O de San Francisco Ozomatlán, 29 Oct 1989, *Contreras 2581* (FCME); 1.8 km al E de San Francisco Ozomatlán, 27 Jul 1988, *Vaca & Vargas-Pérez 98* (FCME); 4 km al E de San Francisco Ozomatlán, 19 Jul 1989, *Vargas-Pérez 57* (FCME).

5. **Mimosa tricephala** Schltdl. & Cham. var. **nelsonii** (B.L. Rob.) Chehaibar & R. Grether, Novon 10: 31. 2000. *Mimosa nelsonii* B.L. Rob., Proc. Amer. Acad. Arts 33: 314. 1898. LECTOTYPE (designated by Grether 2000): **MEXICO**. **Oaxaca**. Between San Gerónimo and La Venta, 13 Jul 1895, *E.W. Nelson 2775* (GH01154786!; isolectotypes: A01154787!, GH01154788!, US).

This variety is recorded for Guerrero for the first time; it was only known in Michoacán and Oaxaca. It grows in deciduous tropical forest at elevations of 150–1250 m and is distributed in the three floristic provinces (Rzedowski 1978) that converge in Guerrero: Balsas Depression, Southern Mountain Ridges, and Pacific Coast.

Specimens examined. MEXICO. **Guerrero**. Mpio. Coyuca de Catalán: 8 km al O de Coyuca de Catalán, carretera Ciudad Altamirano–Los Placeres del Oro, 5 Feb 1993, *Martínez-Bernal et al. 665* (UAMIZ). Mpio. San Marcos: 1 km de la Estancia, carretera Pinotepa Nacional a Acapulco, 31 Jan 1983, *Tenorio et al. 3114* (MEXU). Mpio. Zirándaro: Las Salinas, 3.7 km al E, *Calónico 12850* (FCME); Placeres del Oro, 7 km al NO, *Calónico 12815* (FCME); El Jeriche, a 13 km de la Parota, en el camino Aratichanguio–Zirándaro, 2 Nov 1983, *Campos 937* (MEXU).

6. **Mimosa tricephala** Schltdl. & Cham. var. **tricephala**, Linnaea 5: 591. 1830. TYPE: **MEXICO**. **Veracruz**. "inter Laguna Verde et Actopan", *C.W. Schiede s.n.* (holotype: HAL0064977!; isotypes: BM, RSA0026507!, RSA0026508!).

Mimosa chaetocarpa Brandegee, Univ. Calif. Pub. Bot. 10: 182. 1922. TYPE: **MEXICO**. [**Veracruz**]. Cameron [rancho Camarón], Oct 1921, *C.A. Purpus 8600* (holotype: UC206733!; isotypes: GH01154783!, MO, NY00002531!, photo MEXU! ex NY, US00000818!).

Mimosa tricephala var. *tricephala* is documented from Guerrero for the first time. It occurs in the Balsas Basin in deciduous tropical forest at elevations of 950 m. The typical variety of *M. tricephala* is also distributed in Morelos, Puebla, and Veracruz in Mexico, and it apparently is disjunct in the Guanacate Province in Costa Rica.

Specimens examined. MEXICO. **Guerrero**. Mpio. Atenango del Río: 273 km al NO de Apanguito, 20 Nov 2003, *Aguirre 186* (FCME).

7. **Mimosa grahamii** A. Gray [var. **grahamii**], Pl. Wright. 2: 52. 1853. *Mimosopsis grahamii* (A. Gray) Britton & Rose, N. Amer. Fl. 23(3): 178. 1928. TYPE: **MEXICO**. **Sonora**. Mountain valleys of Sonora, between the San Pedro and the Sonoita, Sep 1851, *C. Wright 1042* (holotype: GH00065129!; isotypes: GH00065140!, MO356344!, NY00002553!).

Mimosa endlichii Harms, Repert. Spec. Nov. Regni Veg. 18: 93. 1922. TYPE: **MEXICO**. **Chihuahua**. Río San Juan, 21 Apr 1906, *R. Endlich 1256* (holotype: B, photo and fragm. US00000835!, fragm. NY00002545!).

Mimosopsis durangensis Britton & Rose, N. Amer. Fl. 23(3): 175. 1928. TYPE: **MEXICO**. **Durango**. Near Huasemote, 15 Aug 1897, *J.N. Rose 3491* (holotype: US00000952!, fragm. NY00003134!).

Mimosa lemmonii A. Gray, Proc. Amer. Acad. Arts 19: 76. 1883. *Mimosopsis lemmonii* (A. Gray) Britton & Rose, N. Amer. Fl. 23(3): 176. 1928. *Mimosa grahamii* var. *lemmonii* (A. Gray) Kearney & Peebles, J. Wash. Acad. Sci. 29: 482. 1939. TYPE: **USA. Arizona**. S Arizona, near Fort Huachuca, Cañon, Jun 1882, *J.G. Lemmon 2692* (fl) (syntype: GH00065130!; isosyntypes: K000791081!, PH00017698!, US00000871!, US00000872!); S Arizona, near Fort Huachuca, Cave Cañon, Sep 1882, *J.G. Lemmon 2693* (fr) (syntype: GH00065131!; isosyntype: NDG24068!).

Mimosa grahamii var. *grahamii* is distributed in southwestern USA and Mexico; it had been found in Sonora, Chihuahua, and Durango; in recent years it has been collected in Querétaro, seeming disjunct from the others. Here, this taxon is recorded for the first time from Guerrero, its known southern limit, at elevations of 1600–1950 m in oak forest in the floristic province of Southern Mountain Ridges.

The pubescence of foliage and flowers varies notably among populations of *Mimosa grahamii*, but those with densely pubescent foliage may be determined as *M. grahamii* var. *lemmonii* (A. Gray) Kearney & Peebles. Further study of this latter taxon is needed to evaluate its typification.

Specimens examined. MEXICO. **Guerrero**. Mpio. Chilpancingo de los Bravo: 26 km sobre la desviación Chilpancingo–Omiltemi–Las Joyas, 27 Mar 1981, *Soto* & *Contreras 539* (FCME). Mpio. Eduardo Neri: Cañada Carrizalillo, 2 km al SE de Amatitlán, 11 May 1996, *Cruz* & *García 875* (FCME). Mpio. Tixtla de Guerrero: 16 km después de Tixtla (entre Ojitos de Agua y la Estacada) carretera Chilpancingo a Chilapa, 31 Mar 1981, *Contreras* & *Campos 911* (FCME).

8. **Mimosa pigra** L. var. **berlandieri** (A. Gray) B.L. Turner, Field & Lab. 24: 15. 1956. *Mimosa berlandieri* A. Gray in Emory, Rep. U. S. Mex. Bound. 2: 61. 1859. *M. asperata* L. var. *berlandieri* (A. Gray) B.L. Rob., Proc. Amer. Acad. Arts 33: 331. 1898. LECTOTYPE (designated by Isely 1971): **MEXICO**. [**Tamaulipas**]. Environs of Matamoros, 1839, *J.L. Berlandier 3146* (GH00065067!; isolectotype: K000082472!, photo MEXU! ex K).

Mimosa asperata L., Syst. Nat., Ed. 10, 2: 1312. 1759. LECTOTYPE (designated by Barneby 1989): P. Miller, Gard. dict., ed. 7, t. 182, fig. 3. 1757. **MEXICO**. ["discovered…at **La Vera Cruz**", by *Houston s.n.*, who sent the seeds to England].

Mimosa pigra var. *berlandieri* has a wide distribution in southern USA and in Mexico, where it occurs in Sinaloa, Nayarit, Jalisco, Colima, San Luis Potosí, Tamaulipas, Veracruz, Oaxaca, Chiapas, Tabasco, Yucatán, Campeche, and Quintana Roo, extending southward in Central America to Belize, Guatemala, and Nicaragua. This taxon is documented here for the first time from Guerrero, where it grows in mangrove and gallery forest at elevations of 0–2200 m. It is distributed in two floristic provinces converging in Guerrero: Southern Mountain Ridges and Pacific Coast.

Specimens examined. MEXICO. **Guerrero**. Mpio. Acapulco de Juárez: Laguna de Tres Palos, 24 Jul 1982, *López s.n.* (FCME). Mpio. General Heliodoro Castillo: Tejamanil, Ejido de Pueblo Viejo, 25 Jan 1993, *Pérez 6701* (FCME).

9. Mimosa polydactyla Humb. & Bonpl. ex Willd., Sp. Pl. 4: 1033. 1806. **TYPE**: [**VENEZUELA**]. "Habitat in America meridionali ad fluvium nigrum prope St. Carlos," *Humboldt* & *Bonpland 3384* (holotype: B-W19070010!, photo F0BN001358! ex B-W).

This species is recorded here for the first time in Guerrero, now its northern limit; in Mexico, it was only known from the state of Chiapas and it has a wide distribution in Central and South America to Argentina. In Guerrero, it grows between 700 and 1000 m elevation, in pine forest into the floristic province of Southern Mountain Ridges.

Specimens examined. MEXICO. **Guerrero**. Mpio. Chilpancingo de los Bravo: Soyatepec, 15 Oct 1994, *Gómez 2871* (FCME); 0.5 km al SO de Agua de Obispo, desviación a Zintlalapa, carretera federal Acapulco–Chilpancingo, 9 Oct 2011, *Redonda et al. 659* (MEXU).

10. Mimosa skinneri Benth. var. **skinneri**, London J. Bot. 5: 85. 1846. **TYPE**: **GUATEMALA**. Cuesta Leona, 1843, *Skinner s.n.* (holotype: K000532816!; isotype: K000532776!, photo MEXU! ex K).

Mimosa tetraneura Brandg., Univ. Calif. Publ. Bot. 6(4): 52. 1914. **TYPE**: **MEXICO**. [**Chiapas**]. Sierra de Tonalá, Sep 1913, *C.A. Purpus 6626* (holotype: UC169739!; isotypes: F0058283F!, photo NY! ex F, MEXU!, US00000963!).

Mimosa longicoma Britton & Rose, N. Amer. Fl. 23: 152. 1928. **TYPE**: **MEXICO**. **Chiapas**. Jalisco Arriaga [Arriaga], Sep 1923, *C.A. Purpus 9069* (holotype: NY00002564!; isotypes: GH00065118!, MEXU00053631!, MO127548!, MO356257!, US00000879!).

Mimosa skinneri is a member of sect. *Mimosa* series *Modestae*; this series and species are new records for Guerrero. *Mimosa skinneri* var. *skinneri* is widely distributed in southern Mexico (Guerrero, Oaxaca, Chiapas, Veracruz, and Tabasco) and it is found in western Mexico (Nayarit), Central America, and Brazil. In Guerrero it grows in secondary vegetation, at 500 m elevation, into the Pacific Coast province.

Specimens examined. MEXICO. **Guerrero**. Mpio. Tlacoachistlahuaca: Rancho del Cura (Xochistlahuacan–Plan de Guadalupe), 25 Apr 1982, *Diego 2640* (FCME).

11. Mimosa tarda Barneby, Mem. New York Bot. Gard. 65: 434. 1991. **TYPE**: **PERU**. **Huánuco**. Prov. Leoncio Prado, Distrito Rupa Rupa: Aucayacu, 24 Mar 1975, *J. Schunke-Vigo 8160* (holotype: NY00003087!; isotype: MO954263!).

Mimosa tarda is a species of wide distribution in America. In Mexico, it was only known from Colima, Veracruz, and Oaxaca. Here, it is documented for the first time from Guerrero. In Central America it grows at elevations of 0–1400 m in deciduous forests and oak forests (Grether 1997), while in Guerrero it is found at elevations up to 500 m, in secondary vegetation "acahuales" in the Southern Mountain Ridges.

Specimens examined. MEXICO. **Guerrero**. Mpio. Tlacoachistlahuaca: 5 km de San Cristóbal, dirección de Santa María Asunción, 25 Jun 1982, *Diego 4036* (FCME).

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to the curators of the following herbaria: Herbario de la Escuela Nacional de Ciencias Biológicas (ENCB), Instituto Politécnico Nacional, Herbario de la Facultad de Ciencias (FCME), UNAM, Herbario Nacional de México (MEXU), Instituto de Biología, UNAM, Herbario Metropolitano (UAMIZ), and Universidad Autónoma Metropolitana-Iztapalapa, and to the Consejo Nacional de Ciencia y Tecnología (Grant. No. 592857 to the first author). Special thanks to Guy Nesom for his improvement of the manuscript.

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CLERODENDRUM (LAMIACEAE) IN THE ARKANSAS FLORA

BRETT E. SERVISS
Department of Biological Sciences
Box H-7570
Henderson State University
Arkadelphia, Arkansas 71999
servisb@hsu.edu

JONATHAN W. HARDAGE
Bismarck, Arkansas 71929
jh201098@reddies.hsu.edu

KEENAN B. SERVISS
Sylvia Street
Arkadelphia, Arkansas 71923

JAMES H. PECK
P.O. Box 705
Cedar Key, Florida 32625
james.peckck@gmail.com

ABSTRACT

Clerodendrum trichotomum Thunb. is reported here as new to the Arkansas flora. This represents the first documented occurrence of the genus *Clerodendrum* outside of cultivation in the state. One, large colony of escaped/naturalized plants of *C. trichotomum* was discovered growing at an expansive dumpsite for horticultural waste and edge of adjacent greenbelt in Clark County. Photographs of *C. trichotomum*, including plants in habitat, along with notes on *Clerodendrum* in Arkansas, are provided.

In 2009, escaped plants of *Clerodendrum trichotomum* Thunb. (harlequin glorybower) were documented at a large dumpsite for horticultural waste in the city of Arkadelphia in Clark County, Arkansas. The origin of the escaped *C. trichotomum* population is presumed to be from horticultural discards, with subsequent establishment. Over the past nine years, plants have increased in number, where at present (2018), a large, presumably clonally established population of *C. trichotomum*, consisting of several dozen stems/plants, ranging from less than 1 m to ca. 4–5 m in height, are present at the dumpsite and along the edge of an adjacent greenbelt; a number of the plants had mature fruits (Figs. 1–2). Although reproductive, spread appeared to be mostly or completely via root suckering. No *C. trichotomum* plants were observed in the disturbed woods that borders the site. This record represents the first documented occurrence of the genus *Clerodendrum* in the state's flora outside of cultivation. In addition to *C. trichotomum*, a number of other non-native, angiosperm species were present at or in the immediate vicinity of the site, including *Ilex cornuta* (Chinese holly), *Lagerstroemia indica* (crepe myrtle), *Ligustrum sinense* (Chinese privet), *Liriope spicata* (creeping lilyturf), *Nandina domestica* (nandina), *Perilla frutescens* (beefsteak-plant), *Photina serratifolia* (Chinese photina), *Triadica sebifera* (Chinese tallow tree), and *Wisteria sinensis* (Chinese wisteria).

Voucher specimen. Arkansas. Clark Co.: Large colony of escaped/naturalized plants, consisting of several dozen stems, ranging from less than 1 m to small trees ca. 4–5 m tall, some plants with mature fruits, at edge of large dumpsite for horticultural waste and adjacent greenbelt, off M.H. Russell Dr., in proximity (N/NW) of intersection of M.H. Russell Dr. and 10th St., Arkadelphia, 14 Sep 2018, *Serviss 8623* (HEND).

Figure 1. *Clerodendrum trichotomum* naturalized in Clark Co., Arkansas. A portion of the colony (in 2018), which has increased in size considerably over the previous nine years since its initial discovery in 2009.

Figure 2. *Clerodendrum trichotomum* plant and habit. (A) Stems and leaves of naturalized plants from Clark County. (B) Close-up view of mature fruits from naturalized plants; several plants at the Clark County site had mature fruits. (C) Flowers (from a cultivated plant of *C. trichotomum*).

Clerodendrum trichotomum is a large, colonial, deciduous shrub or small tree to 10 m that is native to China and Japan (Bailey & Bailey 1976; Krüssmann 1976; Chen & Gilbert 1994). This species is grown for its showy, sweetly-fragrant flowers and colorful fruits. *Clerodendrum trichotomum* sometimes is cultivated in the southern USA, including Arkansas, and previously has been reported as a component of the naturalized floras of Alabama, Florida, Georgia, Louisiana, and North Carolina (Poindexter et al. 2011; Wunderlin and Hansen 2011; Kartesz 2015; Weakley 2015; Keener et al. 2018; USDA, NRCS 2018). *Clerodendrum trichotomum* aggressively spreads via root suckers, with plants forming large clonal stands over time. Root suckers sometimes are produced a distance of several meters from the original plant. Seed production, however, also occurs (observed in Arkansas plants of *C. trichotomum*) and may contribute to naturalization.

A morphologically similar species, *Clerodendrum bungei* (rose glorybower), is a small, colonial, deciduous shrub to 1–2(–2.5) m tall that is native to China (Bailey & Bailey 1976; Krüssmann 1976; Chen & Gilbert 1994) and also cultivated in Arkansas. This species aggressively spreads via suckering, as does *C. trichotomum*, to form extensive stands of plants (Fig. 3). Although not currently documented outside of cultivation in the state's flora, it should be expected as escaped or naturalized in proximity to where plants of the species are cultivated. *Clerodendrum bungei* has been documented in the floras of many states in the southeastern USA (Kartesz 2015; Weakley 2015) and should be expected outside of cultivation in Arkansas.

The two species of *Clerodendrum* may be distinguished reliably using the following key:

1. Plants to 10 m tall, becoming arborescent; leaf margins often entire, sometimes toothed; flowers white to whitish-cream, calyx 10 mm or more in length .... **Clerodendrum trichotomum**
1. Plants generally 1–2(–2.5) m tall with little to no branching of stems; leaf margins with large, serrate teeth; flowers rose-pink, calyx 8 mm or less in length .... **Clerodendrum bungei**

Figure 3. *Clerodendrum bungei* plant and habit for comparison with *C. trichotomum* (from cultivated plants in Arkansas). (A) Plants/clones showing suckering and colonial habit. (B) Flowers. (C) Mature fruits.

ACKNOWLEDGEMENTS

We are grateful to Ms. Kristen Benjamin, Henderson State University, for her helpful editorial suggestions regarding this paper. We also thank the Henderson State University Department of Biological Sciences and the Ellis College of Arts and Sciences for supporting this work.

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A NEW VARIETAL COMBINATION IN *MIMOSA PIGRA* (FABACEAE)

MICHAEL A. VINCENT
Department of Biology
Miami University
Oxford, Ohio 45056-1879
vincenma@miamioh.edu

JAMES L. ZARUCCHI
Missouri Botanical Garden
4344 Shaw Blvd.
Saint Louis, Missouri 63110-2291
James.Zarucchi@mobot.org

KANCHI N. GANDHI
Harvard University Herbaria
22 Divinity Avenue
Cambridge, Massachusetts 02138
gandhi@oeb.harvard.edu

ABSTRACT

The new combination **Mimosa pigra** L. var. **asperata** (L.) Zarucchi, Vincent, & Gandhi is formed to accommodate *M. asperata* and *M. berlandieri*, necessitated by the priority of the varietal name *asperata* from 1806.

Application of the International Code of Nomenclature for Algae, Fungi, and Plants (ICNAFP) necessitates a new combination at the rank of variety in *Mimosa pigra* L. According to Article 11.6, an autonym has priority over the name at the same rank that established it (Turland et al. 2018). This rule determines the correct name when *M. asperata* L. is treated as a variety of *M. pigra*.

Linnaeus (1755: 13–14) published the species name *Mimosa pigra*; conservation of the name with a conserved type was proposed by Verdcourt (1989) and approved at the 1993 Tokyo Congress (http://botany.si.edu/references/codes/props/display_new.cfm [viewed 17 Sep 2018], Wiersema et al. 2015). Linnaeus (1759: 1312) also published the species name *M. asperata*. In later works, the status of these two species varied: as *M. asperata* and var. *pigra* (L.) Willd. (Willdenow 1806: 1035); as *M. asperata* with *M. pigra* as a synonym (Bentham 1875: 437–438, de Candolle 1825: 428, Robinson 1898: 331); as *M. pigra* with *M. asperata* as a synonym (Bassler 1985: 597, Isely 1971: 420); or as distinct species (Barneby 1989, 1991: 437, 440).

For the treatment of *Mimosa pigra*, as either a variety or a synonym of *M. asperata*, Willdenow (1806), Bentham (1875), and Robinson (1898) referred to either the 1759 or 1763 publication of Linnaeus. We speculate that these authors were likely not aware of Linnaeus's 1755 publication.

Although Willdenow's (1806) new combination *Mimosa asperata* var. *pigra* is incorrect, his varietal name is valid and legitimate. As a consequence, the autonym *M. asperata* var. *asperata* was created (Art. 26.3).

Asa Gray (in Emory 1859: 61) published the binomial *Mimosa berlandieri* as a new species. Subsequent authors treated this species as a variety, e.g., *M. asperata* var. *berlandieri* (A. Gray) B.L. Rob., or *M. pigra* var. *berlandieri* (A. Gray) B.L. Turner.

Since the autonym *Mimosa asperata* var. *asperata* has priority from 1806, if *M. asperata* and *M. berlandieri* are considered synonyms at the rank of variety in *M. pigra*, then the correct varietal name must be var. *asperata*. Accordingly, this combination is made here.

Mimosa pigra L. var. **asperata** (L.) Zarucchi, Vincent, & Gandhi, **comb. nov.** *Mimosa asperata* L., Syst. Nat., ed. 10. 2: 1312. 1759. LECTOTYPE (designated by Brenan in Hubbard & Milne-Redhead (eds.), Fl. Trop. E. Africa, Leguminosae 1: 43. 1959): Herb. Linn. No. 1228.32 (LINN).

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ACKNOWLEDGEMENTS

We thank Barney Lipscomb (Botanical Research Institute of Texas) for providing pertinent pages from Field and Laboratory.

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TRES COMPOSITAE NUEVAS (ASTERACEAE) DE LA SIERRA MADRE ORIENTAL (MÉXICO)

JERZY RZEDOWSKI
Instituto de Ecología, A.C.
Centro Regional del Bajío
Apartado postal 386
61600 Pátzcuaro, Michoacán, México
jerzedowski@gmail.com

RESUMEN

Se describen e ilustran tres componentes nuevos de la familia Compositae, endémicos del sector meridional de la Sierra Madre Oriental. **Ageratum grossedentatum** Rzed., **sp. nov.** (tribu Eupatorieae), procedente del noreste de Guanajuato y al parecer más relacionado con *A. corymbosum* Zucc. y con *A. tehuacanum* R.M. King & H. Rob. **Baccharis zamudiorum** Rzed., **sp. nov.** (tribu Astereae), nativa del noreste de Querétaro y mayormente vinculada con *B. thesioides* Kunth. **Koanophyllon potosinum** Rzed., **sp. nov.** (tribu Eupatorieae), conocido del sureste de San Luis Potosí, cercano a *K. gracilicaule* (Sch. Bip. ex B.L. Rob.) R.M. King & H. Rob. Se ofrece además la relación de otras 28 especies de plantas vasculares, de distribución restringida al mencionado macizo montañoso, descritas en los últimos años.

ABSTRACT

Three new components of the family Compositae, endemic to the southern part of Sierra Madre Oriental, are described and illustrated. **Ageratum grossedentatum** Rzed., **sp.nov.** (tribe Eupatorieae), collected in northeastern Guanajuato, seems to be closely related to *A. corymbosum* Zucc. and to *A. tehuacanum* R.M. King & H. Rob. **Baccharis zamudiorum** Rzed., **sp. nov.** (tribe Astereae), native of northeastern Querétaro, is largely allied to *B. thesioides* Kunth. **Koanophyllon potosinum** Rzed., **sp. nov.** (tribe Eupatorieae), known from southeastern San Luis Potosí, is close to *K. gracilicaule* (Sch. Bip. ex B.L. Rob.) R.M. King & H. Rob. A list of 28 additional, recently described species of vascular plants endemic to this mountain range is also presented.

La Sierra Madre Oriental es uno de los importantes centros de concentración de endemismo en México. En un catálogo preliminar Rzedowski (2015) enumeró 659 especies de plantas vasculares de distribución solamente conocida de la parte medular (ca. 55,000 km^2) de tal macizo montañoso. De entonces a la actualidad se han dado a conocer como nuevos al menos otros 28 elementos de esa área y del mismo nivel taxonómico, a mencionar:

Agave doctorensis L. Hern. & Magallón, 2014 (Asparagaceae), de Querétaro
Ageratina eleazari Rzed., 2018 (Compositae), de Querétaro
Ayenia grisea Machuca-Machuca, 2017 (Malvaceae), de San Luis Potosí, Guanajuato, Querétaro, Hidalgo y Veracruz
Calyptranthes moctezumae E. Sánchez & Zamudio, 2016 (Myrtaceae) de Querétaro e Hidalgo
Ceratozamia chamberlainii Mart.-Domínguez, Nic.-Mor., & D.W. Stevenson 2017 (Zamiaceae), de San Luis Potosí e Hidalgo
Ceratozamia totonacorum Mart.-Domínguez & Nic.-Mor., 2017 (Zamiaceae), de Puebla
Dahlia tamaulipana J. Reyes, Islas, & Art. Castro, 2018 (Compositae), de Tamaulipas
Dasylirion micropterum Villarreal, A.E. Estrada, & Encino, 2016 (Asparagaceae), de Coahuila
Erythrina sierra Nesom, 2016 (Leguminosae), de Nuevo León y Tamaulipas
Eugenia huasteca E. Sánchez & Zamudio, 2016 (Myrtaceae) de Querétaro
Eugenia queretaroana E. Sánchez & Zamudio, 2016 (Myrtaceae) de Querétaro
Euphorbia zamudioi V.W. Steinm. & P. Carrillo, 2018 (Euphorbiaceae), de Tamaulipas, Querétaro e Hidalgo
Lithospermum elenae Pat.-Sic., J.L.Cohen & Zamudio, 2018 (Boraginaceae), de Querétaro

Lycianthes glabripetala E. Dean, 2018 (Solanaceae), de Querétaro
Magnolia alejandrae García-Mor. & Iamonico, 2017 (Magnoliaceae), de Tamaulipas
Magnolia nuevoleonensis A. Vázquez & Domínguez-Yescas, 2016 (Magnoliaceae), de Nuevo León
Magnolia pedrazae A. Vázquez, 2013 (Magnoliaceae), de Querétaro
Mammillaria occulta Zamudio & U. Guzmán, 2017 (Cactaceae) de Querétaro
Mammillaria rzedowskiana Zamudio & U. Guzmán, 2017 (Cactaceae) de Querétaro
Osbertia rupicola Rzed. & Zamudio, 2017 (Compositae), de Querétaro
Otatea victoriae Ruiz-Sánchez, 2015 (Gramineae), de Hidalgo
Pachyphytum rogeliocardenasii Pérez Calix & R. Torres, 2018 (Crassulaceae), de Querétaro
Pinguicula robertiana Zamudio & J. Hernández, 2018 (Lentibulariaceae), de San Luis Potosí
Pinguicula rzedowskiana Zamudio & D. Juárez, 2018 (Lentibulariaceae), de Querétaro
Rhynchosia rosaurae Rzed., 2017 (Leguminosae), de Querétaro
Roldana elizondoarum Rzed., 2018 (Compositae), de Querétaro
Salvia guevarae Bedolla & Zamudio, 2017 (Labiatae), de Hidalgo, Querétaro, y San Luis Potosí
Seymeria anita E. Carranza & C. Medina, 2017 (Orobanchaceae), de Querétaro

En la presente contribución se agregan otras tres especies novedosas de la familia Compositae, que solo se han observado en la mitad meridional de la Sierra, lo cual eleva a 690 el monto global conocido de endemismo local de plantas vasculares de este macizo montañoso.

Se describen e ilustran a continuación: *Ageratum grossedentatum* (tribu Eupatorieae) de Guanajuato, *Baccharis zamudiorum* (tribu Astereae) de Querétaro, y *Koanophyllon potosinum* (tribu Eupatorieae) de San Luis Potosí.

AGERATUM GROSSEDENTATUM Rzed., **sp. nov.** TIPO: **MÉXICO. Guanajuato.** Mpio. Atarjea: 7 km al N de Carricillo, sobre el camino a La Florida, ladera caliza con vegetación de encinar, alt. 2200 m, planta herbácea perenne de 70 cm de alto, flores azules, 15 oct 1995, *J. Rzedowski 52906* (holotipo: IEB, isotipos por distribuirse). Figura 1.

Planta herbacea perennis usque 70 cm alta; caules dense puberuli non ramosi; folia opposita laminis late deltato-ovatis 4.5–9 cm longis, 4–8 cm latis, trinervatis, margine grosse dentatis dentibus ad 11 mm longis, pilosis; capitula 10 ad ultra 30 in paniculis compactissimis terminalibus disposita; involucrum campanulatum ca. 5 mm longum, phylariis 18–25 fere aequalibus biseriatis lineari-lanceolatis vel linearibus longe attenuatis, externis trinervatis pilosulis, internis uninervatis glabris vel fere glabris, receptaculo elevato irregulariter conico epaleaceo, floribus per capitulum ca. 30; corollae tubulosae 3–4 mm longae azureae papillosae; achaenia columnari-claviformia ca. 2 mm longa tetrangularia nigra glabra, pappo coroniformi 0.2–0.3 mm longo.

Planta herbácea perenne hasta de 70 cm de alto; tallos varios partiendo de la base de la planta, sin ramificarse, más bien densamente pubérulos con pelos mayormente encorvados, antrorsos, de menos de 0.5 mm de largo, de color café claro; hojas opuestas, peciolos de 4 a 9 mm de largo, pilósulos, láminas anchamente deltoide-ovadas, de 4.5 a 9.5 cm de largo, de 4 a 8 cm de ancho, no pocas veces un poco más anchas que largas, obtusas a redondeadas en el ápice, truncadas en la base, muy toscamente dentadas en el margen, los dientes hasta de 11 mm de largo, romos en el ápice, a veces provistos de un lóbulo lateral, pilosas en el haz y ciliadas en el margen, en el envés pilósulas principalmente a lo largo de las nervaduras, trinervadas, de textura membranácea; inflorescencia en forma de una o a veces dos densas y compactas panículas terminales más o menos hemisféricas, cabezuelas ca. 10 a más de 30, casi sésiles o con pedicelos hasta de 4 mm de largo; involucro campanulado, de ca. 5 mm de largo, sus brácteas 18 a 25, dispuestas en 2 series de longitud similar y a menudo además 1 a 3 brácteas periféricas mucho más cortas, las brácteas linear-lanceoladas o lineares, largamente atenuadas en el ápice, las exteriores pilósulas, con tres nervaduras blanquecinas, las interiores un poco más largas y muy angostas, glabras o casi glabras, con frecuencia fuertemente encorvadas en la parte distal, uninervadas; receptáculo elevado, irregularmente cónico, negruzco, sin páleas, flores por cabezuela ca. 30; corolas tubulosas, de 3 a 4 mm de largo, de los que poco menos de 1 mm corresponden a los lóbulos, papilosas por fuera, azules en fresco; ramas del estilo sobresaliendo ca. 5 mm; aquenios columnar-claviformes, tetrangulares, con frecuencia algo torcidos, de ca. 2 mm de largo, negros, glabros, vilano en forma de corona blanquecina de 0.2 a 0.3 mm de alto.

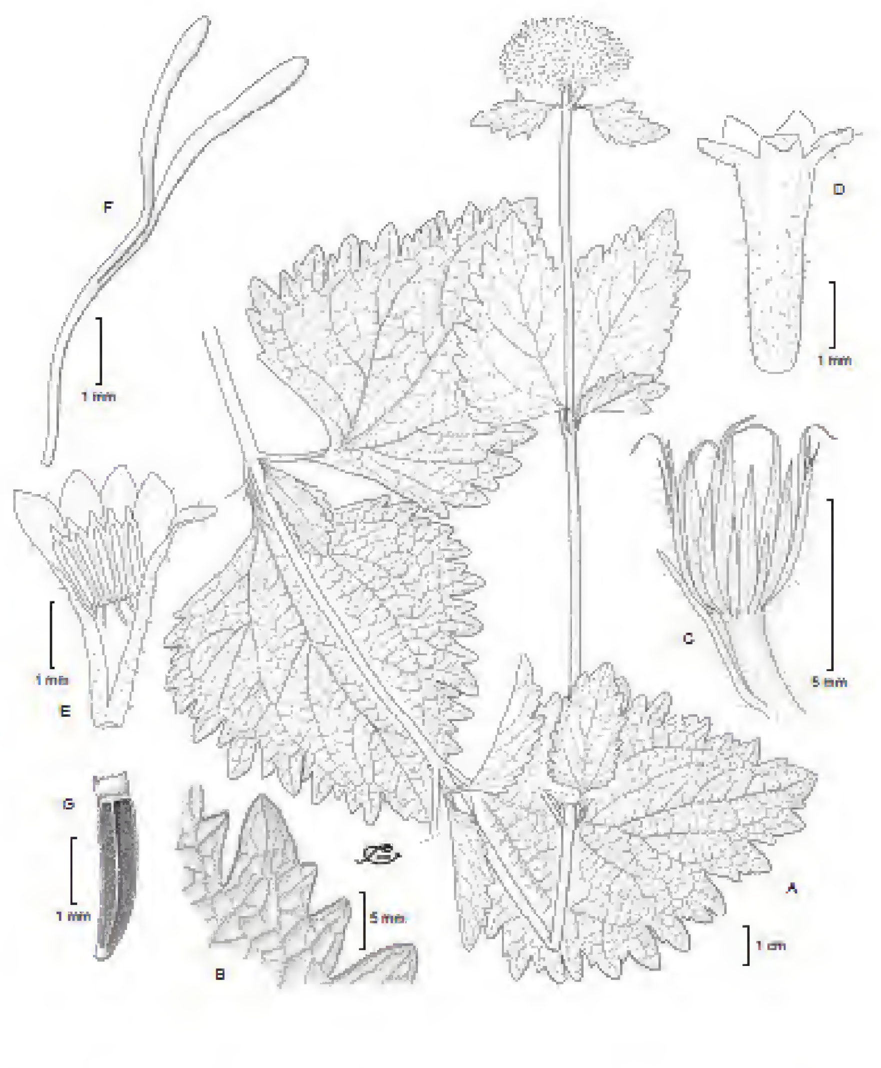

Figura 1. *Ageratum grossedentatum*. A. Rama con hojas e inflorescencia. B. Detalle del margen de la hoja. C. Involucro. D. Corola. E. Corola disecada mostrando el androeo. F. Estilo. G. Aquenio. Ilustrado por Alfonso Barbosa.

Ageratum grossedentatum solo se conoce de la localidad original y muy probablemente representa un estrecho endemismo de un corto sector de la Sierra Madre Oriental.

En virtud de ser planta perenne, sus aquenios glabros y vilano coroniforme, la especie nueva se afilia a la sección *Coelestina* (Cass.) A. Gray (Johnson 1971). Se relaciona más con *Ageratum corymbosum* Zucc., especie muy polimorfa conocida del suroeste de Estados Unidos al sur de México. También posiblemente esté vinculada con *A. tehuacanum* R.M. King & H. Rob., elemento endémico del Valle de Tehuacán, Puebla, y Cuicatlán, Oaxaca, y de áreas adyacentes de Veracruz, anteriormente considerado como parte de *A. tomentosum* (Benth.) Hemsl. De ambos discrepa mayormente en sus hojas con margen muy profundamente dentado. Otras características diferenciales se resumen en el Cuadro 1.

	Ageratum corymbosum	**Ageratum tehuacanum**	**Ageratum grossedentatum**
Hojas			
forma	lanceoladas a anchamente ovadas o rómbicas	ovadas a deltoides	anchamente deltoide-ovadas
largo en cm	2.5 a 10	2.5 a 5	4.5 a 9.5
margen	serrado a casi entero	crenado	tosca y profundamente dentado
pubescencia del envés	estrigosa, pilosa o tomentosa	tomentosa	pilósula
Brácteas involucrales			
número	28 a 55	ca. 25	18 a 25
Flores por cabezuela	50 a más de 100	ca. 50	ca. 30

Cuadro 1. Principales características diferenciales entre *Ageratum corymbosum, A. tehuacanum,* y *A. grossedentatum.*

BACCHARIS ZAMUDIORUM Rzed., **sp. nov.** TIPO: **MÉXICO**. **Querétaro**. Mpio. Pinal de Amoles: aprox. 1 km al SE del Llano de San Francisco, cañada con vegetación de bosque de *Quercus-Pinus,* alt. 2600 m, planta herbácea decumbente de 30–50 cm de alto, flores blancas, más o menos abundante, 15 ago 1990, *E. Carranza 2636* (IEB, duplicados por distribuirse). Figura 2.

Subfrutex decumbens 30–50 cm altus; caules stiati glabri; petioli ad 7 mm longi, laminae foliares ellipticae ad oblanceolatae vel oblongae 2–5 cm longae, 4–10 mm latae, apice acutae, base cuneatae, margine minute serrulatae, papillato-punctatae, discolores, triplinervatae; inflorescentiae terminales paniculiformes axibus puberulis, pedicellis ad 4 mm longis; capitula mascula involucro campanulato ca. 2.5 mm longo, phylariis 12–16 oblongis in 2–3 seriebus graduatis, apice acutis, scariosis, margine dense ciliatis, receptaculum epaleacum, flores per capitulum ca. 10, corollae ca. 2.5 mm longae limbo albido, pappus ca. 35 setis albis apice non incrassatis, corollae longitudinem aequantibus; capitula feminea turbinata vel campanulata 3.5–4 mm longa, phylariis 16–20, oblongis vel lineari-oblongis, graduatis in 3–4 seriebus, apice acutis, scariosis, margine dense ciliatis, receptaculum epaleaceum, flores per capitulum 20–25, corollae filiformes ca. 3 mm longae brunneae, achaenia prismatica ca. 1.7 mm longa, 4-costillata brunnea puberula vel fere glabra, pappus ca. 30 setis albis ca. 4 mm longis.

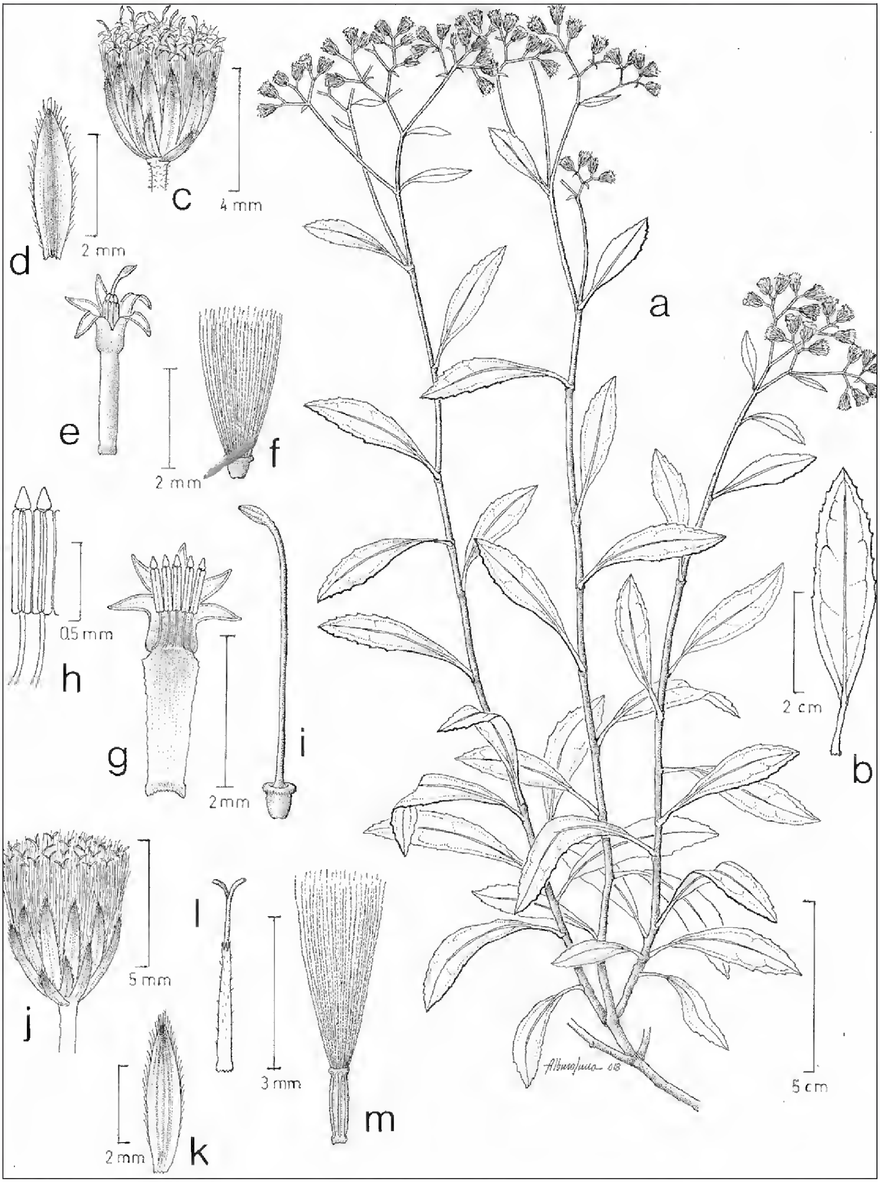

Figura 2. *Baccharis zamudiorum.* a. Rama con hojas e inflorescencias. b. Hoja. c. Cabezuela masculina. d. Bráctea del involucro. e. Corola de flor masculina. f. Aquenio estéril de flor masculina. g. Corola disecada de flor masculina. h. Dos anteras. i. Estilo de flor masculina. j. Cabezuela femenina. k. Bráctea del involucro. l. Corola de flor femenina. m. Aquenio fértil de flor femenina. Ilustrado por Albino Luna.

Planta subarbustiva decumbente de 30 a 50 cm de alto, glutinosa solo ocasionalmente a nivel de cabezuelas; tallos ramificados, estriados, glabros, en su parte basal provistos de raicillas adventicias; hojas alternas, peciolos hasta de 7 mm de largo, láminas elípticas a oblanceoladas u oblongas, de 2 a 5 cm de largo, de 4 a 10 mm de ancho, agudas en el ápice, cuneadas en la base, menudamente serruladas en la mitad o tercio distal, verdes oscuras en el haz, notablemente más pálidas en el envés, papilado-punteadas de manera más manifiesta en el envés, triplinervadas, de textura cartácea; inflorescencias en forma de panículas cimosas terminales, foliosas, moderadamente laxas y más o menos corimbiformes, con ca. 50 o menos cabezuelas, sus ejes fina y esparcidamente pubérulos con pelos de menos de 0.1 mm de largo, pedicelos hasta de 4 mm de largo, pero por lo general más cortos; cabezuelas masculinas con involucro campanulado de ca. 2.5 mm de largo, sus brácteas 12 a 16, oblongas, dispuestas en 2 a 3 series, las exteriores más cortas que las interiores, agudas en el ápice, con línea central verde a café y amplios márgenes de color pajizo, glabras a finamente pubérulas por fuera, densamente ciliadas en el margen, escariosas, receptáculo plano, sin páleas, flores por cabezuela ca. 10, corolas cilíndricas, de ca. 2.5 mm de largo, su estrecho tubo café, de poco menos de 2 mm de largo, garganta prácticamente ausente, el limbo blanquecino, segmentos angostamente triangulares, de ca. 0.7 mm de largo, ramas del estilo oblongas, de ca. 0.4 mm de largo, vilano de ca. 35 cerdas blancas del largo de la corola, su ápice sin ensanchamiento; cabezuelas femeninas con involucro turbinado a campanulado, de 3.5 a 4 mm de largo, sus brácteas 16 a 20, oblongas a linear-oblongas, graduadas en 3 a 4 series, agudas en el ápice, con línea central verde a café y márgenes de color pajizo, glabras a finamente pubérulas por fuera, densamente ciliadas en el margen, escariosas, receptáculo plano, sin páleas, flores por cabezuela 20 a 25, corolas filiformes, de ca. 3 mm de largo, cafés, ramas del estilo de ca. 0.5 mm de largo, cafés oscuras, aquenios prismáticos, de ca. 1.7 mm de largo, con 4 costillas, cafés, pubérulos a casi glabros, vilano de ca. 30 cerdas blancas de ca. 4 mm de largo.

En virtud de sus hojas triplinervadas, punteadas en el envés, así como de sus inflorescencias corimbiformes y receptáculo desnudo, la especie nueva se adscribe a la sección *Punctatae* Giuliano & Nesom, grupo esencialmente mexicano, pero que extiende su área de distribución al suroeste de Estados Unidos.

Es de aceptarse esta ubicación a pesar de las siguientes faltas de coincidencia exacta respecto a la definición original de la mencionada sección (Giuliano y Nesom 2003):

- planta prácticamente sin secreción pegajosa (de *B. z.)* vs. glutinosa;
- margen foliar sin dientes aristados (de *B. z.*) vs. aristado-serrado;
- aquenios prismáticos con 4 costillas (de *B. z.*) vs. rollizos con 5 a 8 costillas;
- cerdas del vilano de las flores masculinas sin engrosamiento apical (de *B. z.*) vs. ensanchados en el ápice.

A su vez, *Baccharis zamudiorum* comparte muchos rasgos vegetativos y, sobre todo de los órganos de reproducción, con *B. thesioides* Kunth, planta distribuida desde Arizona y Nuevo México hasta el centro de la República. Las principales características distintivas entre las dos especies se resumen en el Cuadro 2.

Caracteres	**Baccharis zamudiorum**	**Baccharis thesioides**
Porte	subfrútice decumbente de 30 a 50 cm de alto	arbusto erecto de de 1 a 3 m de alto
Hojas		
cantidad	moderada	muy numerosas
inserción	pecioladas	sésiles
forma	elípticas a oblanceoladas u oblongas	linear-oblanceoladas a angostamente elípticas u oblongas
márgenes	serrulados con dientes sin arista	serrulados con dientes aristados
Aquenios	con 4 costillas	con 5 costillas
Ubicación		
geográfica	Sierra Madre Oriental	Altiplano y Sierra Madre Occidental
ecológica	planta calcífila	planta, al menos de preferencia, calcífuga

Cuadro 2. Principales características diferenciales entre *Baccharis thesioides* y *B. zamudiorum.*

El nombre de la especie se dedica en calidad de homenaje a la labor desarrollada por los biólogos mexicanos de apellido Zamudio, en particular a Graciela Zamudio Varela, estudiosa de los aspectos históricos de la botánica, a Sergio Zamudio Ruiz, taxónomo, interesado en la sistemática del género *Pinguicula*, así como a Rosa María Murillo de Zamudio, quien destacó en el área editorial de la Flora del Bajío y de regiones adyacentes y de la revista Acta Botanica Mexicana.

KOANOPHYLLON POTOSINUM Rzed., **sp. nov.** TIPO: **MÉXICO**. **San Luis Potosí**. Mpio. Ciudad del Maíz: ca. 7 km al E de Agua Zarca, ladera caliza con vegetación de encinar, ca. 1150 m, arbusto de 1.5 m de alto, 26 mar 1959, *J. Rzedowski 10246* (holotipo: IEB; isotipos por distribuirse). Figura 3.

Frutex ca. 1.5 altus; rami juventute araneoso-puberuli; folia opposita, petioli ad 3.5 cm longi, laminae anguste ovatae vel lanceolatae 7–11 cm longae, 3–6 cm latae, apice acuminatae, base rotundatae vel late cuneatae, margine crenato-dentatae, maturitate supra glabrae, subtus ad basem puberulae, triplinervatae, sine punctis glandulosis; paniculae foliosae axillares pauciflorae plures, conjuncte inflorescentiam thyrsiformem foliosam fere compactam ad 40 cm longam facientes, pedicellis ad 10 mm longis; involucra late campanulata 5–6 mm longa et lata, phyllariis ca. 15 leviter imbricatis, anguste oblongis ad lanceolatis, apice plerumque rotundatis, scariosis, receptaculo glabro; capitula ca. 12 floribus; corollae tubulosae ca. 5 mm longae roseae glabrae; achaenia fere linearia et prismatica ca. 4 mm longa 5-costata rubello-brunnea glabra, pappus ca. 25 setis albis longitudinem corollarum aequantibus.

Arbusto de ca. 1.5 m de alto; ramillas leñosas, café-rojizas, araneoso-pubérulas en temprana juventud, pronto glabrescentes; hojas opuestas, peciolos hasta de 3.5 cm de largo, láminas angostamente ovadas a casi lanceoladas, en las hojas principales de 7 a 11 cm de largo, de 3 a 6 cm de ancho, en las del área de las inflorescencias muy numerosas, pero solo de 0.8 de 2.5 cm de largo, acuminadas en el ápice, redondeadas a anchamente cuneadas en la base, crenado-serradas en el margen, verdes oscuras en el haz, mucho más pálidas en el envés, en la juventud areneoso-pubérulas a lo largo de las nervaduras, en la madurez glabras o con algo de pelillos cerca de la base en el envés, sin puntuaciones glandulosas, triplinervadas, de nerviación menuda reticulada, de

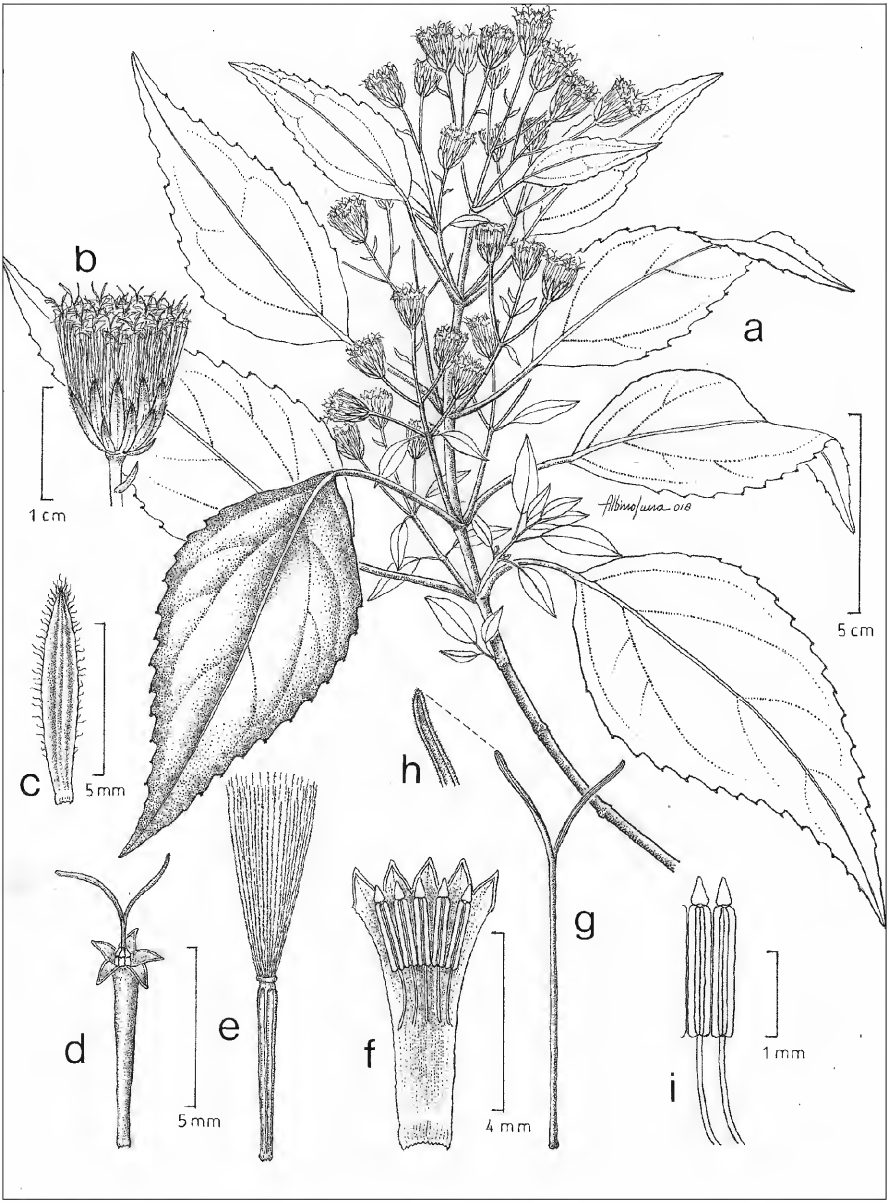

Figura 3. *Koanophyllon potosinum.* a. Rama con hojas e inflorescencias. b. Cabezuela. c. Bráctea del involucro. d. Corola. e. Aquenio. f. Corola disecada mostrando el androceo. g. Estilo. h. Detalle de rama del estilo. i. Dos anteras. Ilustrado por Albino Luna.

textura mambranácea; inflorescencias en forma de varias a numerosas (hasta 14) panículas cortas foliosas ubicadas en las axilas de las hojas en las porciones terminales de las ramillas, que en su conjunto conforman una especie de tirso folioso moderadamente compacto de 20 a 40 cm de largo y de 5 a 9 cm de diámetro, que llega a integrar hasta poco más de 100 cabezuelas, pedicelos filiformes, hasta de 10 mm de largo; involucros anchamente campanulados, de 5 a 6 mm de largo y de diámetro, sus brácteas ca. 15, levemente graduadas en ca. 3 series, angostamente oblongas a lanceoladas, por lo general obtusas a redondeadas en el ápice, las exteriores trinervadas, las interiores uninervadas, delgadas pero escariosas, glabras, mucho más oscuras por fuera que por dentro, sus márgenes hialinos, receptáculo pequeño, algo convexo, glabro, flores por cabezuela ca. 12; corolas rosadas, tubulosas, de ca. 5 mm de largo, de los cuales ca. 0.5 mm corresponde a los lóbulos angostamente triangulares y erectos, glabras; anteras con apéndices diminutos, redondeados en el ápice; ramas del estilo de ca. 1 mm de largo, rosadas; aquenios muy angostos, casi leneariformes y prismáticos, de ca. 4 mm de largo y ca. 0.5 mm de ancho, un poco más anchos hacia el ápice que en la base, con 5 costillas pronunciadas, rojizo-cafés, glabros, vilano de ca. 25 cerdas blancas, del largo de la corola, fácilmente quebradizas.

La especie nueva se conoce de una sola colecta realizada hace ya casi sesenta años en la vertiente externa de la Sierra Madre Oriental en su tramo correspondiente a San Luis Potosí. Probablemente representa un estrecho endemismo de un corto segmento de este macizo montañoso. La falta de especímenes adicionales posiblemente se debe, al menos en parte, al hecho de que florecen en la temporada seca del año.

Koanophyllon potosinum es afín al parecer a *K. gracilicaule* (Sch. Bip. ex B.L. Rob.) R.M. King & H. Rob., planta originalmente descrita de Oaxaca, pero en la actualidad también citada de San Luis Potosí y de otras partes de la República. Las dos especies comparten numerosas características importantes de hojas, flores e inflorescencias (Turner 1997, pp. 120-121), pero difieren en forma decisiva, como se observa en el Cuadro 3.

Caracteres	**Koanophyllon potosinum**	**Koanophyllon gracilicaule**
Ramillas, consistencia	leñosa	herbácea
Hojas		
forma	angostamente ovadas a casi lanceoladas	ovadas a triangulares
venación	triplinervadas	trinervadas
puntos glandulosos	ausentes	presentes
Inflorescencia		
forma general	compacta, tirsiforme	extendida, piramidal
Brácteas involucrales		
ápices	romos	agudos
pubescencia	ausente	presente

Cuadro 3. Principales caracteres diferenciales entre *Koanophyllon potosinum* y *K. gracilicaule.*

Koanophyllon es un género americano segregado de *Eupatorium* con más de 120 especies conocidas, en su gran mayoría habitantes de las Antillas. Para México se han descrito unas 25, de las cuales al menos cuatro son endémicas de la Sierra Madre Oriental.

AGRADECIMIENTOS

Se dan las gracias a la Dra. Martha Rzedowski, quien auxilió en la composición tipográfica. Las ilustraciones son obra de Albino Luna y de Alfonso Barbosa.

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A NEW VARIETAL COMBINATION IN *CASTILLEJA ARVENSIS* (OROBANCHACEAE)

J. MARK EGGER
Herbarium, Burke Museum of Natural History and Culture
University of Washington
Seattle, Washington 98195-5325
m.egger@comcast.net

ABSTRACT

The new combination **Castilleja arvensis** Schltdl. & Cham. var. **pastorei** (Hicken) J.M. Egger is proposed, based on *C. lithospermoides* Kunth var. *pastorei* Hicken. Var. *pastorei* occurs in northern Argentina and adjacent Uruguay and southern Brazil, at the southern margin of the much wider range of typical *C. arvensis*.

In a recent paper (Egger 2017), I reviewed the taxonomic and nomenclatural history of *Castilleja arvensis* Schltdl. & Cham. and provided a lectotype and full synonymy for that species name. In that paper I also presented the rationale for assigning all records determined as *C. lithospermoides* Kunth outside of central Mexico and some specimens from within that region to the widespread *C. arvensis*, as well as supporting the suggestion by Nesom (1992) and T.I. Chuang (annotation label on isotype of *C. lithospermoides* at P, 1993) that the type collection of that entity was synonymous with the Mexico endemic species, *C. scorzonerifolia* Kunth. At that time, I treated *C. arvensis* as a variable but monotypic species, well distinguished from *C. scorzonerifolia* (including some Mexican specimens originally assigned to *C. lithospermoides*) by its annual duration and unique morphological traits. However, after reviewing a number of collections and photographs of plants from south-central South America, it is now clear that one of the named forms I assumed to be indistinguishable from and synonymous with the typical form of *C. arvensis*, actually does deserve formal recognition, based on consistent differences in the coloration of the distal portions of the calyces. This initial oversight resulted from my examination of a unicate type collection obtained in 1911 and lacking its original coloration. This unique form is already described and proposed as a variety of another species (Hicken 1912), thus requiring only the following new combination.

Castilleja arvensis Schltdl. & Cham. var. **pastorei** (Hicken) J.M. Egger, **comb. nov.** *Castilleja lithospermoides* Kunth var. *pastorei* Hicken, Physis (Rev. Soc. Argentina Cienc. Nat.) 1: 30. 1912. TYPE: **ARGENTINA**. En el Cerro del Ruidito (San Luis), 20 Jan 1911, *F. Pastore s.n.* (holotype: SI!).

An image of the holotype sheet is presented below (Fig. 1), as well as images of live plants of both *Castilleja arvensis* var. *pastorei* (Figures 2-4) and plants of the typical variety (Fig. 5 and Fig. 6). Additional images of the latter and other *Castilleja* species mentioned in the paper can be found in Egger 2018.

Discussion

While its range is incompletely known, specimens and/or photographs of *Castilleja arvensis* var. *pastorei* are known from locations east of the Andes Mountains in Cordoba, San Luis, and Tocumen provinces in northern Argentina and from adjacent Uruguay and southern Brazil. While it appears that this variety is limited to the southern margins of the range of *C. arvensis* as a whole, it is not known if or to what extent it is sympatric with the typical variety. Var. *pastorei* should be looked for in Paraguay and eastern Chile. The typical variety replaces it in northern and central Brazil, as well as in the Andes Mountains to the west.

In Hicken's protologue for var. *pastorei,* it was contrasted with typical *Castilleja lithospermoides* (= *C. scorzonerifolia*), using characters of the leaves and flowers that distinguish both varieties of *C. arvensis* from the Mexico endemic *C. scorzonerifolia.* Though not included in the diagnostic features in the protologue, Hicken did mention the distinctive coloration of the calyces in var. *pastorei*: "… el cáliz, el cual es rojizo é híspido." The varieties can be distinguished from each other by the following couplet:

1a. Primary calyx lobes bright to dark greenish ……………………….…… var. **arvensis**
1b. Primary calyx lobes bright to dark reddish ……………..………………. var. **pastorei**

The placement of var. *pastorei* within *Castilleja arvensis* is also supported by a chromosome count reported by Páez et al. (2015) of the diploid number of n = 12 for plants originally determined by the authors as *C. lithospermoides* but verified as *C. arvensis* var. *pastorei* by an accompanying photograph. As the authors of that paper mentioned, this count does not match the count reported by Heckard (1986) and Chuang and Heckard (1993) of n = 24 for *C. lithospermoides* from Mexico. However, examination of all four voucher specimens cited by Chuang and/or Heckard (*Cruden 1180* [LL, MICH, UC]; *Cruden 1320* [UC]; *Cruden 1313* [NY, UC]; *Cruden 1672* [NY, UC] are actually specimens of *C. nervata* Eastw., and, with one exception, (*Cruden 1180*) they were not found within the range of *C. scorzonerifolia* and the synonymous *C. lithospermoides.* It appears that Chuang and Heckard did not consider *C. nervata* in their analysis of the species complex surrounding *C. scorzonerifolia* and assigned specimens of *C. nervata* to their concept of *C. lithospermoides,* thereby unintentionally adding to the confusion around that name. Moreover, published counts for both *C. arvensis* var. *arvensis* (Heckard 1986; Chuang & Heckard 1993) and *C. scorzonerifolia* (Chuang & Heckard 1993) are n = 12. Consequently, while the count by Páez et al. is consistent with its inclusion as a variety of *C. arvensis,* it is not conclusive in separating it from *C. scorzonerifolia.*

ACKNOWLEDGMENTS

My sincere thanks go to Guy Nesom for editorial review and to Andrea A. Cocucci, Shirley Sekarajasingham, and Peter Zika for permission to use their field photographs. I thank the personnel of CAS-DS, MICH, NY, SI, UC, and WTU for assistance with loans of specimens, a photograph of the type specimen (SI), and hospitality during my visits and in correspondence.

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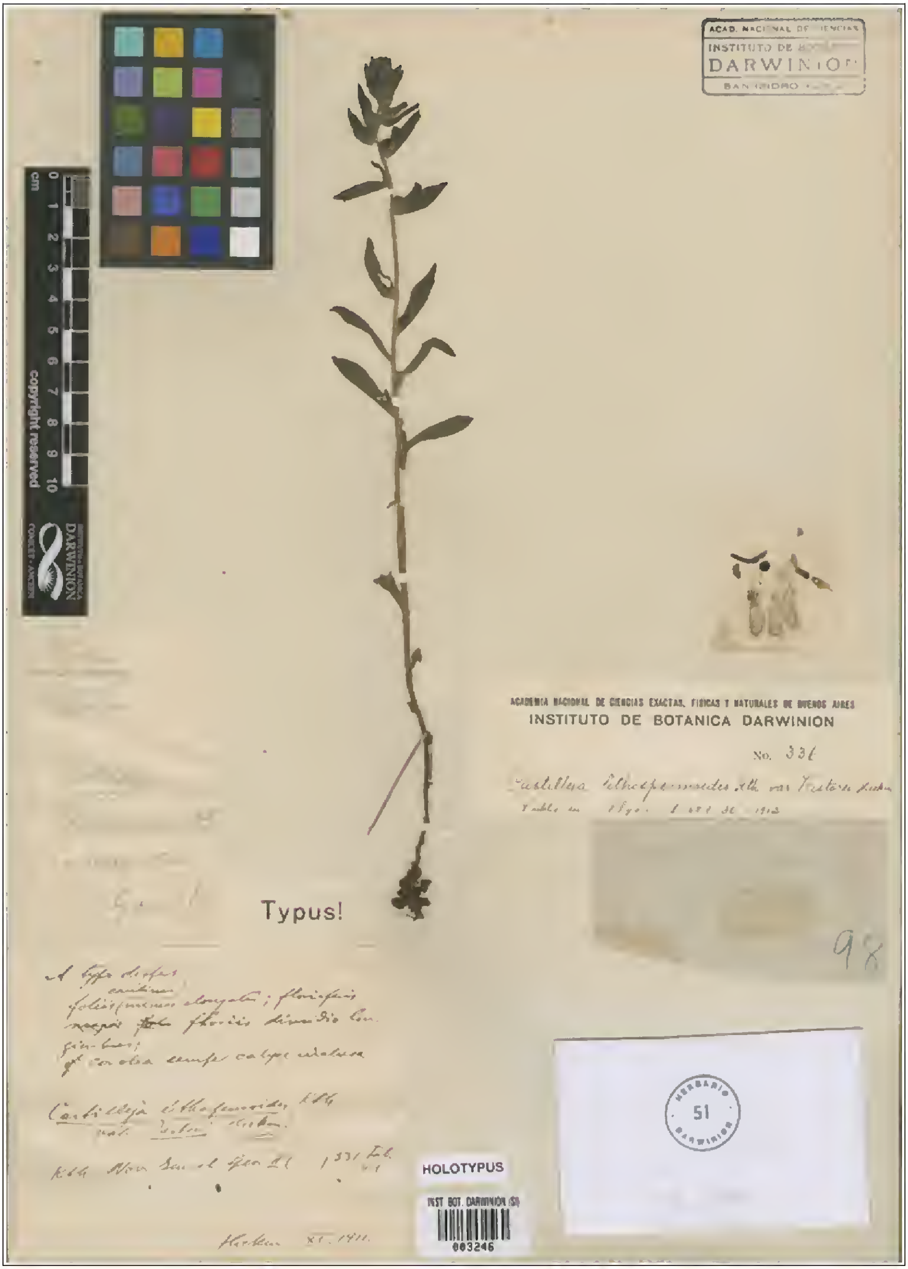

Figure 1. Holotype of *Castilleja lithospermoides* var. *pastorei*, SI.

Figure 2. Two examples of *Castilleja arvensis* var. *pastorei,* from Santa María Department, 4 Nov 2017 (L) and from Cruz del Eje Department, 4 Mar 2012 (R), Prov. Cordoba, Argentina. Photos by A.A. Cocucci.

Figure 3. *Castilleja arvensis* var. *pastorei* from Uruguay, precise location unknown, 9 Dec 2011. Photos by S. Sekarajasingham.

Figure 4. *Castilleja arvensis* var. *pastorei,* Serro de Mar Mountains, Rio Grande do Sul, Brazil, 8 Nov 2011. Photo by P. Zika.

Figure 5. *Castilleja arvensis* var. *arvensis*, east of Agallpampa, Depto. La Libertad, Peru, 16 Apr 2005. Photos by J. M. Egger.

Figure 6. *Castilleja arvensis* var. *arvensis*, Pasachoa Forest Reserve, Pichincha Prov., Ecuador, 13 Jul 1987 (L); Kipuka P'uu O'o, Island of Hawaii, 14 Jul 1999. Photos by J. M. Egger.

Wipff, J.K. and R.B. Shaw. 2018. Taxonomic change in the *Andropogon virginicus* complex (Poaceae). Phytoneuron 2018-73: 1–2. Published 5 November 2018. ISSN 2153 733X

TAXONOMIC CHANGE IN THE *ANDROPOGON VIRGINICUS* COMPLEX (POACEAE)

JOSEPH K. WIPFF
3512 25th Court SE
Albany, Oregon 97322
jkwipff@gmail.com

ROBERT B. SHAW
Department of Ecosystem Science and Management
Texas A&M University
College Station, Texas 77842
rbshaw10@gmail.com

ABSTRACT

As part of ongoing work on the grasses of Texas, we propose the following taxonomic change -- **Andropogon eremicus** Wipff & Shaw, **nom. nov.**, for *Andropogon glomeratus* var. *scabriglumis* C.S. Campb. The epithet *scabriglumis* is unavailable at species rank in *Andropogon* because of the earlier *Andropogon scabriglumis* Swallen.

As part of ongoing work on the *Guide to Texas Grasses* (Shaw & Wipff, in prep.) and on the grasses of Texas in general, it is necessary to discuss aspects of the taxonomy that we are adopting -- changes in rank, generic transfers to allow for the use of generic concepts, new or old, reinstatement of genera and species previously lost to synonymy, and clarification of characters used to delineate difficult genera or species complexes.

Based on Campbell's foundational taxonomic work on the *Andropogon virginicus* L. complex (Campbell 1983), botanists have come to recognize a diversity of taxa within this complex (Weakley, 2015; Weakley & al., 2011, 2018). Campbell (1983) recognized three varieties within *A. glomeratus* (Walt.) Britton, Sterns, & Poggenb. One of those varieties, var. *pumilus* (Vasey) L.H. Dewey, was characterized by sessile spikelets with the keels of the lower glume scabrous below and above the middle. Campbell (1983) recognized two variants within var. *pumilus*: the "Robust Variant" and the "Southwestern Variant." Campbell (1986) treated the two variants of var. *pumilus* (Campbell, 1983) as separate varieties: var. *pumilus* (≡"Robust Variant") and var. *scabriglumis* C.S. Campb. (≡"Southwestern Variant").

Weakley & al. (2011) reinstated *Andropogon glomeratus* var. *pumilus* (≡'Robust variant' sensu Campbell) to specific rank (as *Andropogon tenuispatheus* (Nash) Nash), based on morphology, ecology, and distribution.

Andropogon tenuispatheus (Nash) Nash, N. Amer. Fl. 17(2): 113. 1912. *Andropogon glomeratus* (Walt.) Britton, Sterns, & Poggenb. var. *tenuispatheus* Nash, Fl. S.E. U.S., 61. 1903. *Andropogon virginicus* L. var. *tenuispatheus* (Nash) Fernald & Griscom, Rhodora 37(436): 142, t. 338, f. 1. 1935. *Andropogon virginicus* L. var. *hirsutior* (Hack.) Hitchc. fo. *tenuispatheus* (Nash) Fernald, Rhodora 42: 416. 1940. *Anatherum virginicum* subvar. *tenuispatheum* (Nash) Roberty, Boissiera 9: 213. 1960. **LECTOTYPE** (Campbell, J. Arnold Arbor. 64: 244. 1983): **USA**. **Florida**. Duval Co.: Low ground near river, Jacksonville, Florida, 30 Oct 1894. *A.H. Curtiss 5337* (NY-image!; isolectotypes: GA(2 sheets), GH, NY, W-image!).

Andropogon glomeratus (Walt.) Britton, Sterns, & Poggenb. var. *pumilus* (Vasey) L.H. Dewey, Contr. U.S. Natl. Herb. 2: 496. 1894. *Andropogon macrourus* Michx. var. *pumilus* Vasey, Bot. Gaz. 16: 27. 1891 (non *Andropogon pumilus* Roxb., Fl. Ind. 1: 277. 1820). **TYPE**: **USA**. **Texas**. Val Verde Co.: Seminole Cave, western Texas, 1890, *G.C. Nealley 256* (holotype: US; isotypes: UC, W-image!).

Andropogon tenuispatheus is characterized by sheaths smooth (rarely scabrous), with or with pubescence; raceme sheaths usually less than 2.5 mm wide; ligule membranes less than 1 mm long, ciliate with long hairs; sessile spikelets usually less than 3.8 mm long; found in moist, often disturbed, sites: roadsides, freshwater or brackish swamps, swales, moist woods, and fields. This taxon is common from Virginia west along the coastal plain to Texas, south to northern South America, and the West Indies; but does not occur in the southwestern USA and northwestern Mexico.

Campbell (1986) recognized the "Southwestern variant" of *A. glomeratus* var. *pumilus* as a new variety, *A. glomeratus* var. *scabriglumis*, based on morphology and distribution. Var. *scabriglumis* is distinguished from *A. tenuispatheus* by having scabrous sheaths; raceme sheaths usually more than 2.5 mm wide; ligule membranes 1-2 mm long, ciliate with short hairs; sessile spikelets usually more than 4.2 mm long; restricted to moist soils of seepage slopes and the edges of springs in the southwestern USA and northwestern Mexico. Based on morphology, ecology, and distribution, we recognize var. *scabriglumis* as a distinct species.

We propose here a *nomen novum* at species rank for *Andropogon glomeratus* var. *scabriglumis* C.S. Campb. due to the pre-existence of *A. scabriglumis* Swallen.

Andropogon eremicus Wipff & Shaw, **nom. & stat. nov.** *Andropogon glomeratus* (Walt.) Britton, Sterns, & Poggenb. var. *scabriglumis* C.S. Campb., Syst. Bot. 11: 291. 1986 (non *Andropogon scabriglumis* Swallen, Mem. New York Bot. Gard. 9: 144–145. 1955). **TYPE**: **USA. New Mexico**: Grant Co.: Mimbres Hot Springs, grass around the hot springs, 2 Nov 1851, *C. Wright 2100* (holotype: GH-image!; isotypes: GH-image!, MO, NY, UC).

The epithet *eremicus* ("pertaining to deserts or living in a desert") refers to the confinement of the species to seepage areas and edges of springs in xeric habitats of the southwestern USA. and northwestern Mexico.

ACKNOWLEDGEMENTS

We are grateful for reviews of the manuscript by Kanchi Gandhi (nomenclature), Guy Nesom, and David Rosen, which significantly improved it.

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FIRST REPORT OF *EUPHORBIA HYPERICIFOLIA* (EUPHORBIACEAE) FOR NEW YORK STATE

DANIEL ATHA
Center for Conservation Strategy
New York Botanical Garden
Bronx, New York 10458
datha@nybg.org

EVE LEVINE
212 W 17th St, #3B
New York, NY 10011
elevine800@gmail.com

NATHAN TAYLOR
2310 Hwy 180 E, Lamesa, Texas 79331
anisophyllum@gmail.com

ABSTRACT

Euphorbia hypericifolia L. is documented from New York state for the first time, representing a northward range extension for the species in North America. A key to the identification of *Euphorbia* subg. *Chamaesyce* sect. *Anisophyllum* of New York City is included.

In late July 2018, the second author (EL) observed a member of *Euphorbia* subg. *Chamaesyce* sect. *Anisophyllum* growing under a mature hedge of yew (*Taxus baccata*) on the Upper West Side of Manhattan (New York County) and posted the observation to iNaturalist. After reviewing that observation and a later observation of the same plant in flower and fruit, the third author (NT) identified the plant as *Euphorbia hypericifolia* L. In late August, herbarium specimens were prepared from the Manhattan population and identified by DA and EL. In October, a second population was documented growing along a fence in Bronx County, New York, and identified by DA and NT (Figs. 1 and 2). The presence of two spontaneous populations from areas that have not been recently disturbed or planted suggest that the plants are persistent and naturalized in New York City.

Under natural conditions sect. *Anisophyllum* are found in habitats such as gravel bars, rock outcrops, barrens, glades, alvars, and sand dunes. They may be early successional in these habitats or form part of the climax community. In urban areas such as New York City, they are very common in sidewalk cracks, vacant lots, garden beds, and other open, disturbed areas. Most species produce abundant small seeds with a layer of mucilage that becomes sticky when wet, facilitating transport by humans and animals (Jordan & Hayden 1992).

Euphorbia hypericifolia is native to the American tropics and is likely adventive in the USA (Steinman et al. 2016). It is introduced to Asia and the Pacific Islands (Steinman et al. 2016). It has previously been reported east of the Mississippi from Louisiana, Alabama, Florida, Georgia, South Carolina, and Maryland but not New York state (USDA, NRCS 2018; Werier 2017; Steinman et al. 2016; Weakley 2015; Shetler & Orli 2000).

Voucher specimens. USA. New York. New York Co.: New York City, Manhattan, 165 West End Avenue, between 66th and 70th Streets, 40.777044, -73.98671 (WGS 84, ±10m), ca 15 m elev., 29 Aug 2018, *Atha, Levine, & Kreilick 16039* (NY). Bronx Co.: New York City, grounds of the New York Botanical Garden, NW of the Enid A. Haupt Conservatory, 40.864573, -73.882556 (WGS 84, ±5m), ca 33 m elev., 1 Oct 2018, *Atha 16043* (NY).

Key to *Euphorbia* subg. *Chamaesyce* sect. *Anisophyllum* of New York City

1. Plants glabrous.
  2. Leaves linear or oblong, entire; stipules filiform; exclusively on maritime beaches .... **Euphorbia polygonifolia**
  2. Leaves oblong, elliptic or orbicular, toothed or sub-entire; stipules triangular; widespread.
    3. Plants prostrate, often rooting at the nodes; leaves elliptic or orbicular; stipules appressed .... **Euphorbia serpens**
    3. Plants erect; leaves oblong; stipules spreading .... **Euphorbia hypericifolia**
1. Plants pubescent.
  4. Plants typically with a primary erect or ascending stem; stem pubescence an indistinct longitudinal line of hairs; fruits glabrous .... **Euphorbia nutans**
  4. Plants typically with many branching, prostrate stems from the base; stem pubescence evenly distributed; fruits pubescent or glabrous.
    5. Stem hairs typically appressed, curved; largest leaves to 1 cm long; fruits 1.0–1.3 mm long, conspicuously pubescent; seed coat reddish brown .... **Euphorbia maculata**
    5. Stem hairs typically spreading, ± straight; largest leaves $\geq$ 1 cm long; fruits ca 1.5 mm long, glabrous; seed coat black .... **Euphorbia vermiculata**

Figure 1. *Euphorbia hypericifolia*, whole plant, Bronx County, New York (*Atha 16043*, NY).

Figure 2. *Euphorbia hypericifolia*, close up showing glabrous stems, leaves, and fruits and spreading triangular stipules (*Atha 16043*, NY).

Euphorbia hypericifolia is now known from New York and Bronx counties, New York, and probably occurs elsewhere in New York City and perhaps also the Northeast. Prior to this publication four species in sect. *Anisophyllum* were reported for New York City: *E. polygonifolia*, *E. maculata*, *E. nutans*, and *E. vermiculata* (Atha & Boom 2018). An additional species, *E. serpens*, was reported from the Bronx as a ballast plant and nearby in Nassau County (Lamont et al. 2014). It has recently been observed in Kings County, New York, as part of the Newtown Creek Alliance and Hudsonia plant survey of Newtown Creek (https://www.inaturalist.org/observations/14347860), suggesting the species is indeed persistent and naturalized in the region.

Of the species currently known from New York City, *Euphorbia hypericifolia* is most like *E. nutans* in gross morphology. These are the only two species of the section in our area that are erect-ascending with relatively large oblong leaves, but *E. nutans* has less prominent, appressed stipules, minutely hairy stems, leaves usually with a few long hairs near the base and sometimes over the adaxial surface, cyathia not held in dense glomerules, and larger seeds. Another upright or ascending species with relatively large leaves is *E. hyssopifolia.* It is a Tropical American species that may also be native to the southern USA north to South Carolina (Steinman et al. 2016). The species has recently been observed from Richmond, Virginia (https://www.inaturalist.org/observations/16259840), and identified by photo but it should be vouchered and verified from specimens, especially with seed. With the warming climate, northward migration of the species and the flow of goods and people into New York City, it is probably only a matter of time before *E. hyssopifolia* is found in the New York City area.

ACKNOWLEDGEMENTS

We are grateful to Meryl Rubin for databasing, labeling, and distributing the specimens. Appreciation is extended to the New York City Department of Parks and Recreation for their ongoing collaboration on the flora of New York City. We thank David Werier (New York Flora Association) and Victor Steinmann (Universidad Autónoma de Querétaro) for their helpful comments and suggestions on the manuscript.

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SOLIDAGO AUSTROCAROLINIANA (ASTERACEAE: ASTEREAE), A NEW SPECIES OF SUBSECT. *HUMILES* FROM SOUTH CAROLINA

JOHN C. SEMPLE
Department of Biology
University of Waterloo
Waterloo, Ontario, Canada N2L 3G1
Correspondence: jcsemple@uwaterloo.ca

JOHN B. NELSON
Department of Biological Sciences
University of South Carolina
Columbia, South Carolina 29208

ABSTRACT

A new, apparently very rare species of *Solidago* subsect. *Humiles* is described from a previously unidentified collection made in June 1957 in South Carolina. **Solidago austrocaroliniana** Semple & J.B. Nelson, **sp. nov.**, is compared to other species of the subsection native to the southeastern USA.

An unidentified collection, *Bell 8499*, was included in a loan to the first author of multiple taxa and unidentified collections of *Solidago* from NCU (Thiers, continuously updated; Figs. 1 and 2). In preparation for returning this loan all of the indeterminants were examined and identified, except for the Bell collection from Union Co., South Carolina. The specimen had features most similar to *S. arenicola* and *S. racemosa* (*S. simplex* var. *racemosa* in FNA) but did not fit either species or others in subsect. Humiles (to which the collection is apparently referrable), because the involucres were smaller than those of *S. arenicola* and *S. racemosa* has sparsely hairy ovaries/cypselae. The collection was certainly not *S. kralii* or *S. plumosa.* As well, the plant from which the specimen was made was flowering in early June and the older post-blooming involucres were already developing fruit, thus it would have been in flower in mid to late May.

The second author was asked about possible additional unidentified collections of *Solidago* from Union Co. and presumably nearby counties. None were found at USCH and a trip was made by him in late June of 2013 to explore the location from which the Bell collection was made 56 years earlier (the sewage treatment plant noted in the label data was still across the road). No flowering goldenrods were found at the site, although the basal rosette of one damaged plant (identity unknown) was collected and a sample of another goldenrod taxon not in bloom was collected from a nearby hill, both clearly not conspecific with the Bell plant. The plan had been to gather more material and discover more about the biology of this new species. Instead, it is described here from the original single collection with the hope of stimulating a hunt for more populations by botanists in the greater Union County area of South Carolina.

There is only one normally spring blooming species of *Solidago*, *S. verna* M.A. Curtis ex Torr. & Gray, native to the coastal plain in North and South Carolina; this is a much hairier, non-resinous plant than the new species described below and is a member of subsect. *Argutae* (Semple & Cook 2006). Other species in the genus occasionally bloom in the spring or through much of the flowering season, especially in subtropical and tropical areas. However, all of these species have a primary blooming season in the fall. Thus, it is surprising to discover an additional late spring/early summer-blooming species of goldenrod.

HOLOTYPE: *Solidago austrocaroliniana* Semple, sp. nov
John C Semple [illegible] 2 Jul 2013 University of Waterloo

Multivariate Studies in *Solidago*
Solidago subsect. *Humiles*
K Kornobis & J C Semple Specimen No 1
WAT 2013 University of Waterloo

Herbarium of the University of North Carolina
SOUTH CAROLINA
Union Co.

Pond margins and adjacent deciduous woods southwest of Union opposite sewage disposal plant.

C. Ritchie Bell 8499 5 June 1957

Collected for the "Flora of the Carolinas"

Figure 1. Holotype of *Solidago austrocaroliniana.*

Figure 2. Details of the holotype of *Solidago austrocaroliniana.* A. Rootstock and basal leaves. B. Adaxial surface of lower stem basal leaf. C. Abaxial surface of lower stem leaf. D. Flowering heads. E. Developing disc floret cypsela. Scale bar = 1 cm in A, C, and 1 mm in B, D and E.

SOLIDAGO AUSTROCAROLINIANA Semple & J.B. Nelson, **sp. nov.** TYPE: **USA**. **South Carolina**. Union Co.: SW of Union opposite sewage disposal plant [Cross Keys Hwy, SC-49], 5 Jun 1957, *C.R. Bell 8499* (holotype: NCU!). Figs. 1 and 2.

Plants with features of *Solidago* subsect. *Humiles*; similar to *S. arenicola* but involucres smaller and blooming in spring.

Plants 30–40 cm; stem ascending from a short thick woody branching caudex, to 8 mm thick, mostly embedded in imbricate chaffy bases of older leaves. **Stems** 1, terete, shallowly multicostate, glabrous proximally, sparsely to moderately hirtellous in the inflorescence. **Leaves:** basal and proximal cauline petiolate to winged-petiolate, 24–70 × 5–10 mm; blades spatulate to mostly oblanceolate, tapering, margins distally coarsely but shallowly serrate-crenate, apices acute to rounded, often narrowed to short, often brown callused tipped; mid to distal cauline progressively more narrowly oblanceolate and acute, then to elliptic or lanceolate-elliptic, 35–47 × 6–10 mm, reduced distally, grading into widely ascending to spreading or reflexed bracts; faces abaxially pale, midnerves raised, level reticulum of dark somewhat translucent branch nerves, margins 0-4 fine serrations, ciliate, adaxially darker with only impressed midnerve evident. **Heads** 20–25 (1–5+ per branch), in racemiform or narrowly paniculiform arrays, mostly with primary branches widely to narrowly ascending, proximal most usually longest. **Peduncles** widely ascending, angulate, linear-oblanceolate bracteolate; bracts 1–3, grading into phyllaries, sparsely hirtellous, margins ciliate. **Involucres** broadly cylindrical, 5–6 mm. **Phyllaries** (in 3–4 series) 1–1.3 mm wide, unequal, glabrous; outer mostly green, oblong, blunt, inner spatulate or linear-oblanceolate, somewhat resinous or shiny, distally sparsely minutely glandular. **Ray florets** 5–6; laminae 3–4 mm long 0.8–1.2 mm wide. **Disc florets** 8–12; corollas 4.8–5.5 mm long, lobes 1–1.6 mm. **Cypselae** somewhat compressed-obconic, 2.5–2.7 mm, 1–3-ribbed, glabrous; **pappi** triseriate, whitish to straw-colored, outer bristles fine, 2° outer bristles 60% of longest, 1° outer taping 90–95% of longest, 1° inner somewhat clavate, 4.7–5 mm. **2*n*** = unknown. Known only from the type collection.

Flowering May–June. Mesic woods around pond margin; 140-150 m elevation.

The species is named for the state in which it was discovered, South Carolina.

Solidago austrocaroliniana is most similar to *S. arenicola*, but from its involucre height it is assumed to be diploid. The holotype collection appears to have bloomed first from the shorter main stem, which has flowering and post flowering heads with developing to nearly mature fruit. The most mature heads would have been flowering in May. A lower branch elongated well above the main stem and is producing both immature heads and flowering heads. There is no obvious damage to the main stem that would account for the lower branch elongating as much as it did. Phyllaries can appear shiny-resinous, as is the usually case for species of subsect. *Humiles*.

The three other species of *Solidago* subsect. *Humiles* (Rydb.) Semple native to the southeastern USA also are rare to very rare. **Solidago plumosa** Small is the rarest and is known from rocks along the shore of the Yadkin River at only one population in North Carolina. It was first sampled in 1894 and thought possibly to be extinct (Cronquist 1980) until rediscovered in 1994 by Alan Weakley and Steve Leonard (Alan Weakley, pers. comm.). **Solidago arenicola** B.R. Keener & Kral was discovered growing in sandy alluvial soils at two locations in northern Alabama reported by Keener and Kral (2003) and subsequently at a location in Tennessee (Semple & Cook 2006; Peirson et al. 2012). Floden (2012) proposed that both *S. arenicola* and *S. racemosa* (using the combination *S. simplex* var. *racemosa* (Greene) Ringius) were present together at the Tennessee site. **Solidago kralii** Semple was described in the same journal issue as *S. arenicola* (Semple 2003). It occurs in sandy soils of the fall line counties in central Georgia and southwestern South Carolina and can be locally common. None of these species would be expected to occur in Union County, SC, in moist soils in the upper Piedmont, based on habitat or biogeography.

Subsect. *Humiles* also includes five rare to very rare species in the Great Lakes Region and the northeastern USA and adjacent Canada (*S. chlorolepis* Fern., *S. gillmanii* (A. Gray) Steele, *S. ontarioensis* (Ringius) Semple & Peirson, *S. racemosa* Greene, and *S. randii* (Porter) Britt.), one relatively rare species along the Pacific coast of California and Oregon (*S. spathulata* DC.), one narrowly distributed species in Mexico (*S. simplex* Kunth; Semple et al. 2016) and one widely distributed species in western North America from Alaska to New Mexico in the Rocky Mountains and east across Canada to the Lake Superior shores in Ontario and into northern Michigan (*S. glutinosa* Nutt.; Semple & Peirson 2013; Semple 2016). The ranges of all species are presented in Semple (2018, frequently updated). In the Flora of North America all of the northeastern species were included as varieties in *S. simplex* (Semple & Cook 2006). Peirson et al. (2012) presented arguments favoring species level status for each of the ecologically and morphological distinct taxa, and Semple and Peirson (2013) presented the nomenclature. These species would also be highly unlikely to be found in the "upcountry" of South Carolina.

We thus conclude that the Bell collection represents a new species, based on its unique combination of morphological features, phenology, habitat, and geographic location. We hope that its naming will generate additional searches to locate extant populations that will corroborate its distintiveness.

ACKNOWLEDGEMENTS

This work was supported by a Natural Sciences and Engineering Research Council of Canada Discovery Grant to JCS. Katherine Kornobis is thanked for assistance with collection morphological data on *S.* subsect. *Humiles*. Joan Venn is thanked for her assistance with herbarium loans to WAT. NCU is thanked for loaning many collections of *Solidago* both requested and sent for determination. Keith A. Bradley is thanked for assistance in the field.

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Table 1. Comparison of *Solidago austrocaroliniana* with central and southeastern North American species in subsect. *Humiles.*

	austro-caroliniana	**arenicola**	**kralii**	**plumosa**	**racemosa**
Stems	30–40 cm; glabrous proximally, sparsely to moderately hirtellous in inflorescence	35–80 cm; proximally glabrous, sparsely to moderately hirtellous in infloresence	65–110 cm; glabrous or sparsely strigillose; copiously viscid-resinous in inflorescence	40–100 cm; glabrous, viscid-resinous	6–85 cm; proximally glabrous to strigose-hirtellous in inflorescence
Basal and lower leaves	oblanceolate; rounded to obtuse	spatulate to oblanceolate; acute to narrowly rounded	oblanceolate; acute	oblanceolate; acute (outer obtuse)	spatulate to oblanceolate; usually acute
Mid stem leaves	oblanceolate, acute	elliptic to lanceolate-elliptic, acute	linear-elliptic, acute	linear, acute	lanceolate to linear, acute
Involucre height	5–6 mm	8–12 mm	5–7 mm	4.5–6 mm	4.5-8.1 mm
Rays **Means**	5–6 5.5	6-10 5.6	4–12(–45) 7	2–8 5	2-16 7.5
Ray lamina length	3–4 mm	2.2–5.7 mm	2.1–4.5 mm	2.8–3.3 mm	2-4 mm
Disc florets **Means**	12–15 13.5	9-21 14.7	5-16 10.7	5–15 8.7	6–24 13.4
Disc cypsela	compressed-obconic, glabrous, 2–3 ribs	glabrous, 5-ribbed, narrowed to short neck	compressed-obconic to fusiform, glabrous, 5-8 dark ribs	compressed-obconic, glabrous, shallowly ribbed	narrowly obconic, sparsely to moderately strigose
Disc cypsela pappus	4.8–4.9 mm	3–4 mm	5–6 mm	4–5 mm	3–5 mm
Cypsela pubescence	glabrous	glabrous	glabrous	glabrous	sparsely strigose
Chromosome number	unknown	2n=36	2n=18	2n=18	2n=36, 54

Rzedowski, J. y R. Grether. 2018. *Indigofera mariosousae* (Leguminosae, Papilionoideae), nombre nuevo para una especie del centro de México. Phytoneuron 2018-76: 1. Published 5 November 2018. ISSN 2153 733X

INDIGOFERA MARIOSOUSAE (LEGUMINOSAE, PAPILIONOIDEAE), NOMBRE NUEVO PARA UNA ESPECIE DEL CENTRO DE MÉXICO

JERZY RZEDOWSKI
Instituto de Ecología, A.C.
Centro Regional del Bajío
Apartado postal 386
61600 Pátzcuaro, Michoacán
jerzedowski@gmail.com

ROSAURA GRETHER
Universidad Autónoma Metropolitana, Unidad Iztapalapa
Departamento de Biología, División CBS
09340 Ciudad de México
rgg@xauam.uam.mx

RESUMEN

Se propone el nombre **Indigofera mariosousae** Rzed. & R. Grether, **nom. nov.**, para reemplazar a *Indigofera sousae* Rzed. & R. Grether, que es un homónimo posterior de *I. sousae* M.A. Exell.

ABSTRACT

The name **Indigofera mariosousae** Rzed. & R. Grether, **nom. nov.**, is proposed to replace *Indigofera sousae* Rzed. & R. Grether, which is later homonym of *I. sousae* M.A. Exell.

En un trabajo publicado recientemente (Rzedowski & Grether 2018) se dio a conocer a *Indigofera sousae* como especie nueva, procedente del estado de Michoacán (México). Sin embargo, este binomio es un homónimo posterior de *I. sousae* M.A. Exell, descrita de Mozambique (Exell 1937). Con tal motivo se propone a continuación un nombre nuevo para la planta mexicana.

INDIGOFERA MARIOSOUSAE Rzed. & R. Grether, **nom. nov.**, para reemplazar a *Indigofera sousae* Rzed. & R. Grether, Phytotaxa 327(4): 257. 2018, nom. illeg., non *I. sousae* M.A. Exell, Bol. Soc. Broter. 12: 8. 1937. **TIPO**: **MÉXICO**. **Michoacán**. Mpio. Churintzio: Cerro Zináparo, 3.5 km al SE de Churintzio, 20°07' N, 102°02' W, 29 ago 1992, *I. Trejo 2543* (holotipo MEXU).

La especie africana es bastante distinta de la mexicana, como puede verse de la siguiente comparación: arbusto sin pubescencia glandular (*I. m.*) vs. subfrútice glandular-pubescente (*I. s.*); flores de 7 a 8 mm de largo (*I. m.*) vs. flores de ca. 4 mm de largo (*I. s.*).

AGRADECIMIENTOS

Damos gracias a la Dra. Helen Hartley, de los Reales Jardines Botánicos de Kew, por llamar nuestra atención sobre la existencia de un homónimo previo y la necesidad de proponer el nombre de reemplazo.

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Lamont, E.E. 2018. *Ageratina roanensis* (Asteraceae), a new combination for an endemic species from the Southern Appalachian Mountains. Phytoneuron 2018-77: 1–3. Published 5 November 2018. ISSN 2153 733X

AGERATINA ROANENSIS (ASTERACEAE), A NEW COMBINATION FOR AN ENDEMIC SPECIES FROM THE SOUTHERN APPALACHIAN MOUNTAINS

ERIC E. LAMONT
Honorary Curator
The New York Botanical Garden
Bronx, New York 10458
elamont@optonline.net

ABSTRACT

Ageratina roanensis (Small) E.E. Lamont, **comb. nov.**, is proposed based on *Eupatorium roanense* Small (Asteraceae). This species, which is endemic to the Southern Appalachian Mountains of eastern North America, has been treated for many years as a variety of *Ageratina altissima* (L.) King & H. Robins. [=*Eupatorium rugosum* Houtt.] but differs consistently from it in morphology and ecology.

Small (1933) described *Eupatorium roanense* Small from "Roan Mt., in the Blue Ridge, N. C. and Tenn." Subsequently, Fernald (1942) reduced *E. roanense* to varietal rank as *E. rugosum* Houtt. var. *roanense* (Small) Fern. [=*Ageratina altissima* King & H. Robins. var. *roanensis* (Small) Clewell & Wooten] and for the following 75 years the taxon has been treated as a variety (Fernald 1950; Clewell & Wooten 1971; Cronquist 1980; Gleason & Cronquist 1991; Nesom 2006; Weakley 2015).

Ageratina roanensis is morphologically distinct from *A. altissima* and is endemic to higher elevations (ca. 4000–6600 ft) of the Southern Appalachian Mountains. The two differ consistently in morphology and ecology and both are justifiably recognized as distinct species. Small (1933), Fernald (1950), and Cronquist (in Gleason & Cronquist 1991) have noted distinguishing characteristics, as summarized in the following couplet.

1. Florets mostly 18–34 per head; phyllaries mostly 5–7 mm long, apices cuspidate to acuminate; involucre campanulate or nearly so; leaf blades generally deltate .... **Ageratina roanensis**
1. Florets mostly 9–20 per head; phyllaries mostly 3–5 mm long, apices acute to obtuse; involucre turbinate; leaf blades narrowly to broadly ovate .... **Ageratina altissima**

A new combination is needed for a forthcoming treatment of Asteraceae tribe Eupatorieae in *New Manual of Vascular Plants of Northeastern United States and Adjacent Canada* (Naczi 2016).

AGERATINA ROANENSIS (Small) E.E. Lamont, **comb. nov.** *Eupatorium roanense* Small, Man. S.E. Fl. 1326. 1933 (as *roanensis*). **TYPE: USA. Tennessee.** [Carter Co.]: Roan Mt., 10 Sep 1885, *N.L. Britton s.n.* (holotype: NY!; Fig. 1).

Representative specimens. USA. Georgia. Towns Co.: Brasstown Bald Mt., summit, elev. 4780 ft, 9 Sep 1961, *Jones 866* (NCU). Union Co.: Brasstown Bald, forested slopes and ravines, 25 Aug 1966, *Bozeman 7927* (NCU). **Kentucky**. Harlan Co.: Top of Black Mt., 4100 ft, in woods, 28 Sep 1940, *McFarland & Rogers 29* (TENN). **North Carolina**. Ashe Co.: Near Creston, moist, rich, rocky wooded slope, 13 Aug 1935, *Correll 3989* (GH). Avery Co.: Access road to Blue Ridge Parkway just NE of Linville, ca 4000 ft, roadside and woods' edge, 19 Sep 1981, *Carter 2875* (NY). Buncombe Co.: Ca. 5 mi NE of Barnardsville on Hyw 197, common along edge of mountain stream and shaded roadside bank, 30 Aug 1955, *Wilbur 4798* (NCSC). Cherokee Co.: Mountainside near Junalusko Creek, 8 Sep 1932, *Harbison & Totten s.n.* (NCU). Clay Co.: Buck Creek Area, near Hwy 64 W of Black Gap, bog, 21 Aug

Figure 1. *Ageratina roanensis*, holotype (NY).

1956, *Radford 16140* (NCU). Graham Co.: 9 mi S of Tapoco near Stratton Meadows, oak-hickory forest, 19 Aug 1956, *Radford 16103* (NCU). Haywood Co.: Just W of Maggie on Hwy 19, common on borders of rich hardwood forest, 11 Aug 1965, *Raven 20479* (NY). Jackson Co.: Soco Gap, 31 Aug 1957, *Justice s.n.* (UNC). Macon Co.: Wayah Bald Mt., Nantahala Forest Rd, 4.5 mi W of fish checking station, rocky stream bed on steep mountain slope, 18 Aug 1949, *Godfrey 49986 & Fox* (NCSC). Madison Co.: 4.4 mi W of Canto on Hwy 63, wooded roadbank, 8 Oct 1958, *Ahles 50512 & Duke* (NCU). McDowell Co.: 1.6 mi ENE of Deep Gap on Blue Ridge Parkway, Green Knob Lookout, mountain top, 1 Sep 1956, *Bell 4424* (NCU, NY). Mitchell Co.: Roan Mt., on slope of Roan High Bluff, 6100 ft, in opening in woods of *Abies fraseri* and *Rhododendron catawbiense*, 6 Sep 1941, *Clausen 5599* (NY). Swain Co.: Roadside at Mollie Gap, near Mile High, just outside Blue Ridge Parkway boundary, ca. 5300 ft, 18 Aug 1956, *Mouzon 139* (NCU). Transylvania Co.: NE slope of Fryingpan Mt., 18 Jul 1957, *Freeman 57588* (NCU). Watauga Co.: Blowing Rock, shaded hillside, 15 Oct 1963, *Smyth 804* (VPI). Yancey Co.: Mt. Mitchell, 5500 ft, woods, 14 Sep 1926, *Hunnewell 9990* (GH). **South Carolina**. Oconee Co.: Hwy 130 ½ mi SW of Whitewater Falls, disturbed roadside, 4 Sep 1993, w/o coll name and number (EKY). Pickens Co.: Sassafras Mt., mixed deciduous forest, 22 Aug 1956, *Radford 1655* (NCU). **Tennessee**. Blount Co.: Thunder Head, Great Smoky Natl Park, 17 Aug 1929, *Cain 1* (TENN). Carter Co.: Roan Mt., 6200 ft, in rich loam borders of woods, 22 Aug 1937, *Jennison 21* (TENN). Cocke Co.: Maddron Bald, ca 4500 ft, vicinity of Cosby, moist woods, loam on wooded slope, 3 Aug 1936, *Jennison & Raper 3336* (TENN). Sevier Co.: Clingman's Dome, 6600 ft, moist, rich humus loam, 3 Sep 1935, *Jennison 712* (TENN). Unicoi Co.: Big Bald Mt., 5 Sep 1955, *James s.n.* (TENN). **Virginia**. Bland Co.: Little Walker Mt., Hwy 600, 0.6 mi SE of 601 jct, rich, damp woods, 17 Sep 1969, *Uttal 6770* (LYN). Floyd Co.: Summit of Buffalo Mt., under trees, 25 Sep 1976, *Porter & Condit 2069* (VPI). Giles Co.: In "Bob's field" N of Mt. Lake, 9 Sep 1937, *Givens s.n.* (VPI). Grayson Co.: White Top Mt., 25 Sep 1938, *Roller s.n.* (VPI).

ACKNOWLEDGEMENTS

I am grateful to Robert Naczi and Guy Nesom for reviewing the manuscript and providing helpful suggestions. I thank Matthew Pace, Amy Weiss, Thomas Zanoni, and other staff at The William and Lynda Steere Herbarium, The New York Botanical Garden, for assistance in finding the holotype of *Ageratina roanensis* and imaging it.

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Darrach, M.E. 2018. *Lomatium roneorum* (Apiaceae), a new species from the east slopes of the Cascade Mountains, Washington state. Phytoneuron 2018-78: 1–12. Published 5 November 2018. ISSN 2153 733X

LOMATIUM RONEORUM (APIACEAE), A NEW SPECIES FROM THE EAST SLOPES OF THE CASCADE MOUNTAINS, WASHINGTON STATE

MARK E. DARRACH
Herbarium, Burke Museum of Natural History and Culture
University of Washington
Seattle, Washington 98195
corydalis.mark@gmail.com

ABSTRACT

Lomatium roneorum Darrach, **sp. nov.**, is a narrowly endemic species of probable conservation concern found growing on friable arkosic sandstone substrates of the lower-middle Eocene Chumstick Formation and Mesozoic acidic metamorphic substrates in Chelan County along the east slope of the Cascade Mountains in central Washington state. The species is morphologically distinct in the genus. *Lomatium roneorum* is distinguished from the apparently closely related *L. cuspidatum* Mathias & Constance, which is mostly restricted to ultramafic rock. The new species produces more crowded and numerous glaucous leaflets, shorter blunt-tipped leaflets lacking the elongate apiculus of *L. cuspidatum,* larger fruits with shorter pedicels, and yellowish flowers, typically with a distinctive irregular abaxial russet wash rather than the reddish-purple-brown flowers diagnostic of *L. cuspidatum.* Additionally, plants of *L. roneorum* often produce an involucre composed of a few typically broad bracts. The species is known from four locations near the towns of Leavenworth and Plain, Washington.

Lomatium is by far the largest genus in Apiaceae in North America. A parade of newly-described species and infraspecific taxa over the last decade demonstrates that there remains undocumented biodiversity in the genus. Newly described taxa within the last decade include *L. tamanitchii* Darrach and Thie (2010), *L. ochocense* Helliwell (2010), *L. bentonitum* Carlson & Mansfield (Carlson et al. 2011), *L. pastorale* Darrach & D.H. Wagner (2012), *L. brunsfeldianum* McNeill (2012), *L. swingerae* McNeill (2014), *L. tarantuloides* Darrach & Hinchliff (2014), and *L. knokei* Darrach (2014). In particular, recent molecular genetic sampling and cladistic analysis in the genus and related genera in subfamily Apiodeae has provided significant new understanding (George et at 2014; Smith et al 2018).

Lomatium roneorum was first collected 1 May 1987 by G. Patrick east of Plain, Washington, in Chelan county. Initially identified as *Lomatium cuspidatum,* the collection was later annotated by Dr. Mark Schlessman as being unusual and perhaps worthy of consideration of recognition at varietal rank. Later collections further to the north near Basalt Peak were made by E. Burnett in 1989, and a collection in 1999 by local botanist Thayne Tuason immediately north of the town of Leavenworth, Washington, was also recognized as unusual for *L. cuspidatum.* This 1999 collection was sent to the late Dr. Ronald Hartman at RM, University of Wyoming. His determination of *L. cuspidatum* for these plants perhaps, in part, reflects a dearth of material representing that species at RM. The existence of these plants came to the author's attention in 2009, stemming from a series of photographs taken of the Leavenworth population in 2006. A subsequent field and collecting visit to the Leavenworth area population in June of 2011 was undertaken by the author. Review of this 2011 material with collections at WTU revealed a suite of consistent character differences when compared with other taxa in the genus, and, in particular, *Lomatium cuspidatum* Mathias & Constance.

Lomatium roneorum M.E. Darrach **sp. nov.** Figures 1–8. **TYPE**: **USA**. **Washington**. Chelan Co.: infrequent on open steep friable arkosic tuffaceous sandstone slope, 2.60 km N of Leavenworth, 47.62149 N -126.66228 W, 80% slope, aspect 230°, elev. 636 m (2084 ft), 11 Jun 2016, *M.E. Darrach 1132* (holotype: WTU; isotypes: CIC, OSC, SRP).

Lomatium roneorum combines character states distinct from its immediately associated and regionally contiguous congeners and all other recognized members of the genus. The following characters and ecological parameters are particularly diagnostic in discriminating *L. roneorum* from *L. cuspidatum*: plants with numerous strongly overlapping/crowded blunt-tipped leaflets, all corollas yellow, and most with an irregular russet wash on abaxial surfaces, leaves less planar than *L. cuspidatum*, plants on average larger, fruit pedicels shorter and with fruit dimensions that are significantly larger than *L. cuspidatum*, involucral bracts few, but usually present, while *L. cuspidatum* rarely displays any involucre development. *L. cuspidatum* is restricted to ultramafic substrates, while *L. roneorum* is not known to occur on ultramafic lithologies.

Herbs: Perennial, long-lived, moderately-pleasant aromatic, glabrous and strongly glaucous throughout, caulescent, caudex simple to, rarely, branched. Plants 19–58 cm in height with typical plants approximately 40 cm tall when in mature fruit. Plant stature increasing from anthesis through to fruit maturity. **Root:** taproot, lacking swellings (Figure 1) 20.0–60.0+ cm long by 8–13 mm in breadth at maximum width. Root surmounted by a root crown exposed at/near the surface and lacking any pseudoscape. Roots typically wedged into rock crevices making excavation difficult. Root crown annual scars typically poorly resolved, but approximate ages up to at least 45-years are noted. **Leaves:** old sheathing leaf bases often lacking, but more typically are present just below or at the soil surface obscuring the root crown, leaves 1–11, most typically about 5, venation obscure, glabrous and strongly glaucous, compound, ternate-bipinnate to biternate-bipinnate or biternate-bipinnate and partially tripinnatifid. Basal leaf dimensions 4.0–44.5 cm in length including petiole x 0.8-29.8 cm in width, triangular to quadrate in outline shape. Cauline leaf dimensions 2.7–19.0 cm including petiole x 2.5–8.5 cm, quadrate in outline. Basal leaf petioles 1.7–18.5 cm long, cauline leaf petioles 2.7–9.0 cm. Both with variably-developed winged basal portions, winged bases entire, herbaceous with variably green to discontinuously weak to occasionally moderately-developed light purple anthocyanic coloration at the base. Leaf bases becoming stramineous and chartaceous with age, prominent nerves on winged petioles 10–20. Leaves non-planar, distributed in a distinct, but subdued, 3-dimensional geometry. Leaflets crowded and often upturned, cuneate, elliptical to broadly oblanceolate, shortly mucronate or not. Leaflets 1.0–5.2 mm x 0.4–2.1 mm with typical material 1.7–3.5 mm x 0.8–1.4 mm usually with very fine serrations only visible above 20x magnification. **Inflorescences:** compound, 1–21 with 1–5 being typical; peduncles terete, strongly ascending, straight to curved or weakly sigmoidal, 12.5–62.5 mm at maturity, elongating with age as fruit develops; involucral bracts herbaceous 0–6, typically 1–3, 1.7–14.0 mm x 0.3–3.5 mm. Peduncles equaling to greatly exceeding the leaves as the inflorescence matures. Rays 6–24, unequal in length at maturity and in flower. Rays that are entirely ♂ 0–19, rays of mixed sex 0–21, rays that are entirely ♀, rare. The longer rays bear umbellets that are a mixture of male, female and, to a lesser extent, perfect flowers. Minimum ray length per inflorescence in flower 6.0–35.0 mm, maximum ray length per inflorescence in flower 24.0–58.0 mm. Minimum fruit-bearing ray length per mature infructescence 18.0–41.0 mm, maximum fruit-bearing ray length per mature infructescence 32.0–54.5 mm. Shortest rays usually bearing umbellets with entirely male flowers that do not lengthen with plant maturity. These short, staminate umbellets are typically clustered at the umbel center, they are irregularly deciduous by maturity and tend to bear fewer flowers. Umbellets 1–26 with typical range of 13–21 on most specimens. **Involucel:** bracts green to green-anthocyanic, herbaceous, narrow to linear, bract number 3–10 with typically values of 5–9, distribution radial to irregularly dimidiate. Involucel bracts 0.7–7.4 mm in length, 0.3–2.8 mm in width, glabrous, free to base, often with a well-developed mid-vein, occasionally weakly pinnatifid divided. **Flowers:** primarily andromonoecious on most plants, but some plants or individual inflorescences are polygamo-monoecious. Male flower pedicels smooth, glabrous, 2.8–5.1 x 0.15–0.4 mm in width, female and perfect flower pedicels smooth, glabrous, 1.6–5.9 x 0.3–0.8 mm. Both male and female flowers have very short but well-developed triangular calyx teeth that senesce as the fruit matures. Flowers glabrous 8–34 per umbellet with values of 12–28 typically encountered, petals pale to bright yellow with an irregularly distributed russet wash abaxially, 0.6–2.6 mm long, 0.5–1.2 mm wide, ovate with an adaxially strongly incurved short apiculus; stamens 5 and alternating with the 5 petals, anthers bright yellow to pale yellow, pollen yellow to whitish-yellow, filaments 0.5–2.1 mm. Stylopodia yellowish green to greenish yellow prior to pollination, becoming reddish purple post-pollination. Styles laterally flattened, strongly curved, divergent; ovaries green and glabrous. **Fruit:** hemispherically arranged with 0–17 fruit per umbellet; 4–12 being the most common range, the longer rays usually considerably more fecund, pedicels spreading-ascending to semi-erect, 3.8–9.3 mm with typical values of 5.3–8.3 mm encountered on most specimens. Fruits glabrous, 11.2–17.0 mm long with typical material 13.7–16.3 mm, 4.5–5.9 mm wide. Fruit wing width 0.5–0.8 mm, not obviously thickened, body width 3.4–4.7 mm. Fruit strongly dorsi-ventrally compressed with obtuse base and distal acute margin. Fruit aspect ratio 2.2–3.2. Fruit shape distinctly oblong to occasionally narrowly elliptical, with intervals and nerves both tannish brown and wings a contrasting paler tan. Dorsal fruit surfaces with 3–5 weakly-developed nerves flush with the fruit surface; vittae obscure, 2–8 in the intervals, 6–16 along the commisure, 1–2 on the wings. **Carpophore:** cleft to the base, persistent. A composite illustration is provided in Figures 1 and specimen photographs are in Figures 2 through **8.**

Additional collections examined. **Washington**. Chelan Co.: Above FS road 6101, ca. 0.5 mi SE of Maverick Saddle, ca. 5 mi E of Wenatchee Lake, N 47.831801, W -120.602626, 1,193 m, 27 May 2013, *Legler 12661* (WTU); along Estes Butte trail #1527, ca 1.5 mi from trailhead on slope N of Rock Creek, Chiwawa River drainage, N 47.982077, W 120.78468, 1109 m, 26 May 2013, *Legler 12658* (WTU); ridgetop 1.06 km NNE of Basalt Peak, N 47.98564, W -120.74440, 1698 m, 27 May 2017, *Darrach 1149* with Mary Kline (WTU).

Etymology. The epithet "roneorum" commemorates the surname Rone. It was chosen by the successful bidder for the plant naming auction held for this species in the fall of 2017.

Habitat. *Lomatium roneorum* is known from four populations near the towns of Leavenworth and Plain, Washington. All four sites are characterized by rocky substrates with acidic lithologies ranging from friable tuffaceous arkosic sandstones of the lower-middle Eocene Chumstick Formation to older Cretaceous multiply-deformed metamorphic rocks. Occupied habitats are invariably challenging settings in which successful establishment of plants would appear to be difficult. Ecological settings range from xeric open south-aspect steep slopes to gentle slopes of variable aspect under partial conifer canopy, where susceptibility to being shaded out may play a role in population persistence, particularly in the absence of fire.

Geographic range. *Lomatium roneorum* is presently known from within an area of approximately 250 square kilometers. It is clear, however, that only a very small proportion of this total extent includes occupiable habitat. Comprehensive surveys for the species have not been conducted and it can be reasonably assumed that there are populations remaining to be discovered. The species is sufficiently distinctive and robust in size that reconnaissance surveying using high-quality binoculars is likely to be an effective initial approach in at least some settings.

Similarities and relationships

Lomatium roneorum displays recognized morphological similarities with the apparent ultramafic substrate obligate *Lomatium cuspidatum* Mathias & Constance. The two taxa geographically most closely approach each other at the type locality, with a spatial separation of approximately 3 km and 670 m in elevation difference. Table 1 presents the full suite of character states and parameters that consistently separate the two species. Limited molecular genetic investigations of both *L. roneorum* and *L. cuspidatum* by Dr. James Smith at Boise State University (unpublished data) have not as yet returned conclusive evidence of significant genetic separation between the two taxa. However, distinct and consistent morphological differences and a complete lack of any specimens exhibiting any intermediate character states support recognition of *L. roneorum* at the specific rank.

KEY TO POSSIBLE CLOSE RELATIVES OF *LOMATIUM RONEORUM*

1. Small (<12 cm tall) acaulescent (caulescent) plants with or lacking an obvious shallowly-seated simple tuberous root; rarely, if ever, moniliform.

2. Plants tap-rooted, lacking any tuberous swellings; montane plants with irregularly-toothed partially fused leaflets .... **L. martindalei** (Coult. & Rose) Coult. & Rose
2. Plants with an obvious shallowly-seated simple tuber.

3. Plants usually with a single greatly-reduced photosynthetic cauline bract; mature fruit glabrous; plants typically of mid-montane elevations, usually on rocky mesic substrates .... **L. piperi** Coult. & Rose
3. Plants lacking a cauline bract; mature fruit finely scabrous or glabrous; plants of rocky or deeper loess-derived soils.

4. Maturing fruits glabrous, usually with a distinct anthocyanic rim; fruit pedicels (2–)4.6–11.7(–17) mm; open rocky soil habitats .... **L. canbyi** (Coult. & Rose) Coult. & Rose
4. Maturing fruits finely scabrous, lacking an anthocyanic rim; fruiting pedicels (0.6–)0.8–2.3(–3) mm typically of loess-derived deeper soils .... **L. gormanii** (Howell) Coult. & Rose

1. Larger caulescent or acaulescent plants lacking obvious shallowly-seated simple thickened tuber; deeper-seated moniliform or irregular tubers sometimes present.

5. Caulescent plants with umbellets completely lacking involucel bracts; flowers yellow; mature fruit with aspect ratio (2–)3–5(–8) .... **L. ambiguum** (Nutt.) Coult. & Rose
5. Plants with umbellets usually having an involucel; caulescent or acaulescent; fruit aspect ratio usually <3; flowers yellow, white or purple-brownish-purple.

6. Plants with an obvious swelling at the peduncle terminus; ultimate leaflet segments broad, typically with distal coarse teeth; plants usually acaulescent, but may be distinctly caulescent in Chelan and Kittitas counties, WA .... **L. nudicaule** (Pursh) Coult. & Rose
6. Plants lacking a swelling at peduncle terminus; ultimate leaflet segments various.

7. Plants smaller, never taller than 40 cm; not bushy in stature

8. Plants glabrous; ultimate leaflet segments (1.6–)6.3–48.1(–98) × (0.9–)1.2–2.9(– 4.3) mm; roots typically tuberous moniliform .... **L. geyeri** (S. Wats.) Coult & Rose
8. Plants hairy; ultimate leaflet segments (0.9–)1.3–5.1(–8.6) × (0.3–)0.4–1.2(–2.3) mm; root typically a tap root, occasionally with an irregular deep-seated tuber .... **L. macrocarpum** (Nutt. ex Torr. & Gray) Coult. & Rose

7. Plants robust–larger species occasionally as tall as 1m or more, often bushy in stature.

9. Plants short hairy throughout.

10. Mature fruit (13–)17–24(–32) × (3.5–) 5–8.5(–10) mm; distinctly bushy plants as tall as 1m; restricted to Chelan and Kittitas cos., WA .... **L. thompsonii** (Mathias) Cronq.

10. Mature fruit (7–)11.5–16(–17) mm × (2.5–)3–5(–5.5) mm; slender usually single-stemmed plants throughout east slope of the WA Cascades; ultimate leaflets variably broad (higher elevations) to narrow (lower elevations); plants 2–8 dm. .... **L. brevifolium** (Coult. & Rose) Coult & Rose

9. Plants glabrous or with numerous narrowly triangular to peg-like papillae.

11. Plants with papillae clearly visible under 10x lens.

12. Plants bushy with strong odour when herbage is crushed; papillae widely distributed on plants .... **L. grayi** (Coult. & Rose) Coult & Rose
12. Plants not usually bushy; herbage moderately smelling when crushed; papillae usually restricted to leaf veins and rachises.

13. Mature fruit with well-developed pedicels (3.5–)5.4–10.4(–13.8) mm .... **L. multifidum** (Nutt.) McNeill & Darrach
13. Mature fruit with very short (lacking) pedicels (0.6–)0.8–1.8(–2.5) mm .... **L. dissectum** (Nutt.) Mathias & Constance

11. Plants lacking papillae.

14. Plants with mature fruit deflexed; ultimate leaflet segments (7.3–)12–32(–45) × (0.8–)1.9–5.3(–9.2) mm .... **L. brandegeei** (Coult. & Rose) Macbr.
14. Plants with mature fruit ascending to strict on angled pedicels ultimate leaflet segments distinctly smaller.

15. Ultimate leaflets cuspidate; flowers brownish purple; ultramafic substrates .... **L. cuspidatum** Mathias & Constance
15. Ultimate leaflets shortly apiculate to blunt, not cuspidate; flowers yellow with irregular russet wash; plants of acidic lithologic substrates .... **L. roneorum** Darrach

Discriminating Character	***L. roneorum***	***L. cuspidatum***
Elevation	635 – 1698 m / averaging lower elevation	914 – 2134 m / averaging higher elevation
Substrate	acidic lithologies	ultramafic lithologies
Plant Height	range 19.0 – 58.0 cm / $\bar{x}$ = 38.5 cm 1-stdev = 24.9 – 52.1 cm	range 16.0 – 39.0 cm / $\bar{x}$ = 27.9 cm 1-stdev = 19.5 – 36.3 cm
Leaflet Shape & Distribution	cuneate, elliptical to broadly oblanceolate / numerous, crowded	narrowly elliptical, strongly apiculate cuspidate / fewer, less crowded
Involucre	usually present with at least 1 bract	Absent
Flower Color	always yellow with an abaxial russet wash	always deep reddish to brownish purple
Mature Fruit Pedicel Length	range 3.8 – 9.3 mm / $\bar{x}$ = 6.8 mm 1-stdev = 5.3 – 8.3 mm	range 5.0 – 21.8 mm / $\bar{x}$ = 11.1 mm 1-stdev = 7.3 – 14.9 mm
Mature Fruit Length	range 11.2 – 17.0 mm / $\bar{x}$ = 15.0 mm 1-stdev = 13.7 – 16.3 mm	range 7.3 – 14.5 mm / $\bar{x}$ = 11.2 mm 1-stdev = 9.4 – 13.0 mm
Mature Fruit Aspect Ratio	2.2 – 3.2	1.7 – 3.3

Table 1. Comparison of *Lomatium roneorum* character states and ecologic parameters with *Lomatium cuspidatum* character states and ecological parameters.

Phenology, ecology, and conservation

Emergence of *Lomatium roneorum* occurs each year, depending upon elevation and depth of snowpack, from mid-April to mid-May. Plants are at anthesis from late April through late May and are in full fruit by late May to late June at higher elevations. The plants rapidly senesce thereafter, seed is generally fully dispersed by mid-July, and the plants become largely unrecognizable as they reach full dormancy.

Lomatium roneorum appears to be a long-lived perennial species. However, analysis of root crown scars, a proxy for age utilized in other species in the genus (Darrach & Hinchliff 2014; Darrach 2014), has been inconclusive.

The species is presently known to occur at four, well-separated localities. The population at the type locality comprises approximately 125 individuals; the Maverick Saddle population is very small with only 5 plants documented; the Estes Butte trail population, while not visited by the author, is suspected to comprise a few hundred plants. The largest population is on the Basalt Peak ridgeline, with an estimated 800 plants present. The small population sizes indicate that significant conservation concerns for the species are warranted and that further inventory and assessment efforts should be a high priority. Numerous small seedlings scattered near established plants at all three populations investigated by the author appears to indicate that seed viability and germination are not likely to be significant limiting factors in the persistence of the species. However, the rocky and often friable nature of the substrates clearly present a challenging setting for long-term establishment of reproductive individuals. Recruitment levels are apparently very low.

Associated vascular plant taxa documented to co-occur with *Lomatium roneorum* include the following: *Abies lasiocarpa, Achillea millefolium, Agoseris heterophylla, Agoseris retrorsa, Allium acuminatum, Amelanchier alnifolia, Antennaria rosea, Arctostaphylos nevadense, Balsamorhiza sagittata, Boechera* sp., *Boechera retrofracta, Bromus tectorum, Bromus carinatus, Carex rossii, Castilleja* sp., *Clarkia pulchella, Clarkia rhomboidea, Claytonia lanceolata, Collinsia parviflora, Collomia grandiflora., Collomia tinctoria, Comandra umbellata, Cystopteris fragilis, Dicentra uniflora, Douglasia nivalis, Draba verna, Drymocallis glandulosa, Epilobium brachycarpum, Eriogonum compositum, Eriogonum elatum, Eriogonum* sp., *Eriogonum strictum, Eriophyllum lanatum, Erythronium grandiflorum, Galium aparine, Galium multiflorum, Heuchera cylindrica, Holodiscus discolor, Hydrophyllum capitatum, Ipomopsis aggregata, Lewisiopsis tweedyi, Lewisia columbiana, Linaria dalmatica, Lithophragma glabrum, Lomatium brandegeei, Lomatium brevifolium, Lomatium geyeri, Lomatium nudicaule, Lupinus* sp., *Madia exigua, Mentzelia albicaulis, Mentzelia laevicaulis, Micranthes* sp., *Paeonia brownii, Paxistima myrsinites, Penstemon* sp., *Penstemon pruinosus, Phacelia leptosepala, Phacelia linearis, Pinus contorta, Pinus ponderosa, Plagiobothrys tenellus, Poa bulbosa, Poa secunda, Pseudoroegneria spicata, Pseudotsuga menziesii, Ranunculus* sp., *Rosa* sp., *Sedum lanceolatum, Selaginella densa, Senecio integerrimus* var. *exaltatus, Sorbus sitchensis, Spiraea betulifolia, Tragopogon dubius,* and *Viola purpurea.*

Field observations field suggest that *Lomatium roneorum* is probably not exposed to any significant immediate threats at the present time. The type locality is infested with non-native weedy species, including significant amounts of cheatgrass (*Bromus tectorum*), and the capability of this site to carry fire is of concern. However, most of the plants are in sparsely vegetated locations along the slope. The most salient long-term threats to the species are likely to be ongoing climate modification and genetic isolation between the small populations with concomitant inefficient seed dispersal (Marisco & Hellmann 2009).

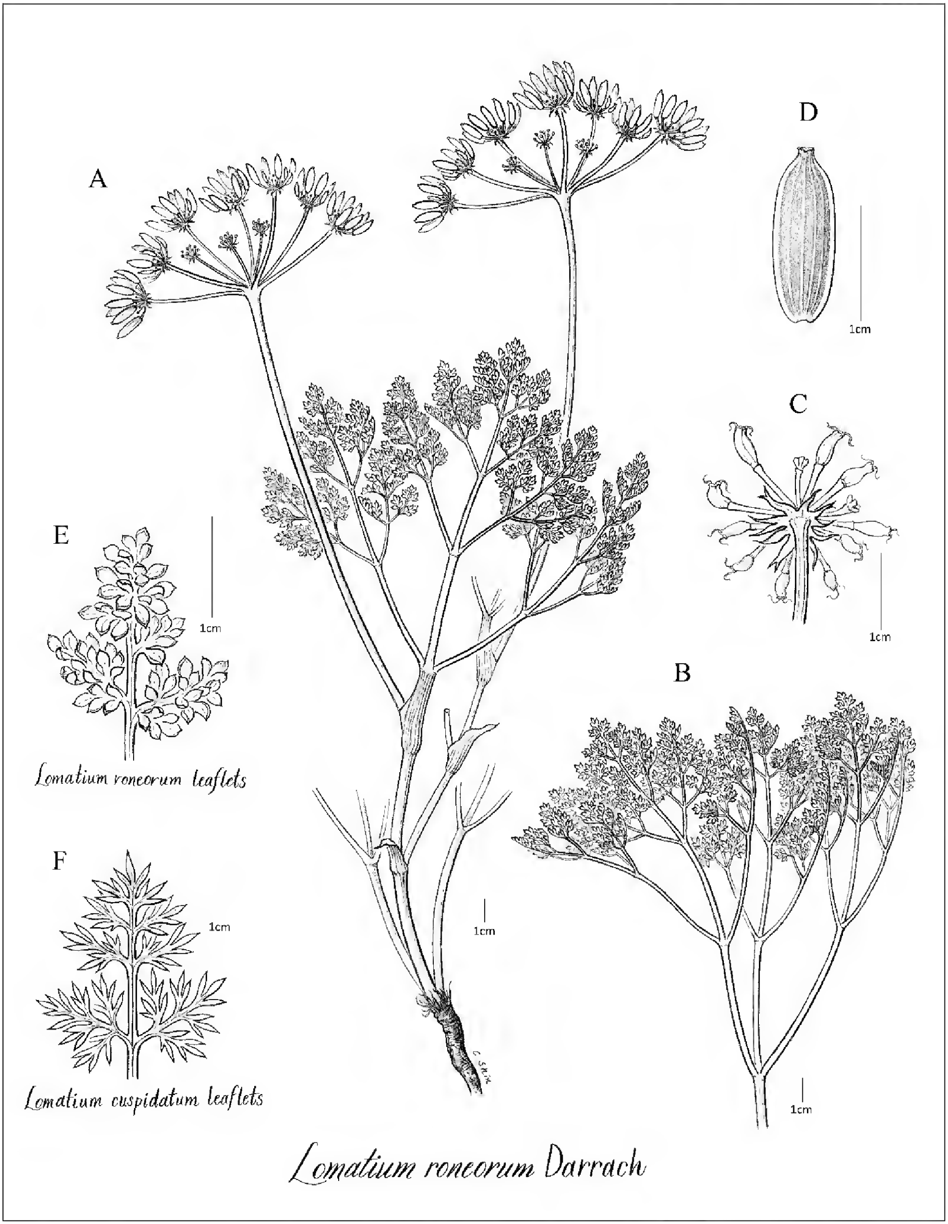

Figure 1. *Lomatium roneorum*. A. Habit of full specimen of plant. B. Primary leaf morphology. C. Involucel morphology on umbellet with immature fruit. D. Mature fruit. E. Detail of *L. roneorum* leaflets. F. Detail of *Lomatium cuspidatum* leaflets for comparison purposes.

Figure 2. Typical steep slope habitat of *Lomatium roneorum* at the type locality on Chumstick Formation sandstone.

Figure 3. *Lomatium roneorum* habitat near Estes Butte trail on metamorphic rock substrate.

Figure 4. *Lomatium roneorum* flowers displaying characteristic irregular russet wash color on abaxial petal surfaces.

Figure 5. *Lomatium roneorum* typical flowering specimen growing from a crevice in the rock substrate.

Figure 6. *Lomatium roneorum* typical leaflet morphology.

Figure 7. *Lomatium cuspidatum* typical leaflet morphology. (WTU image collection 2018)

Figure 8. *Lomatium roneorum*, mature fruit.

ACKNOWLEDGEMENTS

The excellent illustration work by Crystal Shin is acknowledged, as is the financial support of Corydalis Consulting. Mary Kline and Forrest Nichols provided field support, and Ben Legler kindly provided the photographs for Figures 3, 4, and 5. The photo in Figure 7 is provided via the online Burke Museum image collection. Thayne Tuason provided valuable information regarding the species that was incorporated in the text. Thanks also to Joan Frazee, who first brought this species to my attention.

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ERIGERON CONDITII (ASTERACEAE), A NEW SPECIES FROM THE SANTA LUCIA RANGE OF CENTRAL-WESTERN CALIFORNIA

DAVID J. KEIL
Professor Emeritus
Biological Sciences Department
California Polytechnic State University
San Luis Obispo, California 93407
dkeil@calpoly.edu

ABSTRACT

Erigeron conditii D.J. Keil, **sp. nov.** (Asteraceae), is described from the San Carpoforo Creek Canyon of southwestern Monterey and northwestern San Luis Obispo counties, California. It is a member of the *Erigeron foliosus* complex and is disjunct from the taxa recognized in recent treatments as *E. foliosus* var. *mendocinus* and *E. foliosus* var. *hartwegii*, the complex members that it most closely resembles. **Erigeron mendocinensis** D.J. Keil, **nom. nov.**, is proposed as a replacement name at the species level for the illegitimate *E. mendocinus* Greene [=*E. foliosus* var. *mendocinus*].

In May 2004, as a part of a botanical survey, I observed what appeared to be an undescribed species of *Erigeron* L. (Asteraceae) in the San Carpoforo Creek Canyon in northwestern San Luis Obispo Co., California. Because of a confidentially agreement, I was unable to proceed with a formal description of the taxon. In September 2018, I discovered two early 1900s collections of this undescribed *Erigeron* in the University of California Herbarium, one from Monterey Co. and one from San Luis Obispo Co. (Figs. 1, 2). Investigation of these specimens led me to conclude that they are part of the *Erigeron foliosus* Nutt. complex and represent a previously undescribed species.

ERIGERON CONDITII D.J. Keil, **sp. nov.** **TYPE**: **USA**. **California**. Monterey Co.: San Carpojo [Carpoforo], coast, [ca. 35.798461°, -121.282496°], [ca. 215 m], Jun 1912, *I.J. Condit s.n.* (holotype: UC 195576).

Perennial herb from woody base, antrorsely strigillose ± throughout with acute-tipped, multicellular trichomes 0.2–0.3 mm long. Stems multiple, slender, 25–45 cm, simple or sparingly branched, leafy throughout, internodes along most of stem 2–10 mm long. Leaves linear, along most of stem 2.5–6 cm long, 0.7–1.7 mm wide, distally decreasing to linear bracts 2–20 mm long, 0.2–0.8 mm wide. Peduncles not much differentiated except by proximal increase in internode length and gradual decrease of leaves to bracts, trichomes just proximal to heads ascending to spreading. Involucre cup-shaped; phyllaries in 4 series, inner 2 series subequal, 5–6 mm long, 0.5–0.7 mm wide, linear-oblong, acute to acuminate, bodies green with paler marginal zone, narrowly scarious-margined, drying ± straw-colored with darker centers, outer series graduated, 1.5–4 mm long, narrower, linear-acuminate, without paler margin or this very narrow, phyllary bodies minutely puberulent with gland-tipped trichomes ± 0.05 mm long, at least outer phyllaries with appressed to ± ascending, acute-tipped trichomes 0.2–0.75 mm, phyllary midvein with narrow embedded resin gland, this drying golden-brown. Ray flowers 30–40; corollas purple, tubes 2.5–3 mm, puberulent with ascending, gland-tipped trichomes 0.1–0.2 mm long, rays spreading, 6.5–9.5 mm long, 0.8–1.5 mm wide, glabrous. Disk flowers ± 140; corollas yellow, 4–5 mm, tube and throat puberulent with ascending, gland-tipped trichomes ± 0.1 mm long. Achenes [immature] ± 1.5 mm, puberulent with ascending, apically forked trichomes ± 0.2 mm long, ribs 2, golden brown; pappus bristles ± 25, subequal, 4–5 mm long, outer pappus not differentiated.

Figure 1. *Erigeron conditii*, holotype (UC 195576).

Figure 2. *Erigeron conditii,* paratype (*Unangst 901*, UC 146422).

Additional collection examined. **California**. San Luis Obispo Co.: San Carpojo [Carpoforo], in tufts, [ca. 35.771887°, -121.278480°], [60 m], 23 Jul 1908, *Unangst 901* (UC 146422).

Etymology. The new species is named in honor of Dr. Ira J. Condit (1883–1981), who was an instructor in botany and horticulture from 1907 to 1912 at the newly founded California Polytechnic School [now California Polytechnic State University] in San Luis Obispo, California. During his time at Cal Poly, he explored San Luis Obispo Co. and collected plant specimens, often accompanied by Judge E.P. Unangst (Condit 1967), and visited and collected in other parts of the state. He founded a short-lived California Polytechnic School Herbarium of about 4000 specimens, which was later incorporated into the University of California Herbarium (Condit 1967). Many of his collections in UC bear labels from the Cal Poly Herbarium [the type of *Erigeron conditii* is labeled as having come from his private herbarium]. Condit later taught horticulture at the University of California, where he earned a masters degree in 1928; he was awarded a Ph.D. from Stanford University in 1932. Dr. Condit researched and published on a number of subtropical fruit crops in California. He is best known for his research and numerous publications on the genus *Ficus* (Moraceae) (Condit 1967; Riverside Public Library 2006–2009; Wikipedia 2018).

Suggested common name. Condit's fleabane daisy.

Habitat. San Carpoforo Creek [known colloquially as San Carpojo Creek] originates in the Santa Lucia Range of southwestern Monterey Co. and flows into the Pacific Ocean in northwestern San Luis Obispo Co., just to the north of the coastal prominence called Ragged Point (south of the village of Ragged Point). The creek and its tributaries have carved canyons into the rugged western slopes of the Santa Lucia Range. Along some parts of the San Carpoforo Creek Canyon, a well-developed riparian corridor of deciduous and evergreen trees and shrubs borders the channel; in other areas the canyon cuts through exposed bedrock, and vegetation along the channel is sparse.

Specimen labels for the two early collections of *Erigeron conditii* lack habitat data. Access to San Carpoforo Canyon for Condit and Unganst would likely have been via the road to the Polar Star Mine, a complex of nine now-inactive mercury mines located about three miles up San Carpoforo Creek from the coast (Cambria Historical Society 2018; The Diggings 2018). The Polar Star Mine was intermittently productive from 1870 until the mid-20th century. Mining activities in the early 20th century would likely have resulted in considerable disturbance to the vegetation of the canyon.

The population that I observed in San Luis Obispo Co., upstream of the mine, consisted of scattered individuals growing in partial shade of riparian-corridor trees from cracks in a steep sandstone outcrop along the canyon wall at about 60 m elevation. Plants growing nearby included *Eriophyllum confertiflorum*, *Toxicodendron diversilobum*, and *Rubus ursinus*. The site in Monterey Co. where the type specimen was collected would be upstream of that site at a somewhat higher elevation; upper San Carpoforo Creek reaches an elevation of about 340 m. Additional populations are to be sought in similar habitats within the San Carpoforo Creek Canyon or nearby canyons.

Relationships. The holotype and paratype specimens have been annotated by different researchers as three different varieties of *Erigeron foliosus* or noted as having intermediate characteristics. The most recent determination, by Guy Nesom in 1992, is *E. foliosus* Nutt. var. *franciscensis* Nesom. However, a note in an unknown hand above Nesom's annotation label on the paratype sheet (*Unangst 901*) summarizes the problem: “doesn't key there.” With its combination of strigillose stems and leaves, narrowly linear leaves, strigillose and minutely, densely glandular-puberulent phyllaries, long ray corollas, and narrow resinous phyllary midribs, it doesn't key well to any of the varieties of *E. foliosus* in the keys of Nesom (1992, 1993, 2006) or Keil and Nesom (2012).

Various members of the *Erigeron foliosus* complex have been recognized at both the species and varietal ranks. Varietal rank was employed in recent treatments (Nesom 1992, 1993, 2006; Keil & Nesom 2012), but Guy Nesom (pers. comm. 2018) has expressed the opinion that "each of the 'vars.' of *E. foliosus* can justifiably be recognized as species—very little if any intermediacy among them, and each is essentially allopatric with all the others." *Erigeron foliosus* var. *foliosus* [*E. foliosus* sensu stricto] is the only other member of this complex that occurs in the central Santa Lucia Range. It differs from *E. conditii* in having a corymbiform capitulescence with usually more numerous heads, shorter involucres (3.2–4.5 vs. ± 6 mm), more strongly graduated phyllaries, and shorter ray corollas (6–10 vs. 9–12.5 mm). Leaves vary in shape from linear-oblong in forms on the coastal slope to linear-filiform in the interior [the latter recognized by some authors, but not by Nesom (1992), as *E. foliosus* var. *stenophyllus* (Nutt.) A. Gray]. In its general growth form and dimensions, *E. conditii* more closely resembles *E. foliosus* var. *mendocinus* G.L. Nesom of north-coastal California and *E. foliosus* var. *hartwegii* (Greene) Jeps. of the central and northern Sierra Nevada foothills. It is disjunct from both. It differs from *E. foliosus* var. *mendocinus* in having narrower leaves (0.7–1.7 vs. 2–4 mm wide), narrower phyllaries (0.5–0.7 vs. 0.8–1 mm), thick or only narrowly scarious vs. broadly scarious phyllary margins, and orange-resinous phyllary midribs. It differs from *E. foliosus* var. *hartwegii* in having leaves without a prominent unidirectional orientation vs. often mostly with orientation to one side of stems, leaf faces densely and uniformly strigillose vs. faces glabrate to sparsely strigose, abaxial phyllary surfaces densely and prominently glandular vs. glandless or sometimes sparsely and obscurely glandular, and phyllary midnerves narrowly orange-resinous vs. usually not distinct and orange-resinous.

My choice to treat Condit's fleabane daisy as a species necessitates a reevaluation of the taxonomic rank for the taxa recognized as varieties of *Erigeron foliosus* in recent treatments. Valid names are available at the species level for two of these: *E. confinis* Howell (=*E. foliosus* var. *confinis* (Howell) Jeps.), and *E. hartwegii* Greene (=*E. foliosus* var. *hartwegii*). However, *E. foliosus* var. *franciscensis* G.L. Nesom and *E. foliosus* var. *mendocinus* lack valid names at the species level. No species name has been proposed for var. *franciscensis* and, because of its marked similarity to var. *foliosus*, I am not proposing a name for it at the species level. I believe that further investigation of the relationship of var. *foliosus* to var. *franciscensis* is needed. The species name *Erigeron mendocinus* was proposed by Greene (1909), and Greene's publication was the basis for Nesom's (1992) recognition of var. *mendocinus*. However, Greene (1894) had earlier published the name *E. mendocinus* as a replacement for the illegitimate name of a South American *Erigeron,* and therefore, his 1909 *E. mendocinus* is a later homonym. Nesom's use of the epithet "mendocinus" at the varietal level is to be treated as a nomen novum rather than a new combination (Kanchi Gandhi, pers. comm.)—hence the citation of Nesom as author of var. *mendocinus* without Greene's name in parentheses. I am proposing the following as a replacement name at the species level for Greene's illegitimate 1909 *E. mendocinus*:

Erigeron mendocinensis D.J. Keil, **nom. nov.** *Erigeron mendocinus* Greene, Leafl. Bot. Observ. Crit. 2: 9. 1909, nom. illeg.

Etymology. The epithet "mendocinensis" is derived from the geographic name Mendocino, which is used for a cape, city, and county in California. Greene's (1909) epithet "mendocinus" was similarly derived—from Mendocino Co., where the type of his *Erigeron mendocinus* was collected. However, Greene's (1894) epithet "mendocinus" was derived from the city and province of Mendoza in Argentina.

Conservation assessment. *Erigeron conditii* is documented at present by just the two collections cited. The plants I observed in 2003 very likely represent the same population visited in 1908 by Judge Unganst. The status of the Monterey Co. population sampled by Condit is unknown. I observed only a few individuals and did not make an effort to assess the size and extent of the population. It seems likely that additional populations may be present along San Carpoforo Creek or in nearby canyons. The topography in the area is rugged and in large part inaccessible; large areas are in private ownership with limited or no access. The San Luis Obispo County site for *E. conditii* is located along the portion of San Carpoforo Creek that traverses the northern portion of the Hearst Ranch a short distance north of the inactive Polar Star Mine. Portions of the San Carpoforo Canyon in Monterey Co. are within the Los Padres National Forest. Recognition of *E. conditii* as a rare and potentially endangered species seems warranted; I recommend it be considered by the California Native Plant Society for California Rare Plant Rank 1B.1. When evaluated using IUCN (2000) Red List criteria, *E. conditii* qualifies as Endangered (EN) -- high risk of extinction in the wild, based on extent of occurrence estimated to be less than ~100 km^2.

ACKNOWLEDGEMENTS

I thank Guy Nesom, Bruce Baldwin, and John Strother for reviewing my manuscript and for their comments and suggestions.

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REVISION OF THE *ANDROPOGON TERNARIUS* COMPLEX OF SECT. *LEPTOPOGON* (POACEAE) WITH TWO NEW SPECIES FROM PENINSULAR FLORIDA

EDWIN L. BRIDGES
Botanical and Ecological Consultant
Gig Harbor, Washington 98335
ebridges1@gmail.com

STEVE L. ORZELL
Avon Park Air Force Range
Avon Park Air Force Range, Florida 33825
steve.orzell@avonpark.af.mil

ABSTRACT

The *Andropogon ternarius* complex (section *Leptopogon*) has long been taxonomically troublesome, particularly within its center of diversity in Florida, and was not included in the last revision of this section. Two cryptic species, **Andropogon cumulicola** E.L. Bridges & Orzell, **sp. nov.**, and **Andropogon miamiensis** E.L. Bridges & Orzell, **sp. nov.**, are described in relation to three allied taxa, *A, arctatus* Chapm., *A. ternarius* Michx., and *A. cabanisii* Hackel. All are pyrophytic species, flowering profusely following lightning season fires. *Andropogon cumulicola* is a psammophyte of sub-xeric uplands and is apparently endemic to peninsular Florida. It is distinguished from *A. arctatus* by its caespitose habit, sparsely hairy leaves, and longer peduncles and spikelets. In contrast, *A. arctatus* is rhizomatous, with densely whitish-villous basal leaves and occurs in seepage slopes and wet pineland savannas primarily in the Florida panhandle. *Andropogon miamiensis* is described as a narrow endemic of pine rockland savannas in Miami-Dade and Monroe counties, Florida. It is distinguished from *A. cabanisii* by its larger stature, and longer bluish-glaucous leaves.

Andropogon L. (Poaceae: Andropogoneae) is a wide-ranging pantropical and warm-temperate genus of 110-120 species, all with the C_4 photosynthetic pathway (Nagahama & Norrmann 2012). The genus comprises four sections –– *Andropogon* Stapf, *Leptopogon* Stapf, *Notosolen* Stapf, and *Piestium* Stapf (Nagahama et al. 2014). In the western hemisphere, *Andropogon* comprises about 60 species grouped in the first three of these sections (Nagahama & Norrmann 2012). Most species of sect. *Leptopogon* in the western hemisphere are within three species complexes –– the *Andropogon lateralis* complex (hexaploid species of South America), the *A. selloanus* complex (South and Central American diploid species), and the *Andropogon virginicus* complex (North American diploid species) (Nagahama et al. 2013, 2014). As circumscribed by Campbell (1983, 2003) sect. *Leptopogon* includes 12 species and numerous infraspecific taxa in North America north of Mexico.

All 12 of the species of sect. *Leptopogon* recognized by Campbell occur in Florida: *Andropogon arctatus* Chapm., *A. bicornis* L., *A. brachystachyus* Chapm., *A. floridanus* Scribn., *A. glomeratus* (Walt.) B.S.P. (with four varieties), *A. gracilis* Spreng., *A. gyrans* Ashe (two varieties), *A. liebmannii* Hack var. *pungensis* (Ashe) C.S. Campb., *A. longiberbis* Hack., *A. tracyi* Nash, *A. ternarius* Michx. (two varieties), and *A. virginicus* L. (three varieties). Although often sympatric, probable sibling species (varieties and variants) in sect. *Leptopogon* rarely if ever produce hybrids (except within the *glomeratus* group), lack readily distinguishing morphological gaps, are reproductively isolated, and form discrete variants (Campbell, 1980, 1982a, 1982b, 1983, 1986, 2003; Rosen & Wipff 2003; Nagahama & Norrmann 2012). Nevertheless, there continues to be disagreement over the number of recognized taxa. Without Campbell's treatments (1980, 1982a, 1982b, 1983, 1986, 2003) it would have been even more difficult to achieve our understanding of the genus or to discern additional differences between various southeastern *Andropogon* species.

Since Campbell's (1983, 1986, 2003) landmark *Andropogon* treatments, much addition morphological and ecological information has been gathered by the authors and other southeastern botanists (McMillan et al. 2002; Weakley 2015; Weakley et al. 2011). The most recent floristic treatment of *Andropogon* for the southeastern USA (Weakley 2015) recognizes 18 species (not including *A. bicornis* or *A. gracilis*), plus one named and one unnamed variety, as well as alluding to the two new species described in the present manuscript. This, plus recognition of *A. subtenuis* Nash in Small at species rank brings the total number of recognized taxa in sect. *Leptopogon* in the southeastern USA to 24. The two previously unrecognized species described here are a result of our field studies throughout the southeastern USA and especially in Florida, the center of diversity for sect. *Leptopogon* (Hilu 1984).

Based primarily on chromosome numbers and morphology, North American species of sect. *Leptopogon* have been divided into the *Andropogon virginicus* and the *A. ternarius* groups (Hilu 1984; Gould 1967; Campbell 1980), both with their center of diversity in Florida. Within these groups, the present study is concerned with three closely allied but distinct entities: *Andropogon arctatus* Chapm., A. *ternarius* Michx. var. *ternarius*, and *A. ternarius* Michx. var. *cabanisii* (Hack.) Fernald & Griscom, the latter two having been treated as varieties (Fernald & Griscom 1935; Campbell 1983, 2003; Hitchcock, 1950) or species (Nash 1912; Small 1933; Gould 1967; Hilu 1984; Long & Lakela 1971; DeSelm n.d.). *Andropogon ternarius* has been distinguished from *A. cabanisii* by its denser villous inflorescence and fewer intercarinal nerves (0-2, obscure) on the lower glume of the sessile spikelet (Hilu 1984) as compared to 2–3 prominent nerves in *A. cabanisii* (Long & Lakela 1971; Hilu 1984). Furthermore, *A. ternarius* is tetraploid (2n=40), whereas the chromosome counts for members of the *A. virginicus* complex are all diploid (2n=20), although the chromosome number for *A. cabanisii* is not known (Gould 1956; Hilu 1984).

While conducting field work over the past 25 years in Florida we had doubt about the identity of *Andropogon* collections from south-central Florida that keyed with much difficulty to *A. arctatus*. Specimens of *A. arctatus* cited in Campbell (1983) from south-central and southern Florida and questionable reports of *A. arctatus* from south Florida (Gann et al. 2002) seemed improbable. We were familiar with *A. arctatus* from frequently burned pinelands and seepage-herb bogs in the Florida panhandle and northeastern Florida, but these differed in both morphology and habitat from our "south-central Florida entity." Meanwhile we continued to voucher specimens of this *Andropogon* from burned xeric sandy uplands in central and south-central Florida. These specimens differed in gross morphology from *A. arctatus* and *A. cabanisii.* We determined that all specimens at FLAS labeled as *A. arctatus* from peninsular Florida are the same entity as our south-central Florida entity. With additional study, we concluded that what had been called *A. arctatus* (sensu lato) is polymorphic, consisting of the Florida panhandle near-endemic of wetland savannas (typical *A. arctatus* Chapman) and an undescribed species of xeric uplands in peninsular Florida.

The objectives of this study were (1) to identify morphological traits or characters which define cryptic species within the *Andropogon ternarius* complex of sect. *Leptopogon,* (2) to formally describe these cryptic species, and (3) to provide a new key to this group and a discussion of the biogeography and ecology of each species. Since many specimens of *A. cumulicola* had been attributed to *A. arctatus*, *A. cabanisii*, or *A. ternarius*, we deemed it critical to prepare new species descriptions to clarify and segregate salient differences of *A. cumulicola* that had been previously subsumed within the existing species descriptions. These descriptions are based primarily on Florida specimens and may not encompass all of the variation found in the more widespread *A. ternarius.*

Andropogon inflorescence morphology

Before proceeding with discussion of character states in the species considered here, some mention must be made of the difficulty in determining character states within the complex and derived morphology of the *Andropogon* inflorescence. Allred (1982) and Campbell (1983) clarified many of these terms and their comments should be used as additional references in understanding and interpreting the descriptions and keys in this treatment. The inflorescence of species of sect. *Leptopogon* has a complex but highly ordered branching system requiring the use of specialized terminology to describe differences between species in these patterns. Inflorescence units in this group are subtended by expanded stem sheaths or vegetative sheaths which enclose the culm and the bases of the inflorescence peduncles (and can envelop almost the entire inflorescence in some species, such as *A. gyrans*). Each inforescence branch axis also bears a sheath, which as variously been termed the "raceme sheath," "subtending sheath," or "spatheole." For ease of distinguishing these from the stem sheaths or vegetative sheaths subtending the inflorescences, we will use the term "raceme sheath" for these structures, as did Campbell (1983). The raceme sheath subtends the inflorescence peduncle, which is terminated by a pair or small cluster of up to 13 branches or "rames" terminating each inflorescence peduncle. A "rame" is defined as an inflorescence branch that bears repeating pairs of sessile and pedicellate spikelets (Allred 1982) and is characteristic of *Andropogon* in the modern, narrowly defined sense of the genus. The length of the inflorescence peduncle and the number of rames present on each peduncle are important taxonomic characters in this group, as is the total number of “inflorescence units” (a pair or digitate cluster of rames) per culm. Each rame consists of a number of paired spikelets, with one sessile and one pedicellate spikelet in each pair. The sessile spikelet of each pair is almost always bisexual and fertile and constitutes the obvious spikelets of the rames. The pedicellate spikelet is either absent (represented only by its pedicel), vestigal (consisting of undeveloped scales less than 2 mm long), or much reduced and sterile (evident, 2-4 mm long). The dispersal unit within this group of *Andropogon* consists of a sessile spikelet, the pedicel of the pedicellate spikelet (and the pedicellate spikelet if developed), and the rachis internode immediately above the sterile spikelet. In order to understand and assess the characters used in this manuscript, it is recommended that that the user carefully break apart or examine these dispersal units, in order to be certain which parts have various types of pubescence.

We have found that some characters are too variable within species in this group to be of much value in delineating species. Much of this variability is due to variation on a single culm, particularly in terms of peduncle length, raceme sheath length, rame length, and number of inflorescence units per culm. However, most of this variation within a single culm or even within a population is due to differences in maturity within the inflorescence. There is a tendency for the last developing inflorescence units to be smaller in most of these quantitative characters than those developed midway within the flowering season. This is expected, since the rames are themselves indeterminate and are parts of a larger indeterminate inflorescence. Therefore, as the flowering season is ending, rames are produced on shorter peduncles, and each rame is often shorter and consists of fewer spikelets. However, if one measures only the larger inflorescence units on well-developed inflorescences, there are clear differences in the average values of these characters, even between species where the range of these characters overlaps. We have therefore given character states for these variable quantitative characters in a bracketed format, such as (10–) 20–30 (–45), where the majority of well-developed inflorescences will have measurements in the middle of the range and the parenthetical measurements represent infrequent outliers. Another character which may be of some taxonomic utility, but which has not been used in this treatment, is the degree of twisting of the lemma awn. There do seem to be some differences in this character among the following species, but it is complicated by variability due to degree of maturity of a particular spikelet and perhaps due to conditions during the drying of the inflorescence.

Taxonomic treatment

1. **ANDROPOGON CUMULICOLA** E.L. Bridges & Orzell, **sp. nov.** **TYPE**: **Florida**: Polk Co.: Open scrubby pine savanna, ca. 0.5 mi N of Smith Rd jct. with Delta Rd in Avon Park Air Force Range, SEQ, SEQ, NWQ, Sec. 22, T32S, R30E, 27°41'01" N, 81°18'42" W, 6 Nov 2002, *S.L. Orzell & E.L. Bridges 26058* (holotype: USF; isotypes, FLAS, FSU, MO, NCU, NY, TEX, US).

Similar to *Andropogon arctatus* Chapman, differing in its glabrous to sparsely pubescent leaf sheaths, narrower and less pubescent leaf blades, thinner culms, fewer inflorescence units per culm, and shorter peduncles.

Plants with short, stout, knotty rhizomes, usually forming small clumps ca. 10–20 cm in diameter. **Culms** (70–) 95–125 (–155) cm tall, 1.5–2.0 mm in diameter, glabrous, not glaucous, the branches slender, straight, erect to ascending, basal leaves erect, stem leaves erect to slightly spreading. **Leaf sheaths** not scabrous, moderately to densely villous with antrorsely appressed to slightly spreading white hairs, the hairs mostly 1–2 mm long. **Ligule** membranaceous, 0.3–0.6 mm long, very finely ciliate, cilia 0.1–0.3 mm long. **Leaf blades** strongly folded, V-shaped, yellowish-green, (10–) 15–21 (–35) cm long, (1.5–) 2–2.5 (–3.0) mm wide (unfolded), appearing only half as wide due to almost complete folding of lamina, glabrous to sparsely pubescent with long (ca. 3 mm) erratically spreading hairs. **Inflorescence** slender, ca. (30–) 50–60 (–80) cm long and (2–) 3–5 (–7) cm wide, the branches erect, maximum branch order 1–2 (–3), inflorescence units (3–) 8–14 (–27) per culm; distal part of inflorescence axis moderately to densely pubescent, the longest hairs ca. 2–3 mm long and occurring 1–2 mm below base of raceme sheath, mostly exserted above the vegetative sheaths at inflorescence maturity. **Raceme sheaths** (3.5–) 4.5–5.5 (–7.0) cm long, ca. 1–2 mm wide, all exserted from vegetative sheaths. **Peduncles** (38–) 48–65 (–85) mm long, all with 2 rames. **Rames** (20–) 35–45 (–51) mm long, all exserted at maturity, the long rachis internode pubescence evenly distributed. **Sessile spikelets** 4.0–4.5 mm, callus hairs 1–2 mm, keels of lower glume scabrous from below the midpoint, awns (6–) 7–8 (–12) mm long. **Pedicellate spikelets** vestigal or absent. **Anther** 1, ca. 2 mm long, red, yellow, or purple. Figures 1 and 6.

Endemic to peninsular Florida, from Putnam, Clay, and Alachua counties south commonly to Highlands County, with isolated historical records from Charlotte and Collier counties. *Andropogon cumulicola* is an obligate psammophyte occurring in well to excessively well-drained, acidic, loose to compacted siliceous soils. It is found on sub-xeric uplands in peninsular Florida, where it flowers profusely following lightning season fires. It is locally abundant in dry sandy pinelands, sandhills, Florida scrubby pinelands, and occasionally in Florida scrub. It can co-occur with *A. cabanisii*, but no intergrades have been encountered, and these two species are easily distinguished within mixed populations.

We were surprised that *Andropogon arctatus* was mapped in Campbell (1983) and others as occurring in peninsular Florida. Despite extensive floristic study and vegetation sampling of central Florida wet pine savannas, wet grasslands, and seepage slopes, we never encountered an *Andropogon* which would refer to as *A. arctatus* as we knew it from the Florida Panhandle. Meanwhile, we began to recognize an *Andropogon* of xeric sandy uplands in peninsular Florida, different from *A. cabanisii*, with which it was often sympatric. Upon closer examination we realized that they shared at least as many characters with *A. arctatus* as with *A. ternarius* and were perhaps more closely allied with that species although clearly differing in vegetative characters. We then made a large series of field measurements and collections of this entity and determined that it differed from *A. arctatus* and from all other recognized species of section *Leptopogon* in several additional characters.

Figure 1. *Andropogon cumulicola* (from *Orzell & Bridges 26058*). A. Whole plant, dried (scalebars in mm). B. Inflorescence group. C. Rames. D. Dispersal unit. E. Dispersal unit, scalebar not shown, sessile spikelet, rachis joint, and pedicellate spikelet. Photos by James Cheak.

Andropogon arctatus (as circumscribed by Campbell 1983, 2003) is polymorphic, consisting of a species of the Florida panhandle and adjacent southern Alabama, which is found in wetland pine savannas (typical *A. arctatus* Chapm.) and the new species described here, which occurs in sub-xeric uplands of peninsular Florida. These two entities can be difficult to determine on incomplete herbarium specimens but have several consistent differences. Although *A. ternarius* resembles *A. arctatus,* the latter differs significantly in leaf epidermis features (Hilu 1984), its rhizomatous habit, its long, usually solitary anther and shorter spikelets (Campbell 1983, 2003), grooved glumes (Hitchcock 1951), and almost complete chasmogamy (Campbell 1983, 2003). Previous confusion of these species might be attributed to the inclusion of *A. cumulicola* characters within the more broadly defined concept of *A. cabanisii* and *A. arctatus* and the placement of the peninsular Florida specimens (here named as *A. cumulicola)* within either *A. arctatus* (Campbell 1983, 2003; Gann et al. 2002) or *A. ternarius* (Long & Lakela 1971). Although some consider *A. cabanisii* as a variety of *A. ternarius,* we have decided to follow Gould (1967) in recognizing *A. arctatus*, *A. cabanisii*, and *A. ternarius* each at species rank.

Based upon abundance, distribution, and habitat preference data we recommend that *Andropgon cumulicola* be classified as in the category Vulnerable (VU) according to IUCN Red List criteria (IUCN 2001). Although locally abundant, *A. cumulicola* is currently known from 12 counties in peninsular Florida. It requires frequent fire to enhance flowering and to maintain its pyrogenic habitat.

2. **ANDROPOGON ARCTATUS** Chapm., Bot. Gaz. 3:20. 1878. Based on *Andropogon tetrastachyus* Ell. var. *distachyus* Chapm., Fl. South. U.S. 581. 1860, not *Andropogon distachyus* L. 1753. *Andropogon arctatus* Chapm., Bot. Gaz. (Crawfordsville) 3: 20. 1878. *Sorghum arctatum* (Chapm.) Kuntze, Revis. Gen. Pl. 2: 791. 1891. *Leptopogon carinatus* (Nees) Roberty subvar. *arctatus* (Chapm.) Roberty, Boissiera 9: 197. 1960. LECTOTYPE (Campbell 1983): **Florida**. Franklin Co.: Low pine barrens, Apalachicola, without date, *A.H. Chapman s.n.* (NY).

Plants with short, stout, knotty rhizomes, usually forming small clumps ca. 15–30 cm in diameter. **Culms** (90–) 130–150 (–170) cm tall, 2.5–4.5 mm in diameter, glabrous, sometimes somewhat glaucous just below the nodes, the branches slender, straight, erect to ascending, basal leaves spreading to ascending, stem leaves ascending. **Leaf sheaths** not scabrous, usually densely villous with antrorsely appressed to slightly spreading white hairs, the hairs mostly 1–2 mm long, the sheaths often appearing silver in color due to the dense pubescence. **Ligule** membranaceous, 0.3–1.0 mm long, smooth to sometimes densely ciliate, the cilia up to 4 mm long. **Leaf blades** flat to slightly folded, bluish-green to purplish-green (when fresh) (25–) 40–50 (–70) cm long, (3–) 5–6 (–8) mm wide, sparsely to densely pubescent with long (ca. 3 mm) mostly appressed hairs, the lower surface of some leaves silvery-silky like the sheaths. **Inflorescence** slender, ca. 50–90 cm long and 5–15 cm wide, the branches erect, maximum branch order 2–3, inflorescence units (10–) 30–40 (–50) per culm, distal part of inflorescence axis moderately to densely pubescent, the longest hairs ca. 3 mm long and occurring 1–2 mm below base of raceme sheath, slightly included within to long-exserted from vegetative sheaths at inflorescence maturity. **Raceme sheaths** 5.0–8.0 cm long, 2–3 mm wide, mostly exserted from vegetative sheaths. **Peduncles** (50–) 70–90 (–115) mm, with 2–4 rames. **Rames** (30–) 40–50 (–55) mm long, all exserted at maturity, rachis internodes pubescent throughout, the hairs somewhat longer and denser distally. **Sessile spikelets** 4–5 mm long, callus hairs 1.5–3.0 mm, the lower glume strongly concave, nerveless between the keels, keels of lower glume scabrid to short-ciliate for the distal 3/4 of their length, sometimes long-ciliate towards the tip; awn 5–10 (–15) mm long. **Pedicellate spikelets** vestigal or absent. **Anthers** 2.5–3 mm long, red. Figures 2 and 7.

Figure 2. *Andropogon arctatus* (from *Orzell & Bridges 21003*). A. Whole plant, dried (scalebars in mm). B. Basal leaf sheaths. C. Rames. D. Dispersal unit. E. Dispersal unit, scalebar not shown, sessile spikelet, rachis joint (bottom), and pedicellate spikelet (top). Photos by James Cheak.

Andropogon arctatus is primarily found in the Florida Panhandle and adjacent southeast Alabama, where it is relatively common in hillside seepage slopes and wetland pine savannas. We have found it in a very few sites in Clay County in northeast Florida in similar habitats, which is a common disjunction pattern for Florida Panhandle seepage wetland species. There is a curious record from Pamlico County, North Carolina (the specimen at GH, collected by Randolph and Randolph in 1922, annotated as *A. arctatus* by Campbell), which was reported by LeBlond and Sorrie (2001) and which Weakley (2015) considers to be likely a waif. *Andropogon arctatus* is an obligate wetland plant, being found only in seasonally to permanently saturated wetlands but rarely with more than a few cm of surface water. We have recorded it as present in at least 168 locations, with these concentrated in two small regions -- the wetland pine savannas of the Apalachicola Lowlands (mostly in Liberty, Franklin, and Gulf counties, Florida), and the hillside seepage slopes of the western Florida Panhandle (mostly in Walton and Okaloosa counties, Florida). We cite voucher specimens for all counties where we have seen *A. arctatus* except for Escambia County, Alabama, and Leon and Wakulla counties, Florida, where it apparently has never been collected. The sites in Clay County, Florida, where we have seen this species at four locations, are ecotonal seepage slopes known for disjunct locations of seepage species more common in the Florida Panhandle. Kral (1983) described *A. arctatus* with the same narrow circumscription as this manuscript and mapped it only from the central Florida Panhandle, southeast Alabama, and Clay County, Florida.

All specimens of *Andropogon arctatus* that we have seen have thick culms, wide leaves, dense appressed pubescence, tawny hairs, and dark spikelets. In the field it can be identified even when in vegetative condition based upon its relatively large silvery-silky basal leaf sheaths and blades. In describing *A. arctatus*, Chapman (1878) specifically noted that the leaves were "shaggy with long mostly deciduous hairs, as are the sheaths" and gave its habitat and range as "Low pine barrens, West Florida." When in flower it is easily identified based on a generally larger number of inflorescence units, some of which have more than two racemes terminating each peduncle, and the generally darker gray color of the spikelets, in comparison to the whitish to tawny appearance of the racemes of the other taxa considered here. The illustration of *A. arctatus* in Flora of North America (Campbell 2003) is based on specimens now referred to both *A. cumulicola* (*Ray et al. 10490, 10496*) and *A. arctatus* (*Campbell 3937*), and perhaps other specimens. However, since the illustration does not include the plant base and these two species differ little in inflorescence characters, the illustration cannot be clearly referred to only one of these species. It does not show the grooved lower glume of *A. arctatus*, so perhaps the spikelet illustration may be based on an *A. cumulicola* spikelet.

All specimens previously identified as *Andropogon arctatus* from peninsular Florida that we have seen are either definitely or probably referable to *A. cumulicola.* Some specimens are too fragmentary to make a definitive determination. Therefore, what had been called *A. arctatus* (sensu lato) is polymorphic, consisting of the Florida panhandle near-endemic of wetland pine savannas (the true *A. arctatus* Chapman) and the new species of xeric uplands in peninsular Florida, *A. cumulicola.* These two entities are close in many inflorescence characters, but on specimens with ample vegetative material they are easy to separate. Tentatively, we believe that *A. cumulicola* may be more closely related to *A. arctatus* than to either *A. ternarius* or *A. cabanisii*, but there is no molecular data available to clarify relationships in this group. In a phylogenetic reconstruction of the *Andropogon virginicus* complex based on morphological characters, Campbell (1986) found that *A. arctatus* was in a clade with *A. floridanus* in some trees. However, in the consensus tree in of the same study, *A. arctatus* is shown as the basal branch within the complex. Since slight differences in assumptions about character state polarity resulted in changes to these trees based on morphology, the results should be thought of as only a tentative hypothesis of actual evolutionary relationships within the group.

3. **ANDROPOGON TERNARIUS** Michx., Fl. Bor. Amer. 1: 57. 1803. **TYPE**: "**Carolina**," *A. Michaux s.n.* (holotype: P).

Andropogon argenteus Ell., Sketch Bot. S. Carolina 1: 148. 1816, non de Candolle 1813. *Andropogon argyreus* Schultes [nom. nov.], Mant. 2: 450. 1824. *Andropogon elliottii* Chapman [nom. nov.], Fl. South. U.S. 581. 1860. *Sorghum elliottii* Kuntze, Revis. Gen. Pl. 2: 791. 1891. *Anatherum argyreum* (Schultes) Roberty, Boissiera 9: 209. 1960. **TYPE**: [South Carolina?]. Without collection data (holotype: CHARL). Although Hitchcock (1935) contended that *Andropogon elliottii* was intended by Chapman to represent the species now known as *A. gyrans*, Campbell (1983) stated that by citing "*A. argenteus* Ell., not of DC." in the description, Chapman inadvertently made *A. elliottii* a new name for *A. argenteus*.

Andropogon argyreus Schultes var. *macrus* Scribner, U.S.D.A. Div. Agrost. Bull. 1: 20. 1895. **TYPE**: **Florida**. Duval Co.: Without data, *A.H. Curtiss 4592* (holotype: US?).

Andropogon elliottii Chapm. var. *glaucescens* Scribner, Bull. Torrey Bot. Club 23: 145. 1896. *Andropogon scribnerianus* Nash, Bull. New York Bot. Gard. 1: 432. 1900. *Andropogon ternarius* Michx. var. *glaucescens* (Scribner) Fern. & Griscom, Rhodora 37: 137. 1935. **TYPE**: **Florida**. Lake Co.: Vicinity of Eustis, Apr 1894, *G.V. Nash 473* (holotype: US; isotypes: GH, NY).

Plants with short, stout knotty rhizomes, forming small clumps up to 10 cm in diameter. **Culms** stiffly erect, (90–) 100–120 cm tall, 2–3 mm in diameter. **Leaf sheaths** 6–10 mm long, 3–5 mm wide, glabrous to sparsely long-villous, green, not glaucous. **Ligule** membranceous, 1.0–1.2 mm long, the margins slightly erose, not ciliate. **Leaf blades** 30–40 cm long, 3–4 mm wide, green, not glaucous, with long papillose-ciliate margins, particularly in the lower part of the leaf. **Inflorescence** units shortly to moderately exserted from the stem sheaths, thus the inflorescence appearing more compact (than in *A. cabanisii* or *A. miamiensis*). **Peduncles** (80–) 90–110 (–125) mm long, sometimes with a tuft of 4–7 mm long hairs at a point 1–2 mm below the base of the raceme sheath. **Rames** paired, (30–) 45–50 (–55) mm long, the spikelets mostly obscured by the long ciliate hairs of the rachis internodes and pedicels, the rachis internode pubescence not equally distributed, the longer, denser hairs concentrated near the apex, up to 8–9 mm long, spreading, nearly twice the length of the spikelet, pure white to slightly tawny. **Sessile spikelet** 4.5–5.5 (–7.0) mm long, 2-keeled, the first glume somewhat scabrous on the keels, glabrous and smooth to sparsely and minutely scabridulous between the keels, without additional nerves; lemma awns very delicate, tawny, straight to only slightly twisted at the base, (18–) 20–22 (–25) mm long. **Pedicellate spikelet** vestigal, 1–2 mm long. **Anthers** red, ca. 2 mm long. Figure 3.

Sandhill woodlands and savannas, openings in dry-mesic hardwood or hardwood-pine forests, old fields, and cleared openings in other relatively dry and sandy soils. Delaware west to Kentucky and southern Missouri, south to central peninsular Florida and eastern Texas. In central Florida, at its southern range limit, *Andropogon ternarius* seems to be restricted to open longleaf pine sandhill savannas on yellow sand, reaching its southern limit in the few remaining examples of this habitat on the Lake Wales Ridge in Polk County, Florida.

Andropogon ternarius (sensu lato) is similar to *A. arctatus* but differs in having three anthers, longer sessile and pedicellate spikelets (Campbell 2003), and flattened lower glumes (Weakley 2005). Oddly, in the treatment of the varieties of *A. ternarius* in Flora of North America (Campbell 2003), it seems that the characteristics used to distinguish var. *ternarius* and var. *cabanisii* have been reversed. In this treatment, *A. ternarius* var. *cabanisii* is said to have the rames densely villous, the internode hairs are twice as long as the obscured sessile spikelets, and the lower glumes of the sessile spikelets glabrous (sometimes scabrous), but not conspicuously veined between the keels, all of which are characters of var. *ternarius* (Nash 1912; Hitchcock 1950). Conversely, in this treatment *A. ternarius* var. *ternarius* is said to have rames that are sparsely villous, the hairs of the rachis internodes about as

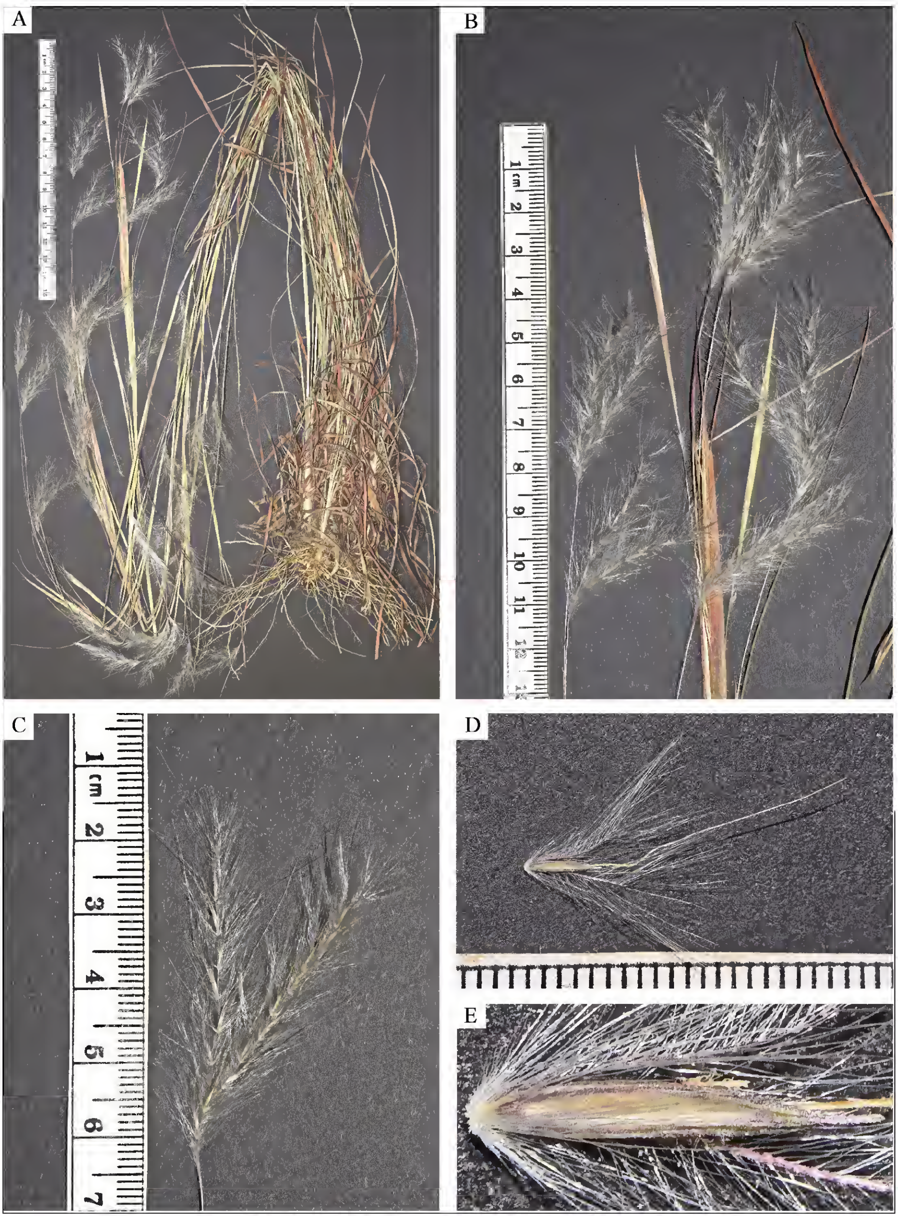

Figure 3. *Andropogon ternarius* (from *Orzell & Bridges 26605*). A. Whole plant, dried (scalebars in mm). B. Inflorescence group. C. Rames. D. Dispersal unit. E. Dispersal unit, scalebar not shown, sessile spikelet, rachis joint (top), and pedicellate spikelet (bottom). Photos by James Cheak.

long as, but not obscuring the sessile spikelets, and the lower glumes scabrous, often with 2 conspicuous veins between the keels, all of which are characters of var. *cabanisii*.

This revised description here of *Andropogon ternarius* has been created to specifically exclude specimens referred herein to *A. cabanisii* and *A. miamiensis*, therefore it is narrower than most previously published descriptions of *A. ternarius*. The description is based mostly on specimens from Florida and southern Georgia and may not encompass all of the variation present in this species from throughout its range.

We considered whether the type specimen of *Andropogon elliottii* var. *glaucescens* (= *A. scribnerianus*) might represent any species other than *A. ternarius* of the present treatment. Nash (1900, 1912) described *A. scribnerianus* as distinct in having the first glume glabrous and shining between the keels, the leaf sheaths glabrous and glaucous, and the leaf blades glaucous. The type specimen for *A. elliottii* var. *glaucescens* does have bluish leaf blades and sheaths, but it is impossible to tell if these were glaucous when fresh. The first glumes are very similar to those we have found in plants of *A. ternarius* from sandhill woodlands in northern and central peninsular Florida, but do not seem to consistently differ from it from other regions. This entity needs further study, but for now it is best accommodated in synonymy of *A. ternarius*.

4. ANDROPOGON CABANISII Hack., Flora 68: 133. 1885. *Andropogon cabanisii* Hack., Flora 68: 133. 1885. *Sorghum cabanisii* (Hack.) Kuntze, Revis. Gen. Pl. 2: 791. 1891. *Andropogon ternarius* Michx. var. *cabanisii* (Hack.) Fern. & Griscom, Rhodora 37: 138. 1935. LECTOTYPE (Campbell 1983): **Florida**. Franklin Co.: Prope Apalachicola, 1884, *A.H. Chapman s.n.* (W digital image!). The sheet at W reads "Ex. Herb. E. Hackel and had been originally identified and distributed by Chapman as *Andropogon arctatus* Chapm. There is also a fragmentary sheet of the original type at US, from the "Specimens obtained from European herbaria in 1922 by Agnes Chase, Ex. Herb. Berlin." In 2010, L. Pignotti designated a specimen at W (1916-0028605) as a syntype, with the same label data as described above for the lectotype. These could be the same sheet, or two sheets with this specimen data at W.

Plants forming small clumps from short, knotty rhizomes, the clumps usually 10–20 cm in diameter. **Culms** ascending to stiffly erect, (115–) 140–170 (–190) cm tall, 2-5-3 (-4) mm in diameter, glabrous, not glaucous, the internodes pinkish-purple to reddish, basal leaves spreading to reflexed, stem leaves progressively shorter, strongly reflexed. **Leaf sheaths** glabrous to sparsely appressed or spreading pubsecent, the surfaces not scabrous. **Ligule** membranceous 0.5–1.0 mm long, not ciliate. **Leaf blades** with the upper surface greenish, the lower surface bluish-green, not glaucous, (20–) 25–32 (–35) cm long, (2.5–) 3–4 (–5) mm wide. **Inflorescence** (50–) 70–90 (–100) cm long, (5–) 10–15 cm wide; Inflorescence units (5–) 10–20 (–26) per culm, inflorescence axis glabrous below the raceme sheath. **Raceme sheath** mostly shortly to moderately exserted from the stem sheath, (60–) 70–80 (–105) mm long, 1–3 mm wide. **Peduncles** (85–) 110–140 (–210) mm long, all exserted from the raceme sheaths. **Rames** paired, (40–) 50–65 (–75) mm long, with spikelets clearly visible through the rachis pubescence. **Sessile spikelets** 6–7 mm long; first glume strongly 2-keeled, the keels densely scabrous-ciliate, particularly in the distal half, 2–3 nerved between the keels, the surface densely scabridulous; callus hairs dense, 1–2 mm long; lemma awns straight or slightly twisted at base, (9–) 11–13 (–17) mm long; rachis internode pubescence unequally distributed, concentrated in distal half of internode, longest hairs 4–6 mm long, spreading to slightly ascending; pubescence of pedicellate spikelet pedicels similar to that of rachis internodes. **Pedicellate spikelet** sterile, slender, 3–4 mm long, scabrous. **Anthers** red, 2–2.5 mm long. Figures 4 and 7.

Figure 4. *Andropogon cabanisii* (from *Orzell & Bridges 22510*). A. Whole plant, dried (scalebars in mm). B. Inflorescence group. C. Rames. D. Dispersal unit. E. Dispersal unit, scalebar not shown, sessile spikelet, rachis joint (bottom), and pedicellate spikelet (top). Photos by James Cheak.

Peninsular Florida, west near the coast to the central Florida Panhandle. Common in scrubby pinelands, mesic to wet-mesic pinelands, and some hyperseasonal grasslands, most often on somewhat poorly drained to poorly drained soils (Spodosols or Alfisols).

5. **ANDROPOGON MIAMIENSIS** E.L. Bridges & Orzell, **sp. nov.** **TYPE**: **Florida**. Miami-Dade Co.: Open grassy pine rockland savanna, on S side of Research Rd, ca. 0.1 mi E of east end of Boy Scout Camp Everglades, ca. 2.7 mi E of Daniel Beard Research Center, Everglades National Park; Long Pine Key 7.5' Quad.; 25° 23' 19" N, 80° 38' 24" W, community dominated by *Pinus densa /Andropogon miamiensis–Schizachyrium semiberbe–Sorghastrum secundum,* with scattered tropical shrubs, 1 Oct 2009, *S. Orzell and E. Bridges 26400* (holotype: USF; isotypes: EVER, FLAS, FSU, GH, MO, NCU, NY, TEX, USF).

Similar to *Andropogon cabanisii* Hackel, differing in its taller stature, fewer inflorescence units per culm, and glaucous culms, basal leaf sheaths, and leaf blades.

Plants with short, stout, knotty rhizomes, usually forming clumps ca. 10–20 cm in diameter. **Culms** (150–) 180–210 (–230) cm tall, 3.0–4.5 mm in diameter, glabrous, slightly to evidently glaucous, internodes purplish-tinged, the branches few, slender, straight, erect to ascending. **Leaf sheaths** smooth, bluish, glaucous, ca. 12–15 cm long. **Ligule** membranaceous, ca. 1.0 mm long, margin erose, without conspicuous cilia. **Leaf blades** green on upper surface, bluish-glaucous on lower surface, glabrous except for a few long (4–7 mm) cilia on lower blade margins, 40–65 cm long, 3–4 mm wide, spreading to somewhat ascending, drying brownish-purple. **Inflorescence** slender, ca. 60–80 cm long and 10–15 cm wide, the branches erect, maximum branch order 2–3; inflorescence units (6–) 8–10 (–12) per culm, inflorescence axis glabrous, long-exerted from vegetative sheaths at inflorescence maturity. **Raceme sheaths** 6.5–8.0 cm long, ca. 1 mm wide, all exserted from the vegetative sheaths. **Peduncles** 125–156 mm long, long-exserted from the raceme sheaths, each with two rames. **Rames** (35–) 45–55 (–62) mm long, all long-exserted at maturity. **Sessile spikelets** 6–7 (–7.5) mm long; callus hairs dense, 1–2 mm long; first glume firm, flat, keeled, the keels ciliate-scabrous, particularly above the middle, the surface minutely scabridulous, with 2–3 rather distinct nerves between the keels; lemma awns (13–) 15–16 (–18) mm long, slightly twisted at base; rachis internode pubescence concentrated near apex of internode, the hairs near the base relatively sparse and 1–2 mm long, the hairs near the apex dense, 3–4 mm long. **Pedicellate spikelets** vestigal, 2–3 mm long, scabrous. **Anthers** red, ca. 2 mm long. Figures 5 and 7.

Endemic to pine rockland savannas in extreme southern Florida, in Miami-Dade and Monroe counties, where it can be a fall aspect dominant after burning.

Andropogon miamiensis is characterized by its large clumps of tall culms and its bluish-glaucous leaves. To our knowledge, no other entities in the *A. ternarius* complex have conspicuously and strongly glaucous foliage. Presence or absence of glaucous foliage has often been used as a taxonomic character in *Andropogon* (i.e., as in *A. glaucopsis, A. capillipes, A. dealbatus*). The populations of the *A. ternarius* complex with glaucous foliage seem to be restricted to pine rockland savannas in extreme southern Florida, such as Long Pine Key in Everglades National Park and Big Pine Key of the Florida Keys. This geographic restriction, coupled with the apparent absence of *A. cabanisii* (sensu stricto) from this region, supports treating this entity at the species level. The presence of this unusual *Andropogon* was first brought to our attention by Dr. Bill Platt of LSU, who had noticed that the plant identified as *A. cabanisii* in vegetation sampling in Everglades National Park was noticeably different from the *A. cabanisii* at Avon Park Air Force Range.

Andropogon miamiensis is the tallest (over 1.8 m) aspect-dominant grass in frequently burned pine rockland savannas of Long Pine Key in Everglades National Park, co-occuring with the much shorter-statured *Schizachyrium semiberbe*. In wetter transitions between well-drained pine rockland savannas and the adjacent marly grasslands, *A. miamiensis* is absent, being replaced by *Schizachyium*

Figure 5. *Andropogon miamiensis* (from *Orzell & Bridges 26400*). A. Whole plant, dried (scalebars in mm). B. Vegetative shoot. C. Rames. D. Dispersal unit. E. Dispersal unit, scalebar not shown, sessile spikelet, rachis joint (bottom), and pedicellate spikelet (top). Photos by James Cheak.

rhizomatum, A. longiberbis, and *A. tenuispatheus* (*A. glomeratus* var. *pumilus*). In previous studies of the vegetation and ecology of the pine rocklands, it has been referred to as *A. cabanisii,* but some authors have described its unique morphology and biology. Craighead (1971), in describing pine rockland savannas, noted that "A most interesting plant of the pineland is a grass locally called fire grass (*Andropogon cabanisii*). This abundant grass develops as numerous gray-green tufts in the tiny pits and crevices of the gray limestone. It remains in the vegetative stage until a fire flashes over the clumps. Soon they begin to develop flower stalks, which reach 5 to 8 feet in height, forming a dense understory that when mature suggests a wheat field ready for harvest." The leaf color, plant height, and rapid flowering response after fire leave no doubt the plant referred to is *A. miamiensis.*

The following key can be used to distinguish the species of *Andropogon* sect. *Leptopogon* in the southeastern USA with long-peduncled rames exserted from both the stem sheaths and raceme sheaths, except for *A. brachystachyus*, which has very short rames (1–2 cm) and a large, diffuse flexuous inflorescence. All other species in sect. *Leptopogon* in the southeastern USA have inflorescences that are much more congested in appearance, either due to the shortening of the peduncles, stem internodes, or both. This key was included within the key to species of *Andropogon* in Weakley (2015), based on an advance copy of this manuscript, in which *A. cumulicola* is keyed as "A. species 1", and *A. miamiensis* is keyed as "A. species 2." The reader is referred to the excellent treatment of *Andropogon* in Weakley (2015) to place this section of the key in the context of the genus within the southeastern USA.

1. Sessile spikelets 4–5 mm long; lemma awns mostly 5–10 mm long; rachis internode pubescence more or less evenly distributed along the internode; inflorescence peduncles mostly less than 9 cm long.

    2. Basal leaf sheaths and upper surface of basal leaf blades appressed-pubescent, often appearing silvery-silky; basal leaf blades mostly 5–6 mm wide; culms 2.5–4.5 mm in diameter; inflorescence units usually more than 30 per culm, each with 2–4 rames .... **Andropogon arctatus**
    2. Basal leaf sheaths moderately to densely villous, but not silvery-silky; basal leaf blades glabrous to sparsely pubescent with spreading hairs, 2–2.5 mm wide; culms 1.5–2.0 mm in diameter; inflorescence units usually less than 15 per culm, all with 2 rames .... **Andropogon cumulicola**

1. Sessile spikelets 5–7 mm long; lemma awns mostly 10–25 mm long; rachis internode with longest hairs concentrated towards its apex; inflorescence peduncles 10–17 cm long.

    3. First glume nerveless and glabrous or nearly so between the keels; raceme internodes with longest hairs 8–9 mm long, somewhat obscuring the spikelets; lemma awns mostly more than 18 mm long; pedicellate spikelet vestigal, 1–2 mm long .... **Andropogon ternarius**
    3. First glume 2–3-nerved between the keels, its surface moderately to densely scabridulous; raceme internodes with longest hairs 3–6 mm long, not obscuring the spikelets; lemma awns mostly less than 18 mm long; pedicellate spikelets evident, 2–4 mm long.

        4. Basal leaf sheaths and lower surface of basal leaf blades bluish-glaucous; culm internodes slightly to evidently glaucous; culms mostly over 180 cm tall, usually with 10 or fewer inflorescence units per culm .... **Andropogon miamiensis**
        4. Basal leaf sheaths and lower surface of basal leaf blades green or bluish-green, not glaucous; culm internodes not glaucous; culms mostly 120–170 cm tall, usually with 10–20 inflorescence units per culm .... **Andropogon cabanisii**

Ecology of the *Andropogon ternarius* complex in Florida

In addition to their morphological and biogeographic differences, there are clear distinctions in habitat preferences between the species discussed in this manuscript. In the process of compilation of site specific floristic lists by habitat in Florida, we have recorded over 5000 occurrences of species of *Andropogon*, including almost 1000 occurrences of the species in this group, of at least 24 taxa. In addition, we have recorded one or more of these species in at over 500 quantitative vegetation sampling plots. This data provided us a clear picture of the habitats of each of these, at least within Florida. Since three of these species are endemic to Florida and one (*A. arctatus*) has at least 95% of its known occurrences within Florida, this enabled us to describe the habitats and degree of habitat overlap for all of these except *A. ternarius*, for which we will focus only on its Florida occurrences.

Andropogon arctatus is an obligate wetland plant found in a narrow set of habitats in the Florida Panhandle and adjacent southeastern Alabama, with a disjunct location in a similar habitat in Clay County, Florida. All of these are either in hillside seepage slopes or wetland pine savannas or wet grasslands between pine savannas and forested wetlands. It is a characteristic species of these habitats in the Apalachicola National Forest (Bridges 2005) and is a frequent and often co-dominant species there and in other parts of the Florida Panhandle. Species of *Andropogon* which often co-occur with *A. arctatus* include *A. dealbatus, A. glomeratus, A. glaucopsis, A. perangustatus, A. virginicus* "Smooth variant", and particularly *A. mohrii*, another species nearly restricted to these habitats.

Andropogon cumulicola is a characteristic species of Florida scrubby pinelands (i.e., "scrubby flatwoods") in central Florida. These are habitats with dry, sandy soils but a seasonally high water table, from the presence of a spodic horizon in the soil which perches the water table during the summer wet season. It is not found in either true Florida scrub on excessively drained white sands, or in well-developed sandhill woodland-savannas on yellow sand entisols. In scrubby pinelands it occurs with a mixture of species characteristic of poorly drained pine savannas and better drained sandhill and scrub. Other species of *Andropogon* often co-occurring with *A. cumulicola* include *A. brachystachyus, A. capillipes, A. gyrans, A. cabanisii,* and less commonly *A. floridanus* and *A. virginicus* var. *decipiens.* Of these, only *A. cabanisii* is within the group of species discussed in this manuscript. The habitat of *A. cumulicola* overlaps the dry end of the habitat range of *A. cabanisii*, and they are clearly distinct when sympatric.

Andropogon cabanisii is primarily a species of pine savannas and open hyperseasonal grasslands and pine savanna of central Florida, rarely found northward to the central Florida Panhandle and south to Collier County. The vast majority of our site-specific records of *A. cabanisii* are from poorly drained spodosols or soils with spodic horizons, from scrubby pinelands only seasonally saturated to the surface to wet grasslands with several weeks or surface inundation during the wet season. It is present in most examples of mesic, wet-mesic, and wet longleaf pine savannas in central Florida and is more occasional in these habitats at least northward to Clay County and west to Franklin County, Florida. Species of *Andropogon* often co-occurring with *A. cabanisii* include *A. brachystachyus, A. capillipes, A. dealbatus, A. subtenuis* (often known as the "tenuous form" of *A. gyrans*), *A. hirsutior*, and *A. virginicus* var. *decipiens.* In disturbed habitats it can sometimes be found with *A. glaucopsis*, and at the wetter end of its habitat range it overlaps the habitats of *A. perangustatus* and *A. virginicus* "Smooth variant." In many of its habitats, it is part of a plant community which often has 4 or 5 species of *Andropogon* within a single square meter and up to 10 species of *Andropogon* within a single natural community at a site.

In contrast, *Andropogon ternarius* within the Florida portion of its range appears to be restricted to well-drained sandhill woodlands and occasional scrub in central Florida. It is rather widespread and common in northern Florida, being found in a wide range of well-drained sandy

Figure 6. *Andropogon cumulicola*. A. Single cespitose clump. B. Rames. C. Culm and leaf base. D. Basal leaves. Photos in the field in Polk (A & C) and Highlands (B & D) counties, Florida.

Figure 7. A. *Andropogon arctatus* basal leaves (Gulf County, Florida). B and C. *Andropogon cabanisii* rames (B) and culm leaves (C), photos by Dave Briley (Highlands County, Florida). D - F. *Andropogon miamiensis* basal leaves (D), habit (E), and leaf base (F) (Miami-Dade County, Florida).

habitats, including open woodlands, longleaf pine sandhill savannas, old fields, and roadsides through these habitats. In central peninsular Florida, most records that are definitively placed within *A. ternarius* are from remnants of longleaf pine sandhill savannas on yellow sands, which are increasingly uncommon in this region of the state. Species of *Andropogon* often co-occurring with *A. ternarius* in central Florida include *A. gyrans, A. floridanus, A. tracyi,* and *A. virginicus* '"Old Field Variant." *Andropogon ternarius* and *A. cabanisii* are found in close proximity at some locations but there they are separated by habitat, with *A. ternarius* in the better drained parts of the site; no intermediates have been seen.

Finally, *Andropogon miamiensis* is restricted to pine rockland savannas of extreme southern Florida, where it is very common in frequently burned examples, to the point of having had a unique local common name ("firegrass") long before it was recognized as a distinct species. These habitats have a fluctuating water table, and this species must be capable of tolerating both extreme droughts and occasional soil saturation to the surface. It is most commonly found in small cracks, crevices, and depressions in limestone, in contrast to the mostly acidic sandy habitats of the other species in this group. Given this habitat restriction, it is unlikely to be found further north than Miami-Dade and Monroe counties, Florida.

ACKNOWLEDGEMENTS

We thank Paul Ebersbach, retired Chief of the Environmental Flight at Avon Park Air Force Range (APAFR), for his continued support of scientific research at APAFR. Sam Van Hook (retired from APAFR), Wayne Taylor, and the staff of the prescribed burning program at APAFR are thanked for conducting prescribed burns that enhanced flowering of the native grasses. Douglas Ripley, retired U.S. Air Force, is credited for securing funding for work on the project. Fieldwork was facilitated by numerous land managers at several state and federal conservation lands. Herbarium curators are thanked, especially Richard Wunderlin and Bruce Hansen at USF and Kent Perkins at FLAS. James Cheak photographed the dried specimens and created the figure page layouts. Some photos of plants in situ were provided by Dave Briley. The type specimen of *Andropogon miamiensis* was collected under Permit Number EVER-2009-SCI-0059 from the National Park Service.

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Appendix 1. Specimens examined

ANDROPOGON CUMULICOLA. **Florida**. Alachua Co.: Flatwoods, Fairbanks, 25 Oct 1927, *Weber & West 144* (FLAS) [questionably this species, could be a small A. ternarius]. Brevard Co.: *Fredholm 6110* (US). Charlotte Co.: Pine-palmetto flatwoods, Caloosa Forest, west replacement pasture, Sec. 31, T42S, R26E, 18 Oct 1963, *Lewis 107* (US). Clay Co.: Open, sandy ground, Penny Farms, 15 Nov 1938, *Swallen 5599* (NY). Collier Co.: Pine flatwoods, 21 Oct 1967, *Lakela 31145* (DUKE, USF). Hardee Co.: Scrub on white sand, 10 Nov 1978, *Hansen 4921* (USF). Highlands Co.: Avon Ridge Lower (HIGH 73); Lake Arbuckle SE 7.5 Quad., Sec 5/6, T34S, R31E, Sec 31/32, T33S, R31E, Avon Park Air Force Range, 21 Oct 1986, *Huck 4657* (FLAS, USF); Avon Ridge North (HIGH 15), Lake Arbuckle SE 7.5 Quad., Sec 18, T33S, R31E, Avon Park Bombing Range, 22 Oct 1986 *Huck 4617* (FLAS); *Campbell 4118* (GH); Scrubby pinelands W of Sandy Hill Grade, ca. 0.7 air mi S of Submarine Lake, Avon Park Air Force Range, SEQ, SEQ, Sec. 19, T33S, R31E, 27°35'20" N, 81°15'30" W, 29 Oct 2002, *Orzell & Bridges 26055* (BRIT, FLAS, GH, MO, NCU, NY, TEX, USF); Frequently burned high-quality *Pinus palustris* sandhill savanna, ca. 0.2 mi E of Echo Springs Rd at a point ca. 1.2 mi N of jct South Fence East Rd, Avon Park Air Force Range, SEQ, SEQ, Sec. 31, T33S, R31E, 27°33'37" N, 81°15'28" W, 6 Nov 1994, *Orzell & Bridges 23393* (FLAS, USF), same location, 7 Nov 2002, *Orzell & Bridges 26061* (USF), same location, 23 Oct 2007, *Orzell & Bridges 26302* (FLAS, NCU, USF); Burned scrubby pinelands, in Echo Range, ca. 0.75 air mi SE of jct Echo Springs Rd and Long Cypress Cut, Avon Park Air Force Range, 27°34'13" N, 81°15'14" W, NWQ, NWQ, NWQ, Sec. 32, T33S, R31E, 7 Nov 2002, *Orzell & Bridges 26064* (FLAS, USF, US); Oak scrub with xeric sandy barrens, in primitive camping area of Highlands Hammock State Park, ca. 0.4 mi SSW of jct CR634 and CR635 at park entrance, ca. 6.5 mi W of Sebring, SEQ, NEQ, Sec. 4, T35S, R28E, 27°27'56" N, 81°31'04" W, 15 Oct 1994, *Orzell & Bridges 23307* (USF). Hillsborough Co.: Tampa, Oct 1877, *Garber s.n.* (NY) [note - not all sheets distributed by Garber with this collection data are A. cumulicola - some are *A. cabanisii*, and some are mixed sheets with culms of both species]; Dry sandy soil, 13 Oct 1904, *Fredholm 6423* (NY); Sandhill with open stand of live oak, dominated by grasses, southeastern sector of USF campus, Tampa, 13 Nov 1963, *O. Lakela 26667* (FLAS); Dry sandy palmetto flatwoods with scattered stunted live oaks, 25 Nov 1975, *Shuey 1507* (USF); Less than a dozen plants in open patches of sand, signs of recent fire, 16 Oct 2008, *Dickman s.n.* (USF); Scrub/scrubby flatwoods, 10 Nov 2009, *Dickman and Lambright s.n.* (USF). Manatee Co.: Pine woods, Bradenton, 30 Oct 1916, *Cuthbert 1454* (FLAS - 2 sheets). Osceola Co.: Small sand-pine scrub, 14 Oct 1960, *Ray et al. 10490* (GH, US USF); 14 Oct 1960 *Ray et al. 10496* (USF). Polk Co.: Indian Head Estates (Polk 41), Dundee 7.5 Quad., Sec 17, T28S, R28E, from intersection of SR 544 and Jim Edwards Rd, turn (?W) on Jim Edwards Rd 0.3 mi., 9 Oct 1986, *Huck 4400* (FLAS); Trailer park and remnant scrub, Camp Mack Rd North (Polk 72), Hesperides 7.5 Quad., Sec 30, T29S, R29E, Home by Robert Cadwell, 7855 Camp Mack Rd, 15 Oct 1986, *Huck 4550* (FLAS); Old Bravo Rd North, Sec 25/26, T32S, R30E., APAFR, *Huck 4622* (FLAS); Indian Head Estates, *Huck 4400* (FLAS); Trailer park and remnant scrub, 15 Oct 1986, *Huck 4532* (USF); Old Bravo Rd North, Avon Park Bombing Range (Polk 74); Lake Arbuckle 7.5 Quad., Sec 25/26, T32S, R30E, 21 Oct 1986, *Huck 4622* (FLAS); Camp Mack Rd (Polk 72), Hesperides 7.5 Quad., Sec 30, T24S, R29E. Home by Robert Cadwell, 7855 Camp Mack Rd. Trailer Park and remnant scrub, 15 Oct 1986, *Huck 4538* (FLAS) [mixed sheet of *Andropogon cabanisii* and *Andropogon cumulicola*, one culm of each on sheet!]; Open, fire-maintained *Pinus palustris* sandhill savanna, ca. 0.45 mi SSW of jct Frostproof Rd and Arnold Hammock Rd, NWQ, SEQ, SEQ, Sec. 11, T32S, R29E, 27°42'30" N, 81°23'11" W, 16 Oct 2003, *Orzell & Bridges 26192* (BRIT, FLAS, TEX, USF); Burned, typic scrubby pinelands ca. 0.7 mi NW of jct Smith Rd and Old Bravo Rd, Avon Park Air Force Range, SWQ, SEQ, NEQ, Sec. 23, T32S, R30E, 27°41'00" N, 81°17'21" W, 12 Nov 2002, *Orzell & Bridges 26070* (BRIT, FLAS, GH, TEX, USF); Frequently burned scrubby pinelands, in Bravo Range, ca. 0.4 mi E of Billig Rd at a point 0.15 mi N of Bravo Rd, Avon Park Air Force Range, SWQ, SWQ, NEQ, Sec. 16, T32S, R30E, 27°41'18" N, 81°20'02" W, 2 Nov 1998, *Orzell &*

Bridges 25461 (FLAS, NCU, TEX, USF); same location, 20 Oct 2009, *Orzell & Bridges 26405* (FLAS, FSU, MO, NCU, TEX, US, USF); Scrubby pinelands between scrub and mesic pinelands, along Road #4, 0.2 mi W of School Bus Rd at a point 4.1 mi S of entrance gate at jct Rucks Dairy Rd, ca. 0.8 mi NW of FL 64, ca. 7 air mi NE of Avon Park, Arbuckle Tract - Lake Wales Ridge State Forest, SWQ, SEQ, Sec. 27, T32S, R29E, 27°39'45" N, 81°24'13" W, 16 Oct 1994, *Orzell & Bridges 23314* (BRIT, FLAS, TEX, USF) [note - Type locality for *Rhynchospora megaplumosa*]. Putnam Co.: Sec 22, T10S, R24E, along C-315, ca 2 km S of jct with FL 20 at Interlachen, sand scrub with *Pinus palustris, Quercus leavis, Garberia frutescens, Ceratiola ericoides* and *Quercus geminata,* 30 Oct 1982, *Skean 879* (FLAS) [identification tentative, not conclusive].

ANDROPOGON ARCTATUS. **Alabama**. Baldwin Co.: Hillside streamhead seepage herb bog on S side of US 90, ca. 2.2 mi W of Seminole, ca. 0.5 air mi SW of Seminole Church, ca. 3.9 mi W of Perdido River and Florida state line, Elsanor 7.5' Quad., EH, SWQ, SEQ, NWQ, Sec. 18, T6S, R6E, 30°31'31" N; 87°30'30" W, 24 Aug 1994, *Orzell & Bridges 22913* (BRIT, MO, USF). Covington Co.: Sandy savanna, ca. 12 mi S of Andalusia, 3 Oct 1971, *Kral 44749* (VDB); Loblolly pine-water oak-galberry wet flatwods on creek floodplain terrace, burned earlier this year, FS332 SE of Salt Pond, N side of Camp Creek, Conecuh National Forest, 15 Oct 1996, *Sorrie 9087* (NCU). Geneva Co.: Savannah area along powerline, occasional, with nearby Andropogon liebmannii, 12 Nov 1999, *MacDonald 13672* (TROY). **Florida**. Bay Co.: Open wiregrass bog, near Sandy Creek, W of Wewahitchka, by Fla. Rte 22, 17 Oct 1978, *Godfrey 76774* (FLAS, FSU); Frequent in moist loamy sand of *Hypericum chapmanii - Ilex myrtifolia* depression in flatwoods, 29 Nov 2001, *Anderson 20117* (FSU). Calhoun Co.: Clear-cut pine flatwoods, 1.4 mi S of Blountstown, by Fla. Rte 71, 1 Nov 1980, *Godfrey 78243* (FLAS, FSU, TTRS); Frequent in pitcher plant bog, 1 Nov 1980, *Godfrey 78252* (FLAS, FSU). Clay Co.: Burned seepy ecotone above acid seep forest at head of unnamed tributary W of Yellow Water Creek, ca. 0.8 air mi S of Duval Co. line, ca. 2.2 air mi NE of Long Branch Ch, ca. 7.6 air mi NNW of Middleburg, Jennings Forest - Black Creek WMA, Fiftone 7.5' Quad., SWQ, SWQ, Sec. 5, T4S, R24E, 30°10'29" N, 81°55'55" W, 16 Oct 1992, *Orzell & Bridges 21141* (FLAS, FTG, USF); Burned seepage slope at headwaters of tributary NE of North Fork Black Creek, S of Long Branch Rd, 0.7 mi SE of State Forest entrance, ca. 7 air mi NW of Middleburg, Jennings SF - Black Creek WMA; Fiftone 7.5' Quad.; NWQ, NEQ, Sec. 18, T4S, R24E; 30°09'23" N, 81°56'33" W, 12 Sep 1999, *Orzell & Bridges 25588* (FLAS, FSU, USF). Escambia Co.: in low pineland, 20 Nov 1983, *Wilhelm 11935* (USF); flatwoods beside Rte 292, 3.5 mi E of jct. C-293, 5 Nov 1977, *Campbell 3944* (NY). Franklin Co.: St. Georges Island, Sep 1867, *Saurman s.n.* (NY); Disturbed titi swamp, essentially clearcut, ca. 4.2 mi N of jct of Fla. 65 and US 98-319, to w of road, S34, 2 Nov 1981, *McDaniel 24744* (FLAS); Wet pineland, clearcuts and chopped with heavy machinery, by Fla. Rte 65, 11.4 mi N of its jct. with US Rte 98 E of East Point and 4.6 mi S on Rte 65 from boundary of Apalachicola National Forest, generally S of Sumatra, 6 Nov 1985, *Godfrey 81962* (FSU, TTRS, USF); Abundant in boggy, open pineland which had been control-burned in summer 1988, by Hickory Landing Road, SW of Sumatra, Apalachicola National Forest, 16 Nov 1988, *Godfrey et al. 82972* (FLAS, TTRS); Scattered, old titi swamp now planted with pines, 2 mi E of Fla. 65 on Bucks Siding Road, Sec. 9, T7S, R7W, Oct 1976, *Conde s.n.* (FLAS). Gulf Co.: Lower slope quaking deep muck poor fen (seepage bog) on W side of Little Sandy Creek (= Alligator Creek), ca. 0.6 air mi NE of creek crossing at Bay Co. line, ca. 13 air mi W of Wewahitchka, Sandy Creek Bogs CARL; Allanton 7.5' Quad., NWQ, SWQ, NEQ, Sec. 31, T4S, R11W, 30°05'43" N; 85°22'54" W, 11 Oct 1992, *Orzell & Bridges 21053* (FLAS, USF), *21055B* (USF); Flatwoods, 9 Oct 1989, *Johnson & White 8652* (FSU). Holmes Co.: Seepage areas in burned upland longleaf pine savanna E of Bealia Rd and W of Sun Lake, ca. 0.6 mi N of County Line Rd and 0.7 mi W of FL 79, 1.0 air mi SW of jct FL 79 and I-10, ca. 2.7 air mi SW of Bonifay; Sun Lake Longleaf Savanna, Poplar Head (& Bonifay) 7.5' Quad.; NWQ, SWQ, Sec. 13, T4N, R15W; 30°45'05" N; 85°41'47" W, 29 Sep 1992, *Orzell & Bridges 20865* (BRIT, FLAS, FTG, MO, NCU, NY, TEX, USF, US). Jackson Co.: Grassy bank under powerline, 2.2 mi E of Arrowhead Campground on Rte 90, 4 Nov 1977, *Campbell 3937* (NY, USF); Wiregrass bog, 14 Oct 1978, *Godfrey et al. 76736* (FSU); Wiregrass bog, near Fla. Rte 280, ca. 3/4 mi N of I-10, S of Sneads, 1 Nov 1980, *Godfrey 78245* (FLAS, FSU); Open bog, power line transect, 1.5 mi S of I-10, S of Sneads, 1 Nov 1980, *Godfrey 78249* (FLAS, FSU). Liberty Co.: Longleaf pine flat bordering open savanna, soil loamy, 16 Oct 1975, *Clewell s.n.* (FSU); Wet flatwoods site, clearcut and recently planted to slash pine, 1.7 mi E of Hosford, S side of Fla. Rte 20, 9 Nov 1976, *Godfrey 75788* (FSU, TTRS); In a very large area of pine flatwoods that had been clearcut, 3.5 mi S of Telogia by Fla. Rte 65, 21 Oct 1981, *Godfrey 79231* (FLAS, FSU, TTRS); Longleaf pine savanna, by Forest Road 123 off to SW of Co. rd 379, NW of Sumatra, Apalachicola National Forest, 24 Oct 1985, *Godfrey et al. 81959* (FLAS, FSU, TTRS, USF); Seasonally wet pine flatwoods, abundant where clear-cut and where soil mechanically much disturbed in preparation for planting slash pine, 2 mi N of Sumatra, 18 Oct 1975, *Godfrey 74577* (FLAS, FSU, TTRS); Frequent in a large area of flatwoods clearcut, site-prepared, and planted to slash pine, probably 1-2 years ago, 4 mi N of Sumatra by Fla. Rte 65, 1 Nov 1977, *Godfrey 76112* (FLAS, FSU, TTRS); Longleaf pineland, controlled-burned 30 Apr 1990, with entirely herbaceous groundflora, by Fla. Rd 379, 15.6 mi S of its jct with Co Rd 12, and generally NW of Sumatra, 3 Oct 1990, *Godfrey & Gholson 84000* (FLAS, NY, TTRS); Damp sandy soil along upper margin of savannah in edge of longleaf pine - wiregrass woods, burned during spring or early summer of 1985, S side of FS Rd 123, 0.2 mi W of jct with State Rte 379, N of Sumatra, Apalachicola National Forest, 24 Oct 1985, *Gholson 11528* (FLAS); 2 year old pine plantation, Rte 65, 4 mi N of Sumatra [Franklin Co on label, but this location must be in Liberty Co], 1 Nov 1977, *Campbell 3919* (FLAS); Large stand of plants scattered in wiregrass ecotone between flatwoods and pitcher plant bog in Apalachicola National Forest west of FR181, 1.8 mi north of its junction with FR 2, NE of Sumatra, flowering after an April burn, 13 Oct 2013, *Johnson 10664* (FSU). Okaloosa Co.: Extensive sapric hillside and streamhead seepage bogs ca. 0.4 mi E of State Forest Rd 49, at a point ca. 2 mi N of jct State Forest Rd 50 at Peaden Bridge over Blackwater River, ca. 9 mi ENE of Munson; Blackwater River State Forest; Blackman 7.5' Quad.; SWQ, NWQ, Sec. 27, T5N, R25W; 30°54'27" N; 86°44'08" W, 25 Aug 1994, *Orzell & Bridges 22931* (F, FLAS, USF); Hillside seepage bogs in longleaf pine savanna ca. 0.8 mi E of State Forest Rd 47 (Beaver Creek Rd) and 1.1 air mi N of FL 4, at head of tributary W of Blackwater River, 6 mi W of Baker, 7.5 mi E of Munson; Blackwater River State Forest; Munson 7.5' Quad.; SWQ, SEQ, NWQ, Sec. 9, T4N, R25W; 30°51'48" N; 86°45'05" W, 29 Aug 1994, *Orzell & Bridges 23074* (BRIT, FLAS, FTG, MO, NY, TEX, USF). Santa Rosa Co.: Recently burned wetland savanna S of unimproved rd 0.6 mi W of FL 281, ca. 0.6 air mi NW of jct I-10 and FL 281, ca. 0.5 air mi N of Avalon Beach, ca. 6 air mi SW of Milton; Milton South 7.5' Quad.; Sec. 6, T1S, R28W; 30°32'15" N; 87°05'45" W, 3 Oct 1992, *Orzell & Bridges 21003* (BRIT, FLAS, MO, NCU, TEX, USF). Walton Co.: Damp pine barrens near Argyle, 2 Oct 1901, *Curtiss 6924* (NY); NW Walton Co, 4 Nov 1939, *Hume s.n.* (FLAS); High streamhead seepage herb bog with quaking mats on tributary to Little Alaqua Creek, 0.4 air mi S of jct Eglin Range Rds 210 and 200, ca. 0.7 air mi SW of New Home, ca. 10 air mi SW of De Funiak Springs; Eglin Air Force Base; Portland 7.5' Quad.; SEQ, SWQ, SWQ, Sec. 3, T1N, R20W; 30°36'15" N; 86°13'51" W, 19 Sep 1993, *Orzell & Bridges 22446* (BRIT, DUKE, FLAS, TEX, USF). **North Carolina**. Pamlico Co.: Moist soil along ditch, marsh land, Hobucken, 13 Jul 1922, *Randolph & Randolph 871* (GH) [specimen not seen, but reported and discussed by LeBlond and Sorrie (2001)]

ANDROPOGON TERNARIUS. **Georgia**. Telfair Co.: Xeric longleaf pine / oak sandhill savanna on riverine sand ridge on N side of Horse Creek, ca. 2 mi upstream from the Ocmulgee River, ca. 10 mi SW of Lumber City, 31°50'55" N, 82°48'56" W, 8 Nov 2009, *Orzell & Bridges 26409* (FLAS, FSU, GA, NCU, USF). **Florida**. Clay Co.: Xeric *Pinus palustris / Aristida beyrichiana - Ctenium floridanum* savanna, ca. 1 air mi S of Duval Co. line and ca. 0.7 air mi W of Yellow Water Creek, ca. 8.1 air mi NW of Middleburg, Jennings Forest - Black Creek WMA, SEQ, SEQ, SEQ, Sec. 6, T4S, R24E, 30°10'20" N, 81°55'59" W, 16 Oct 1992, *Orzell & Bridges 21169* (FLAS, FSU, NCU, USF). *Hamilton Co.*: Typic dry upland burned longleaf pine savanna, ca. 0.8 mi N of FL 6 at a point ca. 0.5

mi E of jct FL 143 at Blue Springs, ca. 2 mi E of Withlacoochee River, ca. 7 air mi SSW of Jennings, SEQ, Sec. 10, T1N, R11E, 30°29'50" N, 83°12'45" W, 5 May 2012, *Orzell & Bridges 26587* (FLAS, FSU, NCU, USF). Lake Co.: Recently burned longleaf pine sandhill savanna, 0.5 mi S of Hartwood Marsh Rd at a point 4.2 mi E of jct US 27, ca. 5 air mi SE of Clermont, NWQ, Sec. 12, T23S, R26E, 28°30'10" N, 81°40'01" W, 22 Oct 2015, *Orzell & Bridges 27042* (FLAS, FSU, NCU, USF). Levy Co.: Sandy roadside through cleared longleaf pine sandhill, at NE corner of jct. FL 24 and NE 112 Ct., ca. 3.5 mi NE of Bronson, opposite "The Church at Sand Hill", SWQ, SEQ, SWQ, Sec. 26, T11S, R17E, 29°29'40" N, 82°35'09" W, 30 Apr 2012, *Orzell & Bridges 26582* (FLAS, FSU, NCU, TEX, USF). Nassau Co.: Cutover xeric sandhill woodland savanna, ca. 0.6 air mi SW of Elbow Landing on St. Marys River, ca. 3.7 air mi NE of Boulogne, ca. 10.5 air mi N of downtown Hillard, SEQ, Sec. 32, T5N, R24E, 30°48'36" N, 81°56'00" W, 17 Oct 1992, *Orzell & Bridges 21207* (BRIT, FLAS, NCU, TEX, USF). Polk Co.: Disturbed sandhill savanna, on N side of Golfview Rd cutoff, just E of Alt Hwy 17 on the north side of Babson Park, SEQ, NEQ, Sec. 29, T30S, R28E, 27°50'30" N, 81°31'56" W, 9 Jun 2011, *Orzell & Bridges 26437* (FLAS, USF); Longleaf pine sandhill woodland on yellow sand, Tiger Creek TNC Preserve E of Babson Park, SEQ, Sec. 2, T31S, R28E, 27°48'39" N, 81°29'12" W, 4 Nov 2011, *Orzell & Bridges 26550* (FLAS, USF); Frequently burned longleaf pine sandhill woodland, E of Billig Rd on Avon Park Air Force Range, NWQ, NWQ, Sec. 4, T32S, R30E, 27°43'50" N, 81°19'49" W, 18 Oct 2012, *Orzell & Bridges 26605* (BRIT, FLAS, FSU, NCU, NY, TEX, USF).

ANDROPOGON CABANISII. **Florida**. Clay Co.: Dry-mesic pine pinelands, ca. 1 air mi S of Duval Co. line and ca. 0.7 air mi W of Yellow Water Creek, ca. 8.1 air mi NW of Middleburg, Jennings Forest - Black Creek WMA, SEQ, SEQ, SEQ, Sec. 6, T4S, R24E, 30°10'20" N, 81°55'59" W, 16 Oct 1992, *Orzell & Bridges 21157* (BRIT, F, FLAS, FTG, GH, MO, NCU, NY, TEX, USF, US). Glades Co.: Mesic slash pine savanna, east of Fisheating Creek, ca. 7 mi SW of Venus, NEQ, Sec. 8, T40S, R29E, 27°00'40" N, 81°26'05" W, 6 Aug 2003, *Orzell & Bridges 26108* (FLAS, USF). Highlands Co.: Oak scrub with xeric sandy barrens, in primitive camping area of Highlands Hammock State Park, ca. 0.4 mi SSW of jct CR634 and CR635 at park entrance, ca. 6.5 mi W of Sebring, SEQ, NEQ, Sec. 4, T35S, R28E, 27°27'56" N, 81°31'04" W, 15 Oct 1994, *Orzell & Bridges 23306* (USF); Mesic longleaf pine savanna, ca. 0.1 mi N of Kulhanek Rd, 0.2 mi E of jct Canady Rd, Avon Park Air Force Range, SEQ, SWQ, SWQ, Sec. 34, T33S, R30E, 27°33'31" N, 81°19'02" W, 29 Oct 1999, *Orzell & Bridges 25763* (FLAS, FSU, NCU, USF). Hillsborough Co.: Tampa, Oct 1877, *Garber s.n.* (NY) [note - not all sheets distributed by Garber with this collection data are *A. cabanisii* - some are *A. cumulicola*, and some are mixed sheets with culms of both species]. Okeechobee Co.: Open wet mesic hyperseasonal grassland, in undeveloped subdivision, ca. 4.6 mi N of FL 724, ca. 11.8 air mi W of Fort Drum, SEQ, NWQ, Sec. 11, T34S, R33E, 27°31'54" N, 81°00'14" W, 21 Oct 1994, *Orzell & Bridges 23351* (BRIT, DUKE, FLAS, FTG, MO, NCU, NY, TEX, USF, US); Scrubby pinelands, on E side of US441, just S o f NE 342nd Trail, NWQ, SWQ, Sec. 34, T33S, R35E, 27°33'33" N, 80°49'24" W, 3 Nov 2011, *Orzell & Bridges 26548* (FLAS, USF). Polk Co.: Burned wet grasslands E of Morgan Hole Creek, S of Smith Rd and a point ca. 0.5 mi W of jct with Durden Rd, Avon Park Air Force Range, NWQ, NWQ, NWQ, Sec. 26, T32S, R30E, 27°40'29" N, 81°18'09" W, 23 Oct 1993, *Orzell & Bridges 22510* (BRIT, F, FLAS, FTG, GH, MO, NCU, NY, TEX, USF, US); Wet-mesic longleaf pine savanna, S of Eight Mile Rd, ca. 0.4 mi NE of jct Blood Rd and Eight Mile Road, Avon Park Air Force Range, SWQ, NEQ, SEQ, Sec. 17, T32S, R31E, 27°41'36" N, 81°14'23" W, 3 Nov 1994, *Orzell & Bridges 23376* (FLAS, FSU, NCU, USF).

ANDROPOGON MIAMIENSIS. **Florida**. Miami-Dade Co.: Scattered in rocky pineland, mostly near road edge, culms to 2 m high, leaves glaucous, edge of road along east boundary of park, Everglades National Park, 26 Oct 1976, *Avery 1298* (FTG); Long Pine Key, 14 Sep 1962, *Craighead s.n.* (FTG); Everglades National Park, Gate 2 1/2, 29 Sep 1963, *Craighead s.n.* (FTG); Homestead, 11

Nov 1962, *Craighead s.n.* (FTG); Rocky pineland with reddish soil, SW 165 Ave - 304 St., Homestead, plants forming clumps, culms to 1.7 m tell, the pink color of the internodes contrasting with the green or brown of the leaf sheaths to give a barber-pole effect, 15 Oct 1982, *Herndon 654* (FTG); In disturbed soil at edge of pineland, Old Cutler Rd and S 62 Ave, Sec. 13, T55S, R40E, 6 Oct 1968, *Avery 546* (FTG); Locally common in sandy pine rockland/muhly prairie ecotone, Nixon Smiley Pineland Preserve, entrance located 1/4 mi east of SW 137th Ave. along SW 128th St, 25.648 N, 80.410 W, 26 Oct 1999, *Woodmannsee 410* (FTG). Monroe Co.: Scattered clumps in rocky pineland, Big Pine Key – culms moderate purplish-red, leaves and sheath moderate olive green, 15 Oct 1965, *Avery s.n.* (FLAS, FTG).

Grayum, M.H. and M. Cedeño-Fonseca. 2018. Typification of *Scindapsus dilaceratus* (Araceae). Phytoneuron 2018-81: 1–4.
Published 20 December 2018. ISSN 2153 733X

TYPIFICATION OF *SCINDAPSUS DILACERATUS* (ARACEAE)

MICHAEL H. GRAYUM
Missouri Botanical Garden
4344 Shaw Blvd.
St. Louis, Missouri 63110
michael.grayum@mobot.org

MARCO CEDEÑO-FONSECA
Programa de Posgrado en Biología / Herbario Luis Fournier Origgi (USJ)
Universidad de Costa Rica
Apartado 11501-2060
San José, Costa Rica
marcovf.09@gmail.com

ABSTRACT

Scindapsus dilaceratus K. Koch & Sello is the basionym of *Monstera dilacerata* (K. Koch & Sello) K. Koch, a name that was long accepted in taxonomic revisions and New World floristic accounts. Recent work has established that *S. dilaceratus* and its homotypic synonyms apply correctly to a widespread Old World species with the prior name *Epipremnum pinnatum* (L.) Engl. The name *Scindapsus dilaceratus* is here neotypified accordingly.

The name *Scindapsus dilaceratus* K. Koch & Sello was published in 1853 or 1854 in a seed catalogue, with a brief Latin description and no illustrations, based on sterile material then in cultivation (under the never-published name "*Philodendron dilaceratum*") at or near the Sanssouci Palace in Potsdam, Germany. The generic placement was apparently prompted by a resemblance to the South American *Scindapsus occidentalis* Poepp. (now accommodated in the genus *Alloschemone*), to which the new species was compared. According to its protologue, *S. dilaceratus* originated "in regionibus Americae tropicis," presaging its application in subsequent years to New World material. Shortly after its publication, *S. dilaceratus* was transferred to *Monstera* (in 1855 or 1856) and later to *Tornelia* (1860) and *Rhaphidophora* (1864). Nowadays, the genera *Scindapsus* and *Rhaphidophora* are restricted to the Old World, and *Monstera* (with *Tornelia* as a synonym) to the New World (see, e.g., Mabberley 2017).

For more than 100 years, beginning in 1878 (Engler 1878) and extending until at least 1993 (Brako & Croat 1993), *Scindapsus dilaceratus* throve as the basionym of *Monstera dilacerata* (K. Koch & Sello) K. Koch, an accepted name used regularly in taxonomic revisions and floristic accounts for various neotropical regions. However, from the start the name *M. dilacerata* was applied very broadly. In particular, specimen citations in the most recent revision of *Monstera* (Madison 1977) revealed that at least four distinct species were subsumed within the concept of *M. dilacerata* (Croat & Grayum 1987). Efforts to comprehend the correct application of the name with reference to the protologue (of *Scindapsus dilaceratus*) and type material were stymied by the brevity and inadequacy of the former, and the apparent absence of the latter. Karl Koch's original material (i.e., the effective holotype) of *Scindapsus dilaceratus* has not been found and was presumably destroyed (with most of the rest of the B herbarium) in a 1943 bombing raid (see Merrill 1943). A photograph of the presumptive holotype, taken by J.F. Macbride ca. 1929–1933 (see Grimé & Plowman 1986) does exist (<http://emuweb.fieldmuseum.org/botany/berDisplay.php?irn=224759&QueryPage=%2Fbotany%2Fsearch_berlin.php>), with prints deposited in various herbaria (e.g., MO-1663837); however, this image is of limited utility and could not be matched to any material from Costa Rica (Grayum 1997), a country to which *M. dilacerata* has been routinely attributed.

For a time, it seemed as though the correct application of *Scindapsus dilaceratus* might never be established conclusively (see Croat & Grayum 1987); however, a breakthrough came with the discovery (by the first author of this paper) of a handwritten note contained within a fragment folder affixed to *Donnell Smith 6808* (US), a Costa Rican specimen now determined as *Monstera dissecta* (Schott) Croat & Grayum (one of the species that had been included in *M. dilacerata*). Said note, dated May, 1898, was penned by British botanist (and sometime Araceae specialist) N.E. Brown, who stated that he had "seen Koch's type" (of *Scindapsus dilaceratus*) and possessed "drawings of it." On that basis, Brown declared that he was "now fully persuaded that it [*S. dilaceratus*] is identical with" *Epipremnum mirabile* Schott, now regarded as a synonym of *E. pinnatum* (L.) Schott, a widespread Old World species (tropical Asia to Australasia and Oceania). This information was immediately communicated to Peter C. Boyce, a specialist on Southeast Asian Araceae, who examined Brown's drawings at K and endorsed his conclusion unreservedly. The synonymization of *Scindapsus dilaceratus* (and its homotypic synonyms) under *Epipremnum pinnatum* was reported by Grayum (1997) and formalized shortly thereafter in Boyce's (1998) revision of *Epipremnum* for West and Central Malesia. Boyce's (1998: 205) pointed observations sounded the death knell for *S. dilaceratus* and its derivatives:

> "...N.E. Brown prepared a drawing of the type (K) that shows it to be an exact match for the pre-adult stage of *E. pinnatum*, even to the pellucid dots next to the mid-rib. Further, on a copy (K) of an article by Brown (1882) dealing with *E. mirabile* (= *E. pinnatum*) there is a note in the margin adjacent to the discussion of *Monstera dilacerata*, in Brown's hand and dated April 1885, stating 'I now believe that *Monstera dilacerata* Koch is identified with *Epipremnum mirabile* Schott'."

Brown (1882) had initially dismissed any connection between *Epipremnum mirabile* and *Monstera dilacerata* but reversed his position three years later, effectively resolving the true identity of *Scindapsus dilaceratus* only seven years after *M. dilacerata* had been taken up as an accepted species name; nonetheless, rampant misapplication of *M. dilacerata* would continue unabated for more than a century. In recent years, however, the name *Monstera dilacerata* has been abandoned in most major floristic works (e.g., Croat 1999; Croat & Stiebel 2001; Grayum 2003). Even so, it appears that its basionym, *Scindapsus dilaceratus*, has not yet been typified properly, so as to guarantee its synonymy under *Epipremnum pinnatum* and banishment from *Monstera*. Madison (1977) neglected to typify *S. dilaceratus*, as did Croat and Grayum (1987) and Grayum (1997). Boyce (1998) cited the type as follows: "Cultivated Berlin Botanic Garden (B† holo; K iso)"; the dagger was clearly meant to acknowledge the demise of Koch's original material at B, while "K iso" suggests that Boyce was accepting some element at K as an isotype. It seems most likely that Boyce's intended "iso[type]" was the Brown drawing mentioned in the passage quoted above (there being no actual duplicate of Koch's collection at K). The drawing in question, currently on file at K, represents an "Outline of [the] Type specimen! in C. Koch's Herbarium" and was executed by N.E. Brown on 3 Jul 1878. Its components concord exactly (even as to leaf folds and tears) with those manifest in Macbride's photo of the specimen itself, discussed previously. The so-called "pellucid dots" referenced by Boyce (1998: 205) are addressed in the following handwritten (presumably by Brown) annotation:

> "These rounded markings represent pellucid spots on the leaf arranged along both sides of the midrib. They are not perforations but are spaces free from parenchyma, being covered by the two epidermal skins only."

Having said all of that, according to a strict interpretation of the International Code of Nomenclature (ICN; Turland et al. 2018), photographs, and drawings of original material prepared after the publication of the pertinent protologue do not themselves qualify as original material (see especially ICN Arts. 9.1 and 9.4; Ross 2002; Staples & Prado 2018); however insightful they may be, such depictions are thus not eligible as holotypes or even lectotypes (see ICN Art. 9.3) and certainly not as isotypes, which must always be specimens (ICN Art. 9.5). This consideraton eliminates both Brown's drawing and the Macbride photo as potential holo-, iso-, or lectotypes, and the apparent absence of any material that may be construed as original leaves neotypification as the only option for *Scindapsus dilaceratus*.

It could be argued that, despite his clear misuse of the term "iso[type]," Boyce may be credited with having neotypified *S. dilaceratus* inadvertently, inasmuch as the usage of terms or phrases such as "neotypus" (ICN Art. 9.23) and "designated here" (ICN Art. 7.11) was not mandated prior to 2001. However, we feel justified in rejecting this notion because Boyce's intended type element was not "clearly indicated by direct citation," as required by ICN Art. 7.11. While it is true that Brown's drawing is the only eligible element discussed in Boyce's (1998: 205) "Notes" under *Epipremnum pinnatum*, it is not referred to there as a "type" (or any equivalent term) and is not referenced at all in Boyce's type citation for *Scindapsus dilaceratus*. Thus Boyce's intent must be deemed conjectural, and his supposed "iso[type]" could conceivably have been some specimen or a different drawing. Indeed, a second drawing of *S. dilaceratus* does exist at K, labeled as a "Tracing from C. KOCH's drawing. 1878." and also annotated (again, presumably in Brown's hand) to highlight "the dots on the surface" of the leaves. Both drawings must have been seen by Boyce, though neither is annotated by him in any way. Clearly, Boyce's (unintended) "typification" of *Scindapsus dilaceratus* was ambiguous in every respect, and we therefore consider that the name has yet to be properly typified, according to the requirements of the Code. We proceed here to neotypify it ourselves, and in so doing, prefer to eschew old illustrations and photos of sterile material and instead designate a good, fertile, modern collection (determined as *Epipremnum pinnatum* by Peter Boyce) as neotype (ICN Art. 9.8).

EPIPREMNUM PINNATUM (L.) Engl., Pflanzenr. IV.23b (Heft 37): 60. 1908. *Pothos pinnatus* L., Sp. Pl. (ed. 2) 2: 1374. 1763. *Monstera pinnata* (L.) Schott, Wiener Z. Kunst 1830(4): 1028. 1830. *Scindapsus pinnatus* (L.) Schott, in Schott & Endl., Melet. Bot. 1: 21. 1832. *Rhaphidophora pinnata* (L.) Schott, Bonplandia (Hannover) 5: 45. 1857. **TYPE**: **India**. t. 183, f. 2 in Rumph., Herb. Amboin. 5. 1747 (lectotype, designated by Merrill 1917: 127).

See Boyce (1998) for a comprehensive heterotypic synonymy of *Epipremnum pinnatum*, including *Scindapsus dilaceratus* and *Epipremnum mirabile* and 10 others.

Scindapsus dilaceratus K. Koch & Sello, in A. Braun et al., Append. Sp. Hort. Berol. 1853: 6. 1853–1854. *Monstera dilacerata* (K. Koch & Sello) K. Koch, in A. Braun et al., Append. Gen. Sp. Hort. Berol. 1855: 5. 1855–1856. *Tornelia dilacerata* (K. Koch & Sello) Schott, Prodr. Syst. Aroid. 356. 1860. *Rhaphidophora dilacerata* (K. Koch & Sello) K. Koch ex Regel, Gartenflora 13: 5. 1864. **TYPE**: Cult. Germany, "In regionibus Americae tropicis indigenus" [fide protologue], *K. Koch* [*s.n.*] (holotype: B, destroyed; photo!). **NEOTYPE (here designated)**: Cultivated at Gemini Botanical Garden, Manalapan, Florida, 11 Jun 1992. *T.B. Croat 73888* (MO-4076916!, -4211564!, -4211565!, -4211566!; isoneotypes F, non vidi, US, non vidi).

Epipremnum mirabile Schott, Gen. Aroid., t. 79. 1858. **TYPE**: **Java**. Schott, Gen. Aroid., t. 79. 1858 (holotype).

The MO neotype of *Scindapsus dilaceratus* represents a single gathering, mounted on four sheets that are clearly labeled ("Sheet 1 of 4," "Sheet 2 of 4," etc.) as being parts of the same specimen (see ICN Art. 8.3).

On a final note, the option of typifying *Scindapsus dilaceratus* in such a way as to maintain *Monstera dilacerata* as an accepted name has been considered (see Grayum 1997) and rejected –– on the grounds that the name *M. dilacerata* has never been used consistently for any particular species and has only been a source of confusion for the duration of its lengthy tenure.

ACKNOWLEDGEMENTS

We thank Simon J. Mayo (K) for providing photographs of illustrations and texts at K. Critical reviews by Fred R. Barrie (MO) and Gerrit Davidse (MO) of the initial draft of this paper resulted in considerable improvement, for which we are grateful. We assume full responsibility for any subsequent errors.

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Egger, J.M. and O.A. Sánchez Velázquez. 2018. Field observations and a new collection of the rare Mexican endemic *Castilleja racemosa* (Orobanchaceae). Phytoneuron 2018-82: 1–12. Published 20 December 2018. ISSN 2153 733X

FIELD OBSERVATIONS AND A NEW COLLECTION OF THE RARE MEXICAN ENDEMIC *CASTILLEJA RACEMOSA* (OROBANCHACEAE)

J. MARK EGGER
Herbarium, Burke Museum of Natural History and Culture
University of Washington
Seattle, Washington 98195-5325
m.egger@comcast.net

OSCAR ABEL SÁNCHEZ VELÁZQUEZ
Faculty of Chemical-Biological Sciences
Universidad Autónoma de Sinaloa
Ciudad Universitaria AP. 1354, Universitarios
Culiacán Rosales, Sinaloa 80030 México
oscar.asv.fcqb@uas.edu.mx

ABSTRACT

A recent collection of the distinctive, rare, and highly localized west Mexico endemic species *Castilleja racemosa* (Breedlove & Heckard) Chuang & Heckard is documented. Field observations from the collection site are provided, including the first published photos of live plants in their natural habitat.

Castilleja racemosa (Breedlove & Heckard) Chuang & Heckard is a little-known species endemic to the Sierra Surutato, a portion of the Sierra Madre Occidental in northeastern Sinaloa, Mexico. The vegetation and ecology of this region was first described by H.S. Gentry (1946). During one of his several collection forays into these mountains, Gentry made the first collection of *C. racemosa*, though he made no mention of it in his paper. While the duplicates were widely distributed, the specimens remained unidentified for 24 years. The ecology of this historically remote region was also characterized by McDiarmid et al. (1976).

The species was first described by Breedlove and Heckard (1970) and was originally placed in its own monotypic genus, as *Gentrya racemosa* Breedlove & Heckard. Later, Chuang and Heckard (1991) placed this entity within an expanded *Castilleja*, based on its chromosome number of $n = 12$, the base number for the genus (Chuang & Heckard 1982), and its seed coat morphology. This placement was confirmed by subsequent phylogenetic studies (Tank & Olmstead 2008; Tank et al. 2009).

The authors of the present paper came into contact through the iNaturalist/Naturalista website. Previously, during 20-23 February 1999, Egger visited the Los Hornos-Ocuragui area in the northern part of the Sierra Surutato, where Breedlove obtained two of his collections, including the type, but he was unsuccessful in locating any populations of *Castilleja racemosa*, at least partly due to human population increases and development in the area. Learning that there was a student in the Ph.D. program in Food Biotechnology at the Universidad Autónoma de Sinaloa who might be interested in attempting to locate extant populations, in early 2018 Egger contacted Sánchez-Velázquez, who offered to search for such populations. Sánchez-Velázquez visited the region on 3 March 2018 and successfully located a population of *C. racemosa* near the pueblo of Surutato. Documentation of his collection and an enumeration of the other collections of this species known to us are presented below. Images of many of these herbarium collections were assembled by Egger and can be viewed on the internet (Egger 2018). We believe that the photos of the live plants of *C.*

racemosa presented below (Figs. 2-11) are the first to be published in any medium. It is significant that all known collections were obtained within a limited portion of northeastern Sinaloa, an indication of the very local endemism of this remarkably distinctive species.

CASTILLEJA RACEMOSA (Breedlove & Heckard) Chuang & Heckard, Syst. Bot. 16: 660. 1991. *Gentrya racemosa* Breedlove & Heckard, Brittonia 22: 21. 1970. **TYPE: MEXICO**. **Sinaloa**. Mpio. Sinaloa de Leyva: Near the settlement of Ocuragui, NE of [San José de] Los Hornos, Sierra Surutato, broad cultivated valley with forests of *Pinus* and *Quercus* around the margins, 6000 ft, 22 Feb 1969, *D.E. Breedlove 16456* (holotype: UC!; isotypes: CAS!, ENCB!, K!, LE, MEXU!, MICH!, NY!, UWM, US!).

Verified collections with associated notes. MÉXICO. Sinaloa. Mpio. Badiraguato: Surutato, 600 m al E del centro del pueblo, 25°48'26.6" N, 107°33'14.5" W, bosque de pino-encino con *Pinus engelmanii*, *Pinus oocarpa*, *Quercus* sp., crece en lugares sombreados, 1453 m, 3 Mar 2018, *Sánchez-Velázquez 1* (HJBC!, WTU!, Fig. 1); a 11 km al N de Surutato por la Brecha Surutato-Santa Rita, llano entre claro de bosque, suelo delgado, dominado por gramineas, rara, +/- 2000 m, 9 Mar 1985, *Aviña y Torres 1501* (MEXU [2]!, UAS?); 5 mi NE of La Cienega along road to Santa Rita, steep moist slope with *Cornus*, *Abies*, oak, pine, etc., 7000 ft, 8 Mar 1971, *Breedlove 19262* (CAS! [accidentally destroyed], JEPS!); Sierra Monterey [central portion of Sierra Surutato], moist, grassy northern slope, pine forest, 5000 ft, 10 Mar 1940, *Gentry 5890* (ARIZ!, CAS!, DES!, GH!, MEXU!, MO!, NA!, NY!, OSC!, WTU!). Mpio. Sinaloa de Leyva: 3 mi N of Los Ornos [= San José de Los Hornos] along road to Ocuragui, steep moist slope with *Alnus*, *Styrax*, *Mahonia*, *Molinadendron*, *Clethra*, *Pinus*, *Quecus*, and *Juglans*, 6500 ft, 7 Mar 1971, *Breedlove 19,200* (CAS! [accidentally destroyed], DAO!, JEPS!, MEXU!, MO!, OSC!, WTU!); specimens grown from seeds from *Breedlove 19,200* on *Helianthus annuus* in greenhouse at Univ. of Calif. Berkeley, 29 Sep 1975, *Heckard s.n.* (NY!, UC!).

Breedlove 19,200 (JEPS) and *Breedlove 19262* (JEPS) were used for the chromosome counts by Chuang and Heckard (1982), and the former was the source of the genetic analysis reported by Tank and Olmstead (2008).

While the description and illustration of *Castilleja racemosa* in the protologue are thorough and generally correspond with the characters of the new collection, there are a few details visible in the collection that amend the original description. These features are particularly evident in the photographs by Sánchez-Velázquez presented below (Figs. 2-11). One is the fact that at least some of the corollas turn from the usual lemon yellow to a rich orange to red-orange with age, presumably following pollination. Also, the conspicuously exserted stigma and distal portion of the style is not mentioned in the description nor apparent in the illustration accompanying the protologue. Breedlove and Heckard also mentioned that the plants of the type collection have entire floral bracts, while those of Gentry's collection often have bracts with one pair of lateral lobes. The plants of the new collection have bracts of both types, suggesting that this is a fluid trait. While the precise location of the Gentry collection is unknown, the "Sierra Monterey" is a little-used name apparently applied to the southeastern portion of the Sierra Surutato, according to the map in his paper, while the type collection by Breedlove is in the northwestern portion. The new collection location is between those of Gentry and Breedlove and contains plants with both morphologies. Whether the clinal variation suggested is significant or not remains to be tested.

In addition to confirming much of the general habitat information recorded in the protologue paper and on the labels of previous collections, such as gentle slope in predominantly pine-oak zone, the new collection of *Castilleja racemosa* was closely associated with and perhaps parasitic on a small, low-growing *Hosackia* species (Figs. 2-3), perhaps *H. alamosanus* (Rose) Gentry (fide T.R.

Van Devender, Sky Island Institute, pers. comm., 2018). Aside from the *Hosackia* species, the habitat in the immediate vicinity of the *Castilleja* plants was otherwise only sparsely populated with an unknown grass species (Poaceae) and one or two other unidentified small herbaceous species, though the area was covered with a rather deep layer of pine needles, dead grasses, and dried plant material (see Figs. 2-6). Sánchez-Velázquez located three small subpopulations, ranging in size from 160 m^2 to 450 m^2 and contained estimated plant densities ranging from 5-10 plants to 15-30 plants per m^2.

Global conservation status

Castilleja racemosa is rare species of extremely limited distribution in a western front range of the Sierra Madre Occidental and is entirely endemic to two municipalities in northeastern Sinaloa. It should be considered globally threatened, if not endangered, at least until its complete distribution and ecology are better understood. It is a unique species in several respects, and its conservation should be a matter of concern, both in an evolutionary sense and in terms of the conservation of plant species in Mexico. It should be looked for in the adjacent portions of the Sierra Madre Occidental in extreme southwestern Chihuahua and extreme northwestern Durango, where seemingly suitable habitat will likely be found. The region west of Guadalupe y Calvo, Chihuahua, might be especially productive in this regard.

ACKNOWLEDGEMENTS

We thank the personnel of the following herbaria for timely assistance with correspondence and/or loans of specimens and for hospitality during visits to their institutions: CAS, HJBC, MEXU, MO, NY, UC and WTU. We also thank the botanists Érika Pagaza, Guillermo Millán, Eva Rivera, and Fernando Colín of the Jardín Botánico Culiacán for technical support and Jorge Vega and Cruz López for field logistics. Finally, we thank Guy Nesom for editorial guidance and suggestions. This paper is dedicated to the memory of Dennis Breedlove, who graciously provided Egger with important information regarding his collections and travels in the Sierra Surutato.

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Jardín Botánico Culiacan **HERBARIO**
EJEMPLARES EN COLECCIÓN

Nombre científico:

Castilleja racemosa (Breedlove & Heckard) T.J. Chuang & Heckard

Familia: Orobanchaceae **Localidad:** Surutato, 600 m al E del centro del pueblo

Municipio: Badiraguato **Estado:** Sinaloa **País:** México

Coordenadas: 25°48'26.6" N, 107°33'14.5 O **Altitud:** 1453 m

Forma de vida: Hierba **Flor:** Flor amarilla persistente **Fruto:** Verde oscuro

Colector: O. A. Sánchez-Velázquez **No. de colecta:** 1

Fecha de colecta: 3/Marzo/2018. **Determinó:** M. Egger, Marzo 2018

Observaciones: Bosque de pino encino con *Pinus engelmanii, Pinus oocarpa, Quercus sp.*, crece en lugares sombreados.

NOTE – LETTERS CORRESPOND TO DNA
SAMPLES OBTAINED FROM SEPARATE PLANTS
FOR ANALYSIS AT ID/TANK LAB
– M. EGGER, 25 OCT. 2018

Figure 1. *Castilleja racemosa*. *Sánchez-Velázquez 1* (WTU). Photo by J.M. Egger

Figure 2. *Castilleja racemosa* in its natural habitat. Note small *Hosackia* species and the thick mulch of pine needles and other plant debris. This and all photos of live plants below by O.A. Sánchez-Velázquez.

Figure 3. *Castilleja racemosa* in its natural habitat. Note small *Hosackia* species and the thick mulch of pine needles and other plant debris.

Figure 4. *Castilleja racemosa* in its natural habitat. Note small *Hosackia* species and the thick mulch of pine needles and other plant debris.

Figure 5. *Castilleja racemosa* in its natural habitat. Note the color change from lemon-yellow to deep orange as the corollas age.

Figure 6. *Castilleja racemosa* in its natural habitat. Full plant (above) and crop (below) to show pubescence of stems and floral details.

Figure 7. *Castilleja racemosa* inflorescence in its natural habitat. Note the color change from lemon-yellow to deep orange as the corollas age.

Figure 8. *Castilleja racemosa* inflorescence in its natural habitat. Note the abundant stipitate-glandular pubescence.

Figure 9. *Castilleja racemosa* in cultivation at Jardín Botánico Culiacán.

Figure 10. *Castilleja racemosa*, dried flower with dissected calyx but undissected capsule (L) and with dissected capsule revealing seeds in late stage approaching maturity. From *O.A. Sánchez-Velázquez 1* (HJBC). Photo by O.A. Sánchez-Velázquez.

Figure 11. *Castilleja racemosa*, fresh bracts (above and center), showing lobes and variation in size, and fresh leaf (below). From *O.A. Sánchez-Velázquez 1* (HJBC). Photo by O.A. Sánchez-Velázquez.

Schilling, E.E. and A. Floden. 2018. Barcoding the Asteraceae of Tennessee, tribes Heliantheae and Millerieae. Phytoneuron 2018-83: 1–9. Published 20 December 2018. ISSN 2153 733X

BARCODING THE ASTERACEAE OF TENNESSEE, TRIBES HELIANTHEAE AND MILLERIEAE

EDWARD E. SCHILLING
Department of Ecology & Evolutionary Biology
University of Tennessee
Knoxville, Tennessee 37996
eschilling@utk.edu

AARON FLODEN
Missouri Botanical Garden
St. Louis, Missouri 63110
afloden@mobot.org

ABSTRACT

Results from barcoding studies of tribes Heliantheae and Millerieae for the Tennessee flora using data from the nuclear ribosomal ITS marker region are presented and include first complete reports of this marker for 14 of the 64 species of the two tribes that occur in the state. Sequence data from the ITS region separated almost all genera of the two tribes in Tennessee from one another, with the exception of *Ratibida* and *Rudbeckia*. The ITS data also distinguished almost all species of the smaller genera, including *Ambrosia*, *Echinacea*, *Parthenium*, and *Verbesina* from one another. In contrast, many (though not all) species of the species-rich *Helianthus, Rudbeckia*, and *Silphium* were not uniquely distinguished by this marker. ITS sequence data provided support for the recognition of several varieties as distinct species, including *Chrysogonum australe* (vs. *C. virginianum*), *Rudbeckia umbrosa* (vs. *R. fulgida*), and *Silphium reniforme* (vs. *S. compositum*). The results of this study provide further evidence of a heterogeneous time frame for migration of Asteraceae lineages into southeastern North America.

The boundaries of the classically recognized tribe Heliantheae have been significantly altered based on the results of recent molecular studies, and in a narrowed circumscription it is just one of several tribes in a group now referred to as the "Heliantheae alliance" (Baldwin 2009). Millerieae with about 380 species is one of several newly recognized tribes in the Heliantheae alliance; the modified tribe Heliantheae sensu stricto now includes 113 genera and about 1500 species (Anderberg et al. 2007). The current study of these two tribes continues the effort to characterize the levels and patterns of molecular diversity found in species of Asteraceae in Tennessee and southeastern North America (Schilling & Floden 2012, 2013, 2014; Schilling 2013; Schilling et al. 2014, 2015) and to broaden the database and assess the potential of the nuclear ribosomal ITS region as a molecular barcode to identify species.

Heliantheae and Millerieae are most diverse in subtropical and tropical regions, with the largest concentrations of species occurring in Mexico, Central America, and South America (Anderberg et al. 2007). Many of the North American representatives of these tribes represent the northern extensions of their respective genera or lineages. Heliantheae is represented in Tennessee by 15 genera and 61 species (Table 1), of which almost all are native; only three genera, each with a single species in Tennessee (*Eclipta*, *Iva*, and *Xanthium*), are introductions and an additional three species of *Helianthus* are considered to be non-native (Chester et al. 2009). Millerieae in Tennessee includes only three species; the two species of *Galinsoga* are non-native, and a single species of *Smallanthus* is native (Chester et al. 2009).

The goal of this study was to sample the nuclear ribosomal ITS marker for all species of Heliantheae and Millerieae that occur in Tennessee to provide a reference base for future taxonomic studies and particularly to facilitate identification of samples of rare species. Many species of

Heliantheae are considered to be rare in the state, including *Acmella repens*, *Chrysogonum virginianum*, *Echinacea pallida*, *E. simulata*, and *E. tennesseensis*, *Helianthus eggertii*, *H. glaucophyllus*, *H. occidentalis*, and *H. verticillatus*, *Rudbeckia subtomentosa* and *R. triloba* var. *pinnatiloba*, and *Silphium brachiatum*, *S. laciniatum*, and *S. pinnatifidum* (Crabtree 2016).

Materials and methods

DNA was extracted from leaf samples either collected fresh or taken from herbarium specimens (Table 1). For most samples the DNeasy Plant Mini Kit protocol (Qiagen, Valencia CA) was used. PCR amplifications and sequencing of the ITS region followed Schilling et al. (2007). A few samples required the use of the internal primers "5.8S 79 for" and "ITS 5.8SR" for sequencing to obtain clean sequence, either because of fungal contamination or because of length polymorphisms (Schilling et al. 2007). GenBank accession numbers are provided in Table 1. Although this study was not designed to undertake a rigorous phylogenetic analysis, a maximum likelihood tree was generated using GARLI as implemented in the Geneious program package to provide a convenient way to make a comparative visualization of the sequence results. A sample of another member of the "Heliantheae alliance," *Polymnia canadensis* L., was utilized as the outgroup. The analysis also incorporated sequences deposited at GenBank of conspecific samples or closely related species.

Results and discussion

Newly obtained ITS sequences for Heliantheae ranged in length from 628-654 bp. For genera in which multiple species were sampled, there were differences in the amount of length variability: samples of *Echinacea* were uniformly 639 bp; samples of *Silphium* fell into two length classes, with a class all of 630 bp and a second of 639-640 bp; samples of *Helianthus* were mostly 651 bp, with two species at 650 bp and one at 654 bp; species of *Ambrosia*, *Verbesina*, and *Rudbeckia* were most variable, with almost every species having a different ITS sequence length. Sequence length polymorphisms, resolvable by sequencing with multiple primers, were encountered in *Ambrosia bidentata*, *Parthenium auriculatum*, *Silphium perfoliatum*, and *Verbesina virginica*. The samples of the two species of *Galinsoga* each exhibited multiple length polymorphisms, making it impossible to obtain clean sequence across the entire ITS region using direct sequencing approaches; a partial sequence for *G. quadriradiata* was included in the analysis. The sample of *Ratibida pinnata* had an extremely long (14 bp) poly C region that acted in the same manner as a length polymorphism in disrupting the ability to obtain clean sequence downstream from it. Sequence length polymorphisms complicate the rapid interpretation of a region used as a molecular barcode, particularly if they are not observed but can also provide identifying information if interpreted accurately.

The ITS sequences of the sampled genera of Heliantheae were different from one another, with one exception (Fig. 1). Samples of the two species of *Ratibida* were placed as an ingroup to *Rudbeckia* (Fig. 1); this is in contrast to the results reported by Urbatsch et al. (2000), which placed *Ratibida* as sister to *Rudbeckia*, and may represent differences in sampling of both genera.

There were differences in the patterns of distinctiveness of species for ITS sequences among different genera. For *Ambrosia* (4 species) and *Verbesina* (4 species), all of the species in Tennessee were distinct from one another. In *Parthenium*, a genus that has been considered to be represented in Tennessee by only a single species, it appears that the two varieties might represent different species. *Parthenium integrifolium* var. *integrifolium* is very widespread, but *P. integrifolium* var. *hispidum* in Tennessee is distinct in both ITS sequence as well as occupying a distinct habitat in cedar glades; at the species level it has been recognized as *P. auriculatum*, although it might prove to be conspecific with *P. hispidum* from the Ozark region (Weakley 2015). The distinctiveness and relationships among the other named varieties of *P. integrifolium* also needs further assessment. Within *Echinacea*,

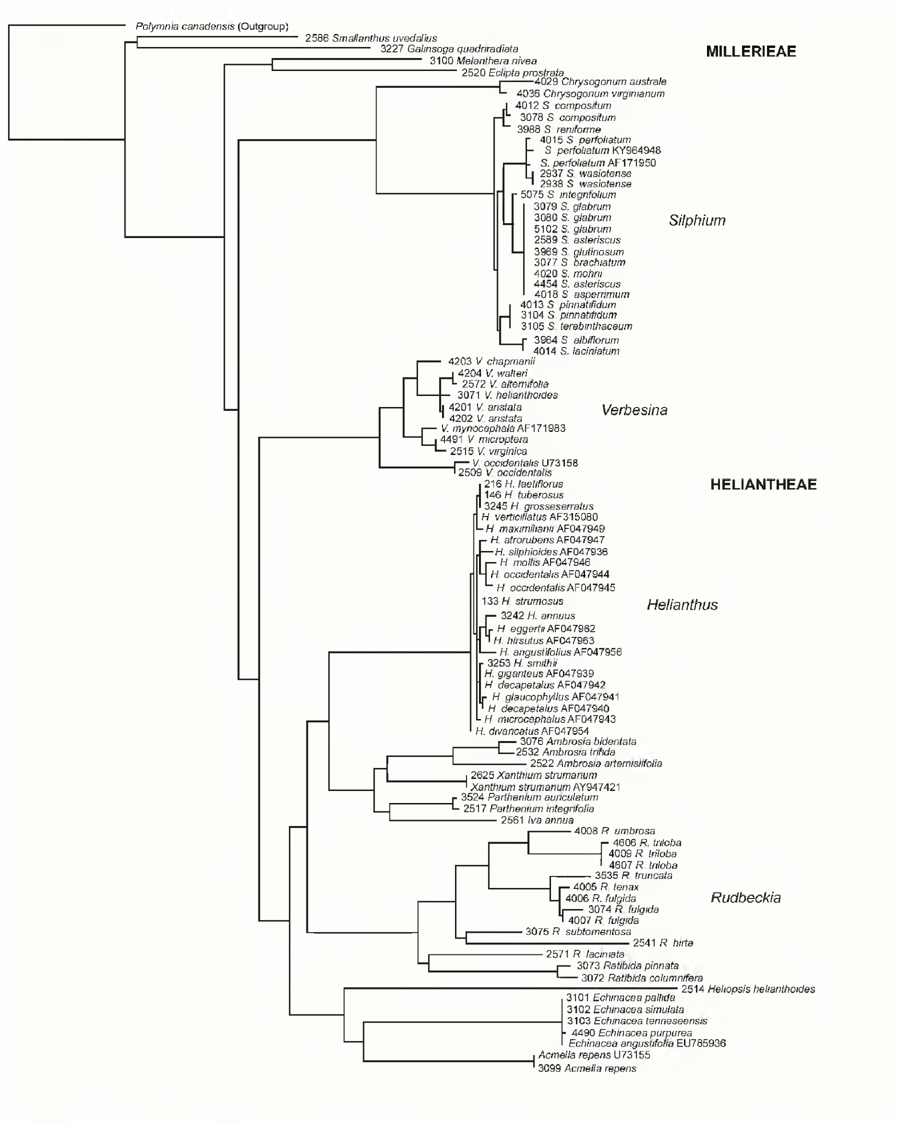

Figure 1. Maximum likelihood tree showing relationships of species of Heliantheae and Millerieae based on ITS sequence data, using *Polymnia* (Polymnieae) as the outgroup. Newly obtained sequences designated by DNA number preceding species name (Table 1); GenBank numbers of other sequences follow species name.

the four species were basically identical to one another, differing only by within-sample positional polymorphisms. As has been documented previously, although there was variability within *Helianthus*, many of the 20 species did not have unique ITS sequence (Schilling et al. 1998). For *Rudbeckia* and *Silphium*, there were major groupings of species, but within the groups there were few or no differences. This suggests that there are varied patterns of the place and timing of variation within different genera. For both *Ambrosia* and *Verbesina*, it seems likely that the species that occur in Tennessee are representatives of lineages that have evolved elsewhere. In contrast, differentiation within *Echinacea, Helianthus*, *Rudbeckia*, and *Silphium* is probably recent and ongoing in the southeastern USA.

A surprising result was the distinctiveness noted between *Chrysogonum australe* (which does not occur in Tennessee) and *C. virginianum*, because these have consistently been considered to be at most varieties despite being allopatric (Stuessy 1977; Nesom 2001), although Weakley (2015) treats them as distinct. Samples of the two differed by at least 10 changes in ITS sequences. The sequence data are accompanied by morphological differences, and *Chrysogonum australe* is notably distinct based on its prominent rhizomes. Preliminary data from additional samples of *C. virginianum* (not shown) suggest that patterns of differentiation within this species are complex and will require adjustment beyond simply elevating the varieties recognized by Nesom (2001) to species level.

The taxonomically most difficult groups of Heliantheae in the southeastern USA are *Helianthus, Rudbeckia*, and *Silphium,* and in each genus there are unresolved taxonomic issues. Perhaps most contentious is the species level taxonomy of *Rudbeckia*, and in the recent floristic guide for Tennessee (Chester et al. 2015) there are actually two different treatments presented, one of which lists 5 species and a total of 12 taxa; the other lists 11 species and 16 total taxa. The major difference in the treatments involves whether to consider *R. fulgida* as a single species with three varieties in Tennessee or separate it into at least 6 species with more outside of the state (e.g., Campbell & Seymour 2013). For the current study it was not possible to undertake the extensive sampling that will be require to resolve the taxonomy. As shown in Figure 1, one of the segregates, *R. umbrosa*, is clearly distinct and is not even placed in the *R. fulgid*a clade, but the remaining ones are not unambiguously different. There are multiple possible explanations for these results, but clearly ITS data will not allow rapid barcoding of variants within *R. fulgida.* Most of the other species of the genus are, however, distinct from one another (Fig. 1). An exception is that samples identified as *R. pinnatilobata* or *R. beadlei* Small (DNA 4606, 4609) from Tennessee were not resolved as distinct from *R. triloba* (DNA 4607); thus there is no support to indicate that the degree of leaf lobing (trilobed vs. pinnately lobed) is taxonomically significant at least within the state. It should be noted that in Claiborne County, where the sample for DNA 4606 originated, plants of the two leaf types both occur in the area. In contrast, the Polk County sample (DNA 4609) had a distinctive overall appearance compared to *R. triloba* as well as a significantly earlier flowering time, so it might still represent a distinct taxon. Also, no sampling was made of *R. pinnatilobata* from Florida, where it was originally described, and it still might represent a distinctive entity.

Within *Silphium*, previous molecular phylogenetic studies have confirmed that the genus is monophyletic (Clevinger & Panero 2000) but have failed to produce a species-level taxonomy that is totally accepted. As found by Clevinger and Panero (2000) the ITS sequence results show that there are several major clades within the genus (Fig. 1), but within each clade there is little differentiation. This result is similar to what was found in *Liatris* (Schilling 2011). The species pair *S. compositum* and *S. reniforme* formed a distinct clade, and the multiple sequence differences between them is in contrast to other clades of the genus, thus supporting morphological differences in suggesting that they be recognized as distinct species rather than varieties of a single species. This clade was not placed with the other clade of sect. *Composita* in the phylogeny, and the two clades differ in the number of ray flowers per head (Clevinger & Panero 2000). In contrast, samples of *S. wasiotense* from its disjunct areas of distribution in Kentucky and Tennessee gave identical ITS sequences, and the species was placed sister to *S. perfoliatum*, as was reported by Clevinger and Panero (2000). The case of *S. integrifolium* reveals some of the complications of the molecular barcoding approach. A specimen originally used in the current study to represent this species from Tennessee (DNA 5102) proved on closer examination to be a misidentified *S. glabrum*. Although there are several specimens of *S. integrifolium* from Tennessee at TENN, all were collected over 50 years ago, and DNA extracts from them failed to amplify. The sequence used in Figure 1 came from a specimen collected in Missouri, and sequence data from it matched ITS2 sequence data for two recently deposited samples in Genbank. However, in the Genbank records from Clevinger and Panero (2000) for *S. integrifolium* it appears that ITS1 and ITS2 (deposited as separate sequences) did not come from the same original samples; the ITS2 sequences matched the others for *S. integrifolium*, but the ITS1 sequences were significantly different, and two other ITS1 sequences deposited from the Clevinger and Panero (2000) study gave 100% match to the matching region of the ITS sequence from the Missouri specimen. Still another ITS sequence for *S. integrifolium* that was very recently deposited (MH984908) appears to represent an interspecific hybrid, and its source was listed as a botanical garden. As noted further below, sequence data from Genbank should not be accepted uncritically as being accurate.

Although not all species of *Helianthus* had unique ITS sequences, there were some notable patterns of variation within the genus. The ITS sequences of the morphologically distinctive *H. mollis* and *H. occidentalis* were identical; in contrast the sequences of *H. atrorubens* and *H. silphioides*, which have not always been recognized as distinct, were different from one another. We have found some individuals that have ITS sequences that were polymorphic at positions for which *H. atrorubens* and *H. silphioides* differed, suggesting that they were of hybrid origin. Thus, ongoing hybridization may blur the boundaries of these two species. Similarly, hybridization between *H. divaricatus* and *H. microcephalus* has been documented, and one sample collected as *H. microcephalus* was polymorphic in ITS sequence at each of the positions for which these two species differ, suggesting that it was a hybrid. The sample tested of the polyploid species, *H. strumosus*, had numerous sequence polymorphisms, suggesting that it might be a recently formed polyploid in which the ITS region had not yet been homogenized.

The results of BLAST searches in GenBank for members of Heliantheae generally gave a top match, and usually an almost identical sequence, to a conspecific sample if the species had been sampled previously. One exception involved *Heliopsis helianthoides* for which the top hits included identical matches to samples labeled *Helianthus annuus* (MG217894) and *Erigeron* sp. (MF349088) and an almost identical sequence of a sample labeled *Platygyrium leptohymenioides* (AJ288573). Another was a sequence for *Carex radiata* (MG216726) which gave a 100% match to sequences from *Ratibida columnifera*. An ITS sequence purported to be for *Campsis radicans* (MG218111) gave a 100% match to *Helianthus annuus*; one for *Heliopsis helianthoides* (MF348947) was a 100% match for the sequences from *Silphium perfoliatum*. In a somewhat less glaring case, the ITS sequences for two species of *Smallanthus* reported by Rauscher (2002) appear to have been swapped, with that for *S. quitensis* almost identical to our sample of *S. uvedalia*, but the one reported for *S. uvedalia* only 96% similar to ours reported here. The presence of inaccuracies in GenBank shows that caution must be taken in using this database blindly as a reference for species identifications from molecular results.

The results presented here for the nrITS marker show the potential for this region to provide identification of unknown material to genus and in many cases to species for members of Heliantheae in Tennesseee. The results also suggest, however, that broader sampling of both taxa and molecular markers is needed to clarify the species level taxonomy of some genera of the group, notably *Rudbeckia* and *Silphium*.

ACKNOWLEDGEMENTS

Thanks to J. Schilling for laboratory assistance, J. May and V. Brown of the University of Tennessee MBRF for help with DNA sequencing, the numerous collectors, notably D. Estes and the late H. DeSelm, who have helped to assemble a broad and useful herbarium at TENN, and the herbarium curators at TENN and MO for access to material. Financial support provided by the Hesler Fund of the University of Tennessee Herbarium.

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Table 1. Plant material used for ITS barcoding studies of Heliantheae and Millerieae. All specimens at TENN unless noted otherwise.

Species	DNA#	Genbank	Voucher info
HELIANTHEAE			
Acmella Rich. Ex Pers.			
A. repens (Walter) Rich.	3099	KX671842	*DeSelm 06-03*, Monroe Co., TN
Ambrosia L.			
A. artemisiifolia L.	2522	KX671843	*Schilling DNA07-2522*, Knox Co., TN
A. bidentata Michx.	3076	KX671844	*Estes 2739*, Giles Co., TN
A. trifida L.	2532	KX671845	*Schilling DNA07-2532*, Knox Co., TN
Chrysogonum L.			
C. virginianum L.	4036	KX671846	*Panero 695*, Scott Co., TN
Non-Tennessee:			
C. australe Alexander ex Small	4029	KX671847	*Rogers 9437A*, Wayne Co., MS
Echinacea Moench			
E. pallida (Nutt.) Nutt.	3101	KX671848	*DeSelm s.n.* 6/29/1992, Coffee Co., TN
E. purpurea (L.) Moench	4490	KX671849	*Floden et al. 2535*, Claiborne Co., TN
E. simulata McGregor	3102	KX671850	*Bailey & Withers* 6/18/2004, Davidson Co., TN
E. tennesseensis (Beadle) Small	3103	KX671851	*Pyne 95-143*, Davidson Co., TN
Eclipta L.			
E. prostrata (L.) L.	2520	KX671852	*Schilling DNA07-2520*, Knox Co., TN
Helianthus L.			
H. angustifolius L.	39	AF047956	*Schilling 89-6*, Morgan Co., TN
H. annuus L.	3242	KX671853	*Schilling 660*, Knox Co., TN
H. atrorubens L.	149	AF047947	*Schilling 140*, Blount Co., TN
H. decapetalus L.	139	AF047940	*Schilling 117*, Knox Co., TN
H. divaricatus L.	154	AF047954	*Schilling OS-98*, Sevier Co., TN
H. eggertii Small	107	AF047962	*Schilling 90-16*, Davidson Co., TN
H. giganteus L.	250	AF047939	*Schilling 171*, Jefferson Co., TN
H. glaucophyllus D.M.Sm.	138	AF047941	*Schilling 138*, Unicoi Co., TN
H. grosseserratus M.Martens	301	AF047951	*Schilling 301*, Knox Co., TN
H. hirsutus Raf.	127	AF047963	*Schilling 90-17*, Davidson Co., TN
H. maximiliani Schrad.	109	AF047949	*Schilling 109*, Knox Co., TN
H. microcephalus Torr.&A.Gray	131	KX671855	*Schilling 131*, Knox Co., TN
H. mollis Willd.	203	AF047946	*Schilling 90-8*, Davidson Co., TN
H. occidentalis Riddell	213	AF047944	*Schilling 303*, Davidson Co., TN
H. silphioides Nutt.	3247	AF047936	*Schilling & Spring Ark-47*, Hardeman Co., TN
H. smithii Heiser	3253	KX671856	*Schilling & Spring Ark-44*, Polk Co., TN
H. strumosus L.	133	KX671857	*Schilling 90-26*, Davidson Co., TN

H. tuberosus L.	146	KX671858	*Schilling 90-3*, Davidson Co., TN
H. verticillatus Small	1188	AF315080	UT Gardens Plant
H. x *laetiflorus* Pers.	216	KX671854	*Schilling 90-9*, Knox Co., TN
Heliopsis Pers.			
H. helianthoides Sweet	2514	KX671859	*Schilling DNA07-2514*, Knox Co., TN
Iva L.			
I. annua L.	2561	KX671860	*Schilling DNA07-2561*, Knox Co., TN
Melanthera Rohr.			
M. nivea (L.) Small	3100	KX671861	*Lincicome & McCoy s.n.*, 9/2002, Perry Co., TN
Parthenium L.			
P. auriculatum Britton	3524	KX671862	*Guthrie 1988*, Decatur Co., TN
P. integrifolium L.	2517	KX671863	*Schilling DNA07-2517*, Knox Co., TN
Ratibida Raf.			
R. columnifera Raf.	3072	KX671864	*DeSelm s.n.* 7/12/97, Campbell Co., TN
R. pinnata Barnh.	3073	KX671865	*McNeilus 99-546*, Knox Co., TN
Rudbeckia L.			
R. fulgida Aiton	3074	KX671866	*Estes & Beck 8360*, Coffee Co., TN
	4006	KX671867	*DeSelm s.n.*, Williamson Co., TN
	4007	KX671868	*Beck 6260*, Marion Co., TN
R. hirta L.	2541	KX671869	*Schilling DNA07-2541*, Knox Co., TN
R. laciniata L.	2571	KX671870	*Schilling DNA07-2571*, Knox Co., TN
R. subtomentosa Pursh	3075	KX671871	*Chester 4202*, Montgomery Co., TN
R. tenax C.L.Boynton & Beadle	4005	KX671872	*Datillo 1015*, Maury Co., TN
R. triloba L.	4607	KX671873	*Estes et al.* Cumberland Co., TN
	4009	KX671874	*Floden et al 2012-198*, Polk Co., TN
	4606	KX671875	*Floden et al 2536*, Claiborne Co., TN
R. truncata Small	3535	KX671876	*Floden & Zale 2279*, Union Co., TN
R. umbrosa C.L.Boynton & Beadle	4008	KX671877	*Estes 1464*, Lewis Co., TN
Silphium L.			
S. asteriscus L.	2589	KX671878	*Schilling DNA07-2589*, Knox Co., TN
	4018	KX671879	*Bailey & Lincicome s.n.*, Franklin Co., TN
S. brachiatum Gatt.	3077	KX671880	*Patrick et al. 1555a*, Franklin Co., TN
S. compositum Michx.	3078	KX671881	*DeSelm s.n.* 8/23/2005, Roane Co., TN
	4012	KX671882	*DeSelm s.n.*, Greene Co., TN
S. glabrum Eggert	3079	KX671883	*Patrick 1564a*, Franklin Co., TN
	3080	KX671884	*DeSelm s.n. 8/29/1997*, Decatur Co., TN
	5102	MK305127	*Bailey & Harden 8/18/2004*, McNairy Co, TN
S. laciniatum L.	4014	KX671886	*McNeilus 96-844*, Haywood Co., TN
S. mohrii Small	4020	KX671887	*Estes 922*, Giles Co., TN
S. perfoliatum L.	4015	KX671888	*DeSelm 04-18*, Hancock Co., TN
S. pinnatifidum Elliott	3104	KX671889	*Pyne 94-262*, Rutherford Co., TN

	4013	KX671890	*Beck 4828*, Hamilton Co., TN
S. reniforme Raf.	3988	KX671891	*Floden & Schilling 8/15/2013*, Greene Co., TN
S. terebinthaceum Jacq.	3105	KX671892	*DeSelm s.n. 8/26/1988*, Sevier Co., TN
S. wasiotense Medley	2937	KX671893	*Floden 565*, Campbell Co., TN
Non-Tennessee:			
S. albiflorum A. Gray	3964	KX671894	UT Gardens Plant
S. glutinosum J.R.Allison	3969	KX671895	UT Gardens Plant
S. integrifolium Michx.	5075	MK305126	*Yatskievych 4257*, MO (MO)
S. wasiotense Medley	2938	KX671896	*Risk 6758*, Knox Co., KY
Verbesina L.			
V. alternifolia (L.) Britton	2572	KX671897	*Schilling DNA07-2572*, Knox Co., TN
V. helianthoides Michx.	3071	KX671898	*Chester 14636*, Gibson Co., TN
V. occidentalis (L.) Walter	2508	KX671899	*Schilling DNA07-2508*, Knox Co., TN
V. virginica L.	2515	KX671900	*Schilling DNA07-2515*, Knox Co., TN
Non-Tennessee:			
V. aristata A.Heller	4021	KX671901	*McNeilus 90-726*, Santa Rosa Co., FL
	4022	KX671902	*Kral 31363*, Geneva Co., AL
V. chapmaii J.R.Coleman	4023	KX671903	*Evans s.n.*, 5/25/1979, Liberty Co., FL
V. microptera J.R.Coleman	4491	KX671904	*Keeney s.n.*, 9/15/1972, Uvalde Co., TX
V. walteri Shinners	4024	KX671905	*Thomas* 152955, Pike Co., MS
Xanthium L.			
X. strumarium L.	2625	KX671906	*Schilling DNA07-2625*, Knox Co., TN
MILLERIEAE			
Galinsoga Ruiz & Pav.			
G. parviflora Cav.	3512	-	*Kelly 1040*, Williamson Co., TN
G. quadriradiata Ruiz & Pav.	3227	KX671907	*Schilling 11-21*, Knox Co., TN
Smallanthus Mack.			
S. uvedalius (L.) Mack.	2586	KX671908	*Schilling DNA07-2586*, Knox Co., TN

McNair, D.M., J. Fox, R. Lindley, S.D. Carnahan, M.E. Taylor, and E. Makings. 2018. Identifying *Abutilon parishii* (Malvaceae) and similar species in Arizona and Sonora. Phytoneuron 2018-84: 1–12. Published 20 December 2018. ISSN 2153 733X

IDENTIFYING *ABUTILON PARISHII* (MALVACEAE) AND SIMILAR SPECIES IN ARIZONA AND SONORA

DANIEL M. MCNAIR
WestLand Resources, Inc.
Tucson, Arizona
danielmcnair@gmail.com

JANET FOX
Tucson, Arizona

RIES LINDLEY
University of Arizona Herbarium (ARIZ)
Tucson, Arizona

SUSAN D. CARNAHAN
University of Arizona Herbarium (ARIZ)
Tucson, Arizona

MARK E. TAYLOR
United States Forest Service,
Tonto National Forest

ELIZABETH MAKINGS
Arizona State University Vascular Plant Herbarium (ASU)
Tempe, Arizona

ABSTRACT

We provide a visual aid for identifying *Abutilon parishii* along with similar genera and species in the mallow family (Malvaceae) that occur in Arizona and Sonora. The primary species featured are *Abutilon mollicomum, A. palmeri, A. parishii, A. reventum,* and *A. wrightii,* with briefer coverage provided for *A. abutiloides, A. incanum, A. parvulum, A. theophrasti, Anoda abutiloides,* and *Herissantia crispa.* Three of the species featured, *A. parishii, A. reventum,* and *Anoda abutiloides,* are of conservation concern.

Abutilon (Malvaceae) species in North and Central America are typically recognizable as woody or herbaceous perennial shrubs with leaves that are simple, alternate, long-petiolate, cordate-based, toothed, and stellate-haired. Flowers are axillary or in panicles with yellow to orange petals; schizocarps typically contain 4–10 (25) mericarps (Fryxell 1988; Fryxell & Hill 2015). Similar New World genera include *Anoda, Bakeridesia, Callianthe, Herissantia, Pseudabutilon,* and *Sida* (Fryxell 1988, 1997a; Donnell et al. 2012). Various *Abutilon* species are widely cultivated (Austin 2004; Fryxell & Hill 2015; Saini et al. 2015) and commonly referred to in English as Indian mallow, flowering-maple, pintapan, and velvet leaf.

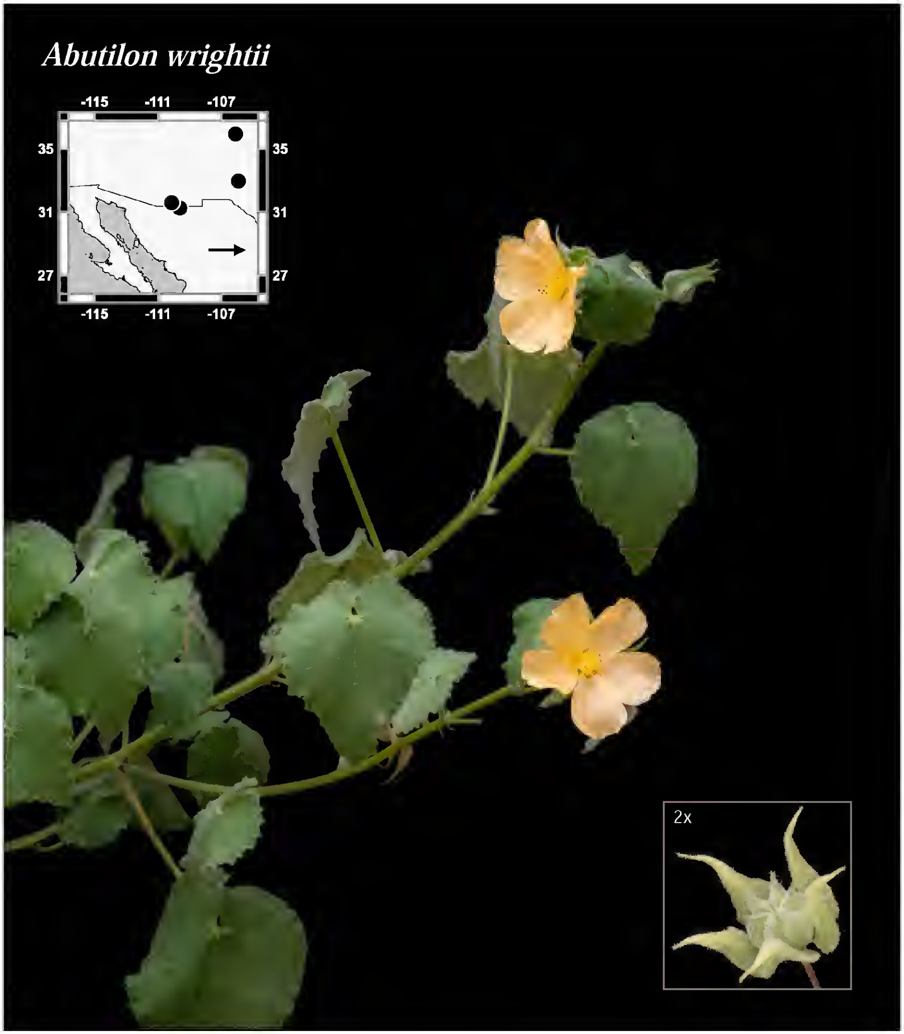
The taxonomic boundaries of the genus *Abutilon* are still poorly understood and may continue to be revised (Fryxell 2002; Tate et al. 2005; Donnell et al. 2012), but past estimates have calculated approximately 160 species worldwide (Fryxell & Hill 2015). Fryxell and Hill, in their *Flora of North America, North of Mexico* treatment of the genus, included 17 native species occurring from California to Florida. For our region of study, Arizona and Sonora, we estimate there are at least 13–14 native species of *Abutilon* and one introduced species. We provide a working draft list and key for these and similar species in Appendices A and B.

Abutilon mollicomum **(Willd.) Sweet** [*Abutilon sonorae* A. Gray]. Mature blades to 25 cm long with maple-like lobing; blade margin hairs to 0.5 mm; mature petioles and stems with hairs 2–4 mm. Upright herbaceous perennial shrub to 3 m tall; only woody at base. Sepals (lower right image) to 1/2 length of mericarps; mericarp apices = 1–2 mm; flowers typically open for a few hours in the afternoon. Plants typically occur in rocky habitats to 1500 m, Arizona to Veracruz; NatureServe G5. The synonym *A. sonorae,* used by Asa Gray in 1853, persists in many collections, though Fryxell (1988) found that Willdenow had described the species as *Sida mollicoma* (1809) before Gray. This species is probably the most common of the large-leaved *Abutilon* in our region.

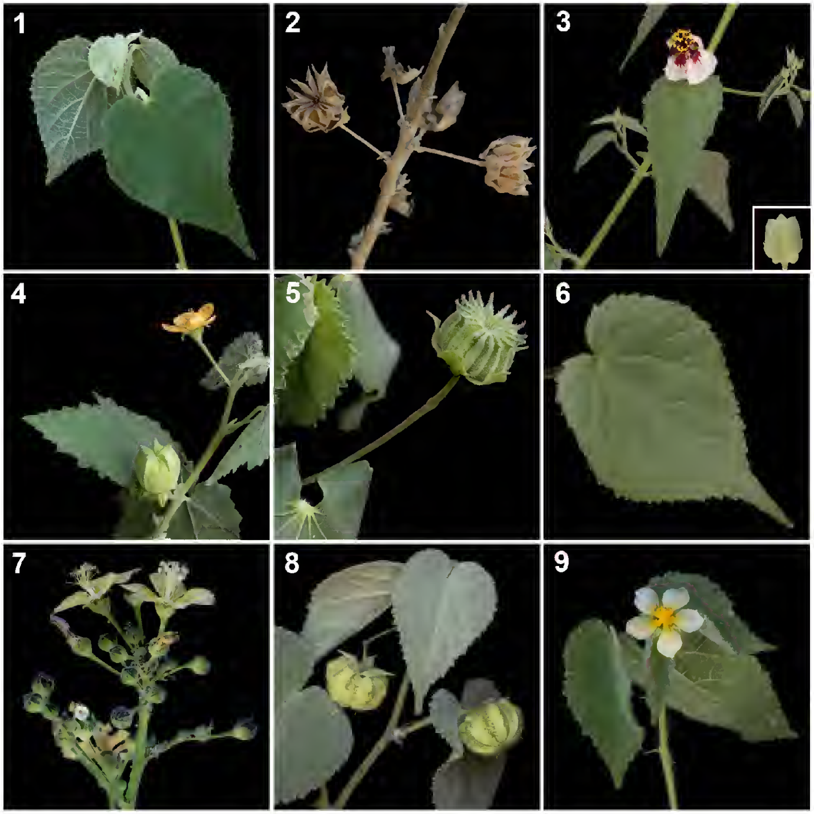
***Abutilon palmeri* A. Gray.** Most blades under 18 cm, the wide outline similar to *A. reventum*, though more velvety to the touch; blade margin hairs to 0.5 mm. Upright herbaceous perennial shrub to 2 m; only woody at base. Sepals (lower left image) about equal to mericarp apices; flowers open afternoon to evening. Plants occur mostly in California, Arizona, Sonora, and Baja California; NatureServe G4G5. *Abutilon parishii* was synonymized under this name in the first edition of the Arizona Flora, a decision that was reversed in the Supplement (Kearney et al. 1960).

***Abutilon parishii* S. Wats.** Mature blades under 18 cm with long, acuminate tips; blade margin hairs 0.75–1.25 mm; petiole and stem hairs to 2.5 mm. Upright herbaceous perennial shrub to 2 m; only woody at base. Sepals (lower right image) half the length or slightly longer than schizocarp; mericarp apices 1–2 mm; flowers opening, if at all, for a few hours in the late afternoon to evening. Plant occurs in rocky habitats to 1500 m in Arizona and Sonora; NatureServe G3, U.S. Forest Service Region 3 and BLM Sensitive. Future conservation studies should refer especially to the large baseline dataset contained within the Status Report for *A. parishii* submitted to the U.S. Fish and Wildlife Service by Van Devender et al. (1994). See also: Van Devender et al. (1991), AGFD Abstract (2000), ARPC (2001), CPC (2018).

Abutilon reventum **S. Wats.** Mature blades to 25 cm long, often with relatively small lateral lobes and a long acuminate tip that may curl inward as shown above; blade margin hairs under 0.5 mm; mature petioles and stems appearing glabrous, rarely with sparse, single-based hairs to 3 mm. Upright herbaceous perennial shrub to 2.5 m; only woody at base. Sepals (lower left image) to 1/2 the length of mericarps; mericarp apices subtle or absent; flowers opening for a few hours in the afternoon. Similar to *A. mollicomum*, *A. xanti* [*A. carterae*], and *A. palmeri*. See Fryxell (1988). Plant occurs in rocky habitats to 1500 m in Arizona to Oaxaca; NatureServe G3G5, N2 in Arizona.



Abutilon wrightii A. Gray. Mature blades to 8 cm; leaf tip acute to rounded; blade margin hairs to 0.75 mm; petiole and stem hairs to 2 mm. Decumbent herbaceous perennial shrub under 0.5 m tall; young plants not always decumbent; base of plant usually herbaceous. Sepals (lower right image) long and often obscuring the schizocarp; calyces flared at base; mericarp apices to 2 mm; flowers opening late afternoon to evening. Plant occurs in various habitats to 1500 m with approximately 10 known locations scattered across New Mexico, Sonora, and Arizona; much more commonly recorded from Texas and northeastern Mexico; NatureServe G4. Note that young plants may be mistaken for *A. parishii*. See discussions in Hamilton (1932), Shreve & Wiggins (1964), and Reina-Guerrero & Van Devender (2013).



Other morphologically similar species in the region

1–2. *Abutilon abutiloides* (Jacq.) Garcke ex Britt. & Wilson. A common woody per. shrub to 2 m with smooth gray bark above the base; sepals often large, obscuring schizocarp (but not as long as in *A. wrightii*); leaf and stem hairs more clustered than with other spp.; possible synonyms still needing further investigation include *A. berlandieri*, *A. californicum*, *A. lignosum*, and *A. scabrum*.

3. *Abutilon incanum* (Link) Sweet. A common woody per. shrub to 2 m with smooth gray bark similar to *A. abutiloides*; leaf hairs on this and similar spp., such as *A. malacum* and *A. parvulum*, are nearly impossible to see without magnification; see J. Fryxell (1983) and Felger et al. (2015).

4. *Abutilon parvulum* A. Gray. The smallest leaved *Abutilon* in the region; per. shrub to 0.5 m.

5. *Abutilon theophrasti* Medik. Introduced; herb. per. shrub mostly occurring in cultivated fields; large leaves superficially similar to *A. reventum*; unlikely to occur with similar spp. treated here; has a relatively large schizocarp with more mericarps than native species; see Appendix A.

6–7. *Anoda abutiloides* A. Gray. A woody per. to 3 m with greenish bark; leaf tips long-acuminate; NatureServe G3; limited to Arizona and Sonora.

8–9. *Herissantia crispa* (L.) Briz. [*Abutilon crispum*]. A common herb. per. shrub, usually decumbent; fruits papery, transparent; leaf margins often doubly serrate.

METHODS

For species identification we relied on the following: (1) photographic observations of wild and cultivated plants; (2) a study of type specimen images hosted by GBIF (2018); (3) in-person study of specimens at the University of Arizona Herbarium (ARIZ), the Arizona State University Vascular Plant Herbarium (ASU), and the Desert Botanical Garden Herbarium (DES); and (4) a review of taxonomically relevant literature and data (especially Watson 1885, 1886; Hamilton 1932; Kearney et al. 1951, 1960; Shreve & Wiggins 1964; P. Fryxell 1976, 1988, 1993, 1997a, 1997b, 2002; J. Fryxell 1983; Tate et al. 2005; Donnell et al 2012; Felger et al. 2015; Fryxell & Hill 2015; Verrier 2018; SEINet 2018; GBIF 2018; CPC 2018).

Several plants photographed in this study were obtained from Desert Survivors Nursery in Tucson, Arizona (desertsurvivors.org). Indirect sunlight was used to illuminate whole plant scenes, with a black cotton cloth draped behind the subjects. Artificial lighting was used for the fruit close-ups using six Ikea Jansjo lights attached to a makeshift scaffolding. Each Jansjo light was diffused with a white table tennis ball cut to fit over it. Digital photographs were taken in Raw format using Nikon DSLRs paired with prime lenses, especially the Tokina 100mm. Raw format images were processed in Adobe Lightroom (especially using the "blacks" and "whites" adjustment sliders). The Adjustment Brush feature in Lightroom, with a lowered exposure slider, was used to further darken background areas in each image.

The maps we include were generated in QGIS (2018) using herbarium specimen data from SEINet (2018). Latitude and longitude grids are provided along the borders of each map with the U.S.A.-Mexican border running through the center and the Pacific Ocean in dark gray. Updated occurrence maps and other imagery can be found at SEINet (http://swbiodiversity.org) and its partner network, Red de Herbarios del Noroeste de México (http://herbanwmex.net/portal/). Some SEINet occurrences used in creating the maps in this paper will need further verification and/or annotation.

ACKNOWLEDGMENTS

This project began as a collaboration between WestLand Resources, Inc., the Tonto National Forest Service, and Resolution Copper to understand *Abutilon parishii* distribution and population health. Funding for the first author's work on this paper was provided by Resolution Copper.

David Bertelsen (University of Arizona Herbarium), one of the authors of the 1994 U.S. Fish and Wildlife Status Report, reviewed multiple versions of this paper and offered helpful suggestions and corrections. Jim Verrier (University of Arizona Herbarium) also offered helpful suggestions based on his experience with the genus *Abutilon* in the Santa Catalina Mountains. Mac Alford (University of Southern Mississippi) offered helpful taxonomic advice. Ann Shivers-McNair (University of Arizona) and Breck Jacoby (WestLand Resources, Inc.) offered helpful comments on readability. Guy Nesom (Phytoneuron) served as our final reviewer and editor.

We would also like to thank Shelley McMahon, George Ferguson, and Mima Falk at the University of Arizona Herbarium for their help accessing specimens. Andrew Salywon facilitated specimen access at the Desert Botanical Garden Herbarium and shared data on *Abutilon*. We would like to thank Desert Survivors Nursery (desertsurvivors.org) for promoting the use of native plants, such as *Abutilon*, in Tucson landscaping. We would also like to thank other collaborators at WestLand Resources, Inc., involved with *Abutilon* research: David Cerasale, Aaron Graham, Marissa Buschow, Matt Geiger, Myles Traphagen, Tiffany Alvarez, Dave Ward, and John Neddermeyer.

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APPENDIX A

Working draft key for *Abutilon parishii* and similar species in Arizona and Sonora

1. Hairs on blade margins and elsewhere generally ≤ 0.2 mm and difficult to see without magnification, giving plants a nearly glabrous appearance; leaves usually concolorous, i.e. light green above and below. See *A. incanum* [*A. pringlei*], *A. malacum*, *A. mucronatum*, *A. parvulum*, *A. trisulcatum*.
1. Hairs on blade margins and elsewhere generally ≥ 0.3 mm (sometimes shorter in *A. abutiloides*) and visible without magnification; some species with strongly discolorous leaves, i.e. dark green above and whitish beneath (e.g., *A. parishii*), though this character is not always consistent.

2. Largest blades 15–25 (30) cm on mature individuals; plants to 3 m.

3. Petiole and stem hairs to 4 mm .... **Abutilon mollicomum**
3. Petiole and stem hairs generally under 3 mm.

4. Plants not conspicuously velvety; carpels ≥ 15; (introduced) .... **Abutilon theophrasti**
4. Plants conspicuously velvety; carpels ≤ 11; native.

5. Petiole and stem surfaces completely obscured by thick layer of minutely stellate hairs; of limited distribution in eastern Baja California Sur deserts and coastal regions, and also on the mainland in coastal Sonora and Sinaloa .... **Abutilon xanti**
5. Petiole and stem surfaces visible through hairs .... **Abutilon reventum**

2. Largest blades generally < 15 cm on mature individuals; plants generally under 2 m.

6. Mature plants with grey bark well above the base of the plant; most hairs on plant under 0.3 mm, especially on stems and petioles .... **Abutilon abutiloides**
6. Mature plants herbaceous; petiole hairs usually at least to 0.5 mm or longer

7. Mature stems decumbent or at least several at a 45° angle (*Pseudabutilon* stems sometimes erect); blades usually under 9 cm.

8. Schizocarp wall papery, transparent .... **Herissantia crispa**
8. Schizocarp wall hardened, opaque.

9. Blade pubescence dense, obscuring abaxial surface .... **Abutilon wrightii**
9. Blade pubescence sparse, not obscuring abaxial surface .... **Pseudabutilon thurberi**

7. Mature stems upright on mature plants; largest blades 12–18 cm.

10. Length to width ratio of mature blades nearly 1:1 .... **Abutilon palmeri**
10. Length to width ratio of mature blades nearly 3:2 .... **Abutilon parishii**

APPENDIX B

Working draft list of *Abutilon* and similar species in Arizona and Sonora.

For information on infrageneric divisions in *Abutilon* including sects. *Armata*, *Mexabutilon*, and *Oligocarpa*, see J. Fryxell (1983) and P. Fryxell (1976; 1988; 2002). See also Felger et al. (2015) for illustrations of several of the genera and species below.

Abutilon abutiloides [*A. lignosum*]
Abutilon berlandieri (possible synonym of *A. abutiloides*)
Abutilon californicum (possible synonym of *A. abutiloides*)
Abutilon incanum [*A. pringlei*]
Abutilon malacum
Abutilon mollicomum [*A. sonorae*]
Abutilon mucronatum
Abutilon palmeri
Abutilon parishii
Abutilon parvulum
Abutilon reventum
Abutilon trisulcatum
Abutilon wrightii
Abutilon xanti [*A. carterae*]
Anoda abutiloides
Anoda pentaschista
Herissantia crispa [*Abutilon crispum*]
Hermannia pauciflora
Hibiscus spp.
Horsfordia spp.
Malvastrum bicuspidatum
Pseudabutilon thurberi [*Abutilon thurberi*]
Rhynchosida physocalyx
Sida abutilifolia [*Sida procumbens*]
Sphaeralcea spp.